



TO COMPARE THE EFFICACY OF BUTEYKO BREATHING EXERCISE AND 90/90 BALL & BALLON BREATHING EXERCISE IN PATIENTS WITH STAGE 1 AND STAGE 2 CHRONIC OBSTRUCTIVE PULMONARY DISEASE.

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ABSTRACT

Introduction - Chronic Obstructive Pulmonary Disease is defined as chronic inflammatory lung disease which is characterized by Progressive airflow limitation. The Global prevalence of Chronic Obstructive Pulmonary Disease (COPD) among people with age 30-79 years was 10.3% ⁽⁴⁾ and in India the prevalence is 7%.

Methodology- Ethical clearance was obtained from Institution Ethical Committee. Total 40 participants were included in this study according to the inclusive criteria; participants were allocated by randomization method into two groups. GROUP A included 20 participants (90/90 Ball and Balloon exercise) and GROUP B included 20 participants (Buteyko Breathing exercise) for 5 days in a week.

Result- Effect of GROUP A was assessed by using Paired t Test /Wilcoxon's Signed Rank Test. Effect of GROUP B was assessed by using Paired t Test / Wilcoxon's Signed Rank Test. Comparison Between both GROUP was done by using unpaired t Test / Mann-Whitney Test. Results indicated statically significant difference within the group for all parameters and statistically significant improvement between groups difference were found for FEV₁ and FEV₁/FVC.

Conclusion- Both breathing exercises were equally effective in enhancing functional capacity and reducing exertion levels, the 90/90 Ball and Balloon Breathing Exercise concluded more beneficial in improving FEV₁ and FEV₁/FVC values.

KEYWORD'S – COPD, 90/90 Ball & Breathing Exercise, Buteyko Breathing Exercise, Digital Spirometer, Six Minute Walk Test, Modified Borg Scale.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a chronic inflammatory lung disease characterized by airflow limitation and tissue destruction.^[1] The Pathophysiological changes in COPD occur due to chronic inflammation. Inhaled exposures can trigger inflammatory response in airway & alveoli leading to disease in genetically predisposed individuals. It occurs by an imbalance between increased protease activity & reduced anti-protease activity. Normally, lung proteases (neutrophil elastase, matrix metalloproteinases, and cathepsins) helps to break down elastin and connective tissue as part of tissue repair, while anti-proteases (alpha-1 antitrypsin, secretory Leuk proteinase inhibitor, elafin, and matrix metalloproteinase tissue inhibitor) which maintains a protective balance. In COPD patients, neutrophils release excessive proteases, overwhelming the anti-protease defense, leading to tissue destruction and mucus overproduction. Activated neutrophils and macrophages generate oxidative stress, producing free radicals that further inhibit anti-proteases, causing bronchoconstriction, mucosal swelling, and excessive mucus secretion. As COPD progresses, inflammation increases and, in advanced stages, persists even after smoking cessation.^[2]

The Incidence of COPD increases with age above 30. It is commonly seen in males. The Global prevalence of Chronic Obstructive Pulmonary Disease (COPD) among people with age 30-79 years was 10.3%^[3] and in India the prevalence is 7%.^[4] Other causes for COPD include environmental and occupational exposure, alpha 1 antitrypsin deficiency or genetically which cause chronic inflammation of Airways, lung parenchyma, pulmonary vasculature and obstruction of airway which causes decrease in Forced Expiratory Capacity (FVC) and Peak Expiratory Flow Rate (PEFR).^[5] Diagnosis of COPD can be done through various investigation like Chest x- ray which shows hyper inflated lungs. Through Spirometry / Pulmonary Function Test (PFT) the FEV₁ and FEV₁ / FVC value are calculated, a value of less than 0.7 of FEV₁/ FVC confirm the diagnosis of COPD. Commonly hypoxemia, respiratory acidosis and hypercapnia are seen in Arterial blood gas report of COPD patients.^[5]

The goal of treatment in COPD is improving the quality of life and reduce exacerbation & mortality. Bronchodilators such as beta 2 agonists, Inhaled corticosteroids and antibiotics are the most common pharmacological treatment along with breathing exercise for relieving symptoms in COPD patients. Breathing exercises, strength and endurance exercise are the commonly prescribed treatments and were found to be effective in relieving symptoms of COPD.^[6,7] Breathing exercise are highly targeted focusing directly on breathing efficiency and are less restrictive by the environment.^[8] Breathing exercise also improves pulmonary function, dyspnea, and exercise capacity.^[9]

The Buteyko breathing technique was developed by Dr. Konstantin Pavlovich Buteyko, who believed that it could help to treat numerous chronic conditions. This method focuses on increasing carbon dioxide levels in the body. The Buteyko technique is a technique which retrains the body's breathing pattern to correct the chronic hyperventilation and hypocapnia. Influence on nitric oxide is the biochemical mechanism of Buteyko. Nitric oxide which is involved in various physiological responses such as bronchodilation, vasodilation & oxygen transport. In paranasal sinus large amount of nitric oxide is made, thus the nitric oxide level is affected during Buteyko exercise as it has large insistence on nasal breathing. Patient using Buteyko breathing exercise are taught to use combination of increased abdominal muscle tone and relaxation of other breathing muscle to reduce volume of breathing. Low volume breathing reduces effort of breathing which leads to relaxation of respiratory muscles and improve function of diaphragm that helps to reduce amount of hyperinflation, commonly seen in chronic obstructed pulmonary disease.^[10] Inspiratory muscle weakness is the main clinical findings in COPD. The primary muscle for respiration is diaphragm which is a dome shaped, muscular and membranous structure which separates thoracic and abdominal cavities. Due to weakness of Diaphragm, it leads to the decreased mobility of Diaphragm. In COPD hyper inflammation and shortening of Zone of Apposition (ZOA) is the central cause for diaphragm

weakness. [11] Decreased elastic recoil of lung and increased airway resistance obstruct the expiratory flow which causes hyper inflammation of lungs. Due to which there is reduction in flow and pressure generating capacity of diaphragm and negative impact on respiratory muscle mainly diaphragm this leads to reduction in diaphragm length. It is the main mechanism due to which diaphragm force generating capacity is affected. Hyper inflated lungs cause altered chest shape which leads to reduction in ZOA. [11]

Maintaining an optimal Zone of Apposition of diaphragm is the most critical factor faced by the Physiotherapist. [12-14] Dome/Umbrella shape area of Diaphragm attach to the inner aspect of rib cage is defined as the Zone of Apposition. [15] Zone of Apposition directs the Diaphragmatic tension controlled by abdominal muscle which makes the role of ZOA important. Researchers have compared the effect of 90-90 ball and balloon breathing exercise with diaphragmatic Breathing exercises in COPD patients. [11] But as there are less literatures that are present which shows comparative effect of Buteyko Breathing exercise and 90-90 ball and breathing exercises along with Diaphragmatic Breathing of both the exercises in stage 1 and stage 2 COPD patients and hence this study was conducted.

METHODOLOGY

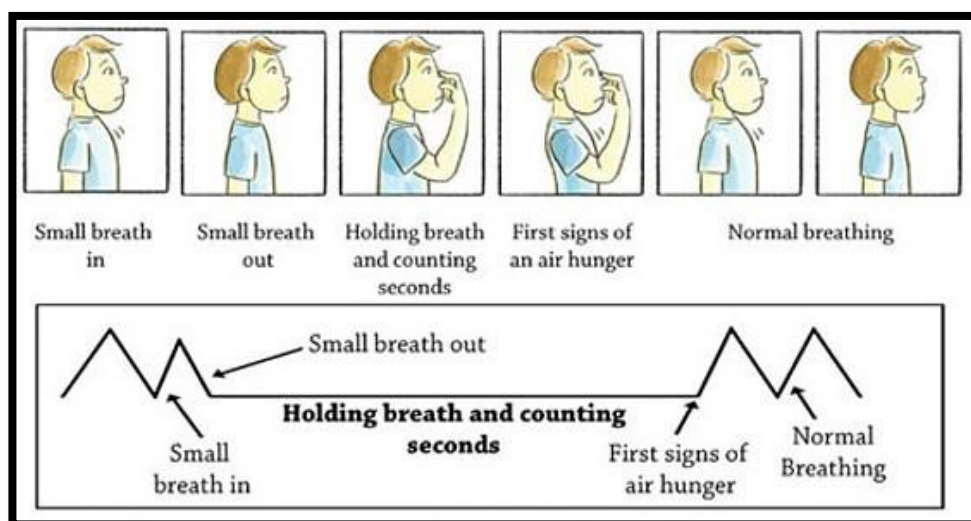
The study was conducted at D.Y. Patil Medical College Hospital and Research Institute, Kolhapur, for a period of 6 months. Patients were selected based on the inclusion and exclusion criteria.

Inclusion criteria Patients with age group of 45 - 64 years and all genders and diagnosed with Stage 1 and Stage 2 COPD according to GOLD criteria by Physician.

Exclusion criteria Patients having Rib fracture, Cardiac condition and Thoracic surgery.

Ethical clearance was obtained from the institution ethical committee. Prior written consent form from the participants was obtained. Pre assessment value was recorded before the study was started. The participants were divided into two group i.e. Group A and Group B including 20 in each group. Participants were educated about the condition and procedure of the exercise was explained in detail. Group A received Buteyko breathing exercise for 5 days for a week with diaphragmatic breathing exercise and Group B received 90/90 ball and balloon exercise for 5 days for a week with diaphragmatic breathing exercise. Data was collected on all study variables will be entered in MS Excel to prepare Master sheet.

Pre and post assessment of FEV₁ and FEV₁/FVC was done for each participant of each group through digital spirometry. Modified Borg scale is used for rating the exertion level, patient was instructed to perform 6 min walk test, after which the patient rate the level of exertion according to the modified borg scale. Pre and post exertion level of the same activity and the parameters was assessed for the patient. (22,29)



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RESULT

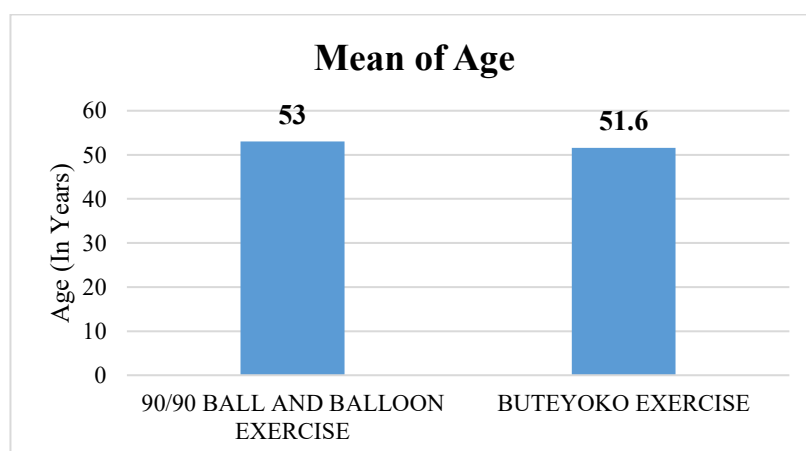
Table No.1 Gender distribution

GENDER DISTRIBUTION		
Gender	Frequency	Percentage
Male	27	67.50%
Female	13	32.50%
Total	40	100.00%

Among the 40 participants, 27 (67.50%) were male and 13(32.50%.) were female.

Table No. 2 Age Distribution

Variable	Exercise Group	Mean	S.D.	P-value
Age	90/90 BALL AND BALLOON EXERCISE	53	6.23	0.2566
	BUTEYOKO EXERCISE	51.6	7.06	



The mean age for Group A was 53 years (S.D. 6.23), while Group B had a mean age of 51.6 years (S.D. 7.06).

Table No. 3 Group wise comparison of FEV₁/FVC and FEV₁

DIGITAL SPIROMETER				
Variable	Group	Mean	S.D.	P-value
FEV ₁ /FVC	A	0.67	0.01	2.81E-06
	B	0.62	0.05	
FEV ₁	A	67.35	1.35	2.81E-06
	B	61.75	4.55	

(*indicates P-value (<0.05) is significant)

Table 3. represents a group-wise comparison of post-intervention FEV₁/FVC and FEV₁ values, highlighting a significantly greater improvement in **Group A** in comparison to **Group B**. The mean of FEV₁/FVC for **Group A** was **0.67** with a standard deviation of **0.01**, while for **Group B**, it was **0.62** (S.D. **0.05**) (P-value: **2.81E-06**). Similarly, the mean FEV₁ for **Group A** was **67.35** with a standard deviation of **1.35**, whereas for **Group B**, it was **61.75** with a standard deviation of **4.55** (P-value: **2.81E-06**).

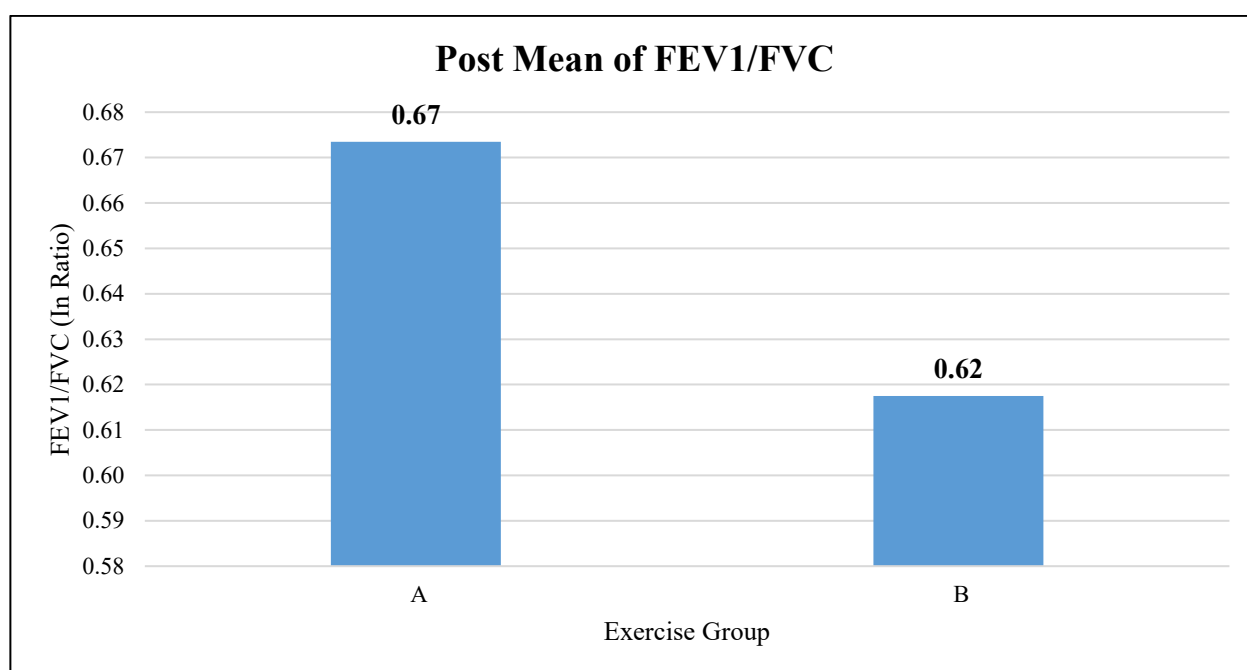


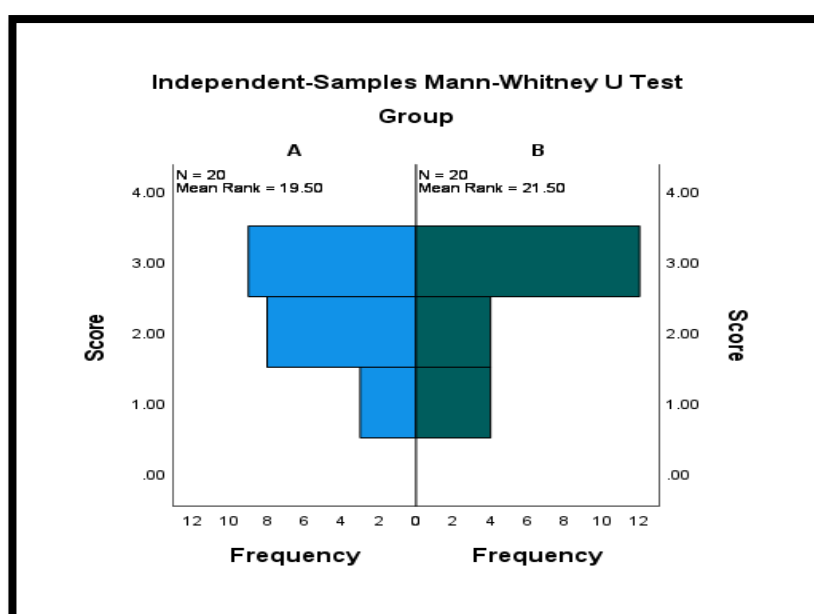
Table No. 4a

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig. ^{a, b}	Decision
1	The distribution of Score is the same across categories of Group.	Independent-Samples Mann-Whitney U Test	.602 ^c	Accept the null hypothesis.
a. The significance level is .050.				
b. Asymptotic significance is displayed.				
c. Exact significance is displayed for this test.				

Table No. 4b Group wise comparison of Borg Scale

Independent-Samples Mann-Whitney U Test Summary	
Total N	40
Mann-Whitney U	220.000
Wilcoxon W	430.000
Test Statistic	220.000
Standard Error	33.547
Standardized Test Statistic	.596
Asymptotic Sig. (2-sided test)	.551
Exact Sig. (2-sided test)	.602

Tables **4a** and **4b** represent a group-wise comparison of Borg Scale scores for **Group A** and **Group B**, indicating that the score distribution is similar between both groups. The significance level of **0.050** suggests that both interventions are equally effective.



SIX MINUTE TEST	Variable	Exercise Group	Mean	S.D.	P-value
REST	RR	A	16.20	1.01	0.1608
		B	16.55	1.19	
	SPO2	A	97.95	0.76	0.1638
		B	98.20	0.83	
	PR	A	77.60	5.29	0.4375
		B	77.35	4.68	
AFTER EXERCISE	RR	A	21.30	1.30	0.2518
		B	21.60	1.50	
	SPO2	A	99.20	0.77	0.0759
		B	98.85	0.75	
	PR	A	110.65	6.31	0.2493
		B	111.90	5.21	
DISTANCE COVER		A	350.20	23.21	0.0138*
		B	332.40	25.84	

Table No. 5 Group wise comparison of Six-minute Walk test

Table 5. represents a group-wise comparison of the six-minute walk test parameters at rest and after activity, highlighting differences among **Group A** and **Group B**. At rest, the mean of **RR** for **Group A** was **16.20**, while for **Group B**, it was **16.55** (P-value: **0.1608**). The mean of **PR** at rest was **77.60** for **Group A** and **77.35** for **Group B** (P-value: **0.4375**). The mean of **SpO₂** for **Group A** was **97.95**, whereas for **Group B**, it was **98.20** (P-value: **0.1638**). After activity, the mean of **RR** for **Group A** was **21.30**, while for **Group B**, it was **21.60** (P-value: **0.2518**). The mean of **PR** after activity was **110.65** for **Group A** and **111.90** for **Group B** (P-value: **0.2493**). The mean of **SpO₂** for **Group A** was **99.20**, while for **Group B**, it was **98.85** (P-value: **0.0759**). These findings suggest that both interventions are equally effective in improving physiological parameters. However, the mean **distance covered** was **350.20 meters** for **Group A** and **332.40 meters** for **Group B**, with a P-value of **0.0138**, indicating that **Group B was more effective** in improving the distance covered.

DISCUSSION

Evidence from previous studies indicates that COPD prevalence increases with age, rising exponentially after 30 yrs. The incidence of COPD in individuals over 30 ranges from 1.6% to 28.3%. Therefore, we included an age group with a clinically and statistically significant mean age. [16] Additionally, previous research suggests that COPD prevalence in males aged over 30 varies between 2% and 22%, whereas in females, it ranges from 1.2% to 19%, indicating a lower prevalence among women. This higher prevalence in males may be co related to factors such as smoking, tobacco chewing, & exposure to harmful chemicals. In the recent study, males accounted for 67.5% of the cases. [16]

In the recent study, a spirometer was used to screen for COPD and measure FEV1 and FEV1/FVC. Spirometer is considered GOLD standard tool for diagnosis of COPD with FEV₁/FVC <70% indicating presence of disease. [17]

A previous study conducted by Yeddu Lakshmi Narayana in 2021 indicated that a decreased Zone of Apposition (ZOA) is associated with reduced ribcage expansion and increased abdominal expansion. Prolonged maintenance of this posture for respiration can lead to diaphragm shortening, lung hyperinflation, and increased reliance on accessory muscles for efficient breathing. Due to the absence of the diaphragm's piston-like movement, the ZOA shortens, which leads to reduce ability of diaphragm for intake of air. This occurs due to insufficient tangential tension on the ribs and limited caudal movement during contraction, ultimately leading to lower trans-diaphragmatic pressure. Additionally, the diminished activation of the transverse abdominis further impacts breathing efficiency. As the diaphragm shortens, thoracic expansion decreases, resulting in increased lung volumes and hyperinflation. This increase in lung capacity contributes to breathlessness and limitations in daily activities. The 90/90 ball and balloon breathing exercise has been found to help restore the ZOA, improve vital capacity, enhance breathing efficiency, and reduce perceived exertion. Another study conducted by Sumi Rose on the effects of the 90/90 Bridge with Ball and Balloon Exercise in asymptomatic individuals with suboptimal breathing demonstrated that this exercise is designed to optimize respiration and neuromuscular control. By inhaling with a balloon in mouth while keeping the ribs depressed, airflow is directed into the lungs, promoting apical expansion—when the shoulder is raised above head. This movement also stretches the pectoralis muscles and facilitates chest expansion. Apical chest expansion has been shown to improve lung vital capacity. The 90/90 bridge position with ball and balloon exercises helps lengthen Zone of Apposition (ZOA), leading to alterations in lung volumes and improved quality of life. Additionally, the resistance provided by the balloon during exhalation activates the abdominal musculature, increases ZOA of the diaphragm, and enhances pulmonary function by improving FEV1 and the FEV1/FVC ratio. [18]

In previous literature by Snehal S. Mavkar on the effect of the Buteyko Breathing Technique as an adjunct to routine physiotherapy on pulmonary functions in patients undergoing off-pump coronary artery bypass surgery concluded that the technique primarily aims to restore the breathing center's ability to adapt to elevated carbon dioxide (CO₂) levels, thereby reducing minute ventilation rates. This is achieved by relaxing auxiliary breathing muscles and increasing abdominal muscle

engagement, training individuals to reduce their breathing volume. These mechanisms collectively decrease respiratory effort, promote muscle relaxation, and enhance diaphragmatic function. The study supports these principles, demonstrating the effectiveness of the Buteyko Breathing Technique in improving respiratory outcomes, particularly in FEV1, FVC, and the FEV1/FVC ratio.^[19]

Previous study conducted by Enny Virna Yuniarti on decreased expiratory peak flow in COPD patients using the Buteyko Breathing Technique (BBT) found that this therapy focuses on controlled breathing to slow and reduce airflow into the lungs. Regular practice of this technique can help alleviate symptoms and reduce the severity of respiratory issues. The key benefits of Buteyko breathing exercises include encouraging shallower breathing, training breathing patterns through structured exercises, and improving COPD symptom control while reducing recurrence rates. As a simple yet effective COPD management strategy, BBT aims to minimize airway constriction through shallow breathing exercises.^[20]

BBT works by increasing carbon dioxide levels and resetting chemoreceptor thresholds, potentially aiding in reducing lung hyperinflation. The technique's primary breath control method, reduced volume breathing, encourages individuals to lower their minute ventilation by decreasing tidal volume (the size of each inhalation and exhalation). It is crucial that patients remain relaxed during this process to counteract the body's natural response of increasing respiratory rate in reaction to reduced tidal volume. The Buteyko method is designed to "retrain" the body's breathing patterns, addressing chronic hyperventilation and hypocapnia to improve COPD management. By slowing rapid, shallow breathing and preventing hyperventilation, it helps maintain optimal carbon dioxide levels in the blood. Additionally, structured breathing exercises may enhance lung capacity, leading to more efficient oxygen absorption. The focus on relaxation and stress reduction contributes to deeper, more effective breathing, which can positively impact oxygen saturation levels. Moreover, BBT may help reduce respiratory tract inflammation, improving airflow and oxygen exchange. According to the Bohr Effect, adequate carbon dioxide pressure in the blood and lungs facilitates oxygen release from hemoglobin, further enhancing oxygen delivery and overall respiratory efficiency.^[20]

The improvement in FEV1 and FEV1/FVC observed in both groups indicates that both breathing techniques effectively enhance lung function and airflow limitation in COPD patients. However, the superior improvement seen in the 90/90 ball and breathing exercise group suggests that this technique may have a more pronounced effect on respiratory mechanics. This could be attributed to its emphasis on diaphragmatic control, postural alignment, and the facilitation of optimal breathing patterns, which may contribute to better lung expansion and ventilation efficiency. These findings align with previous research that emphasizes the role of postural and breathing exercises in improving pulmonary function in COPD patients.

Hyperventilation may contribute to bronchospasm, as the body attempts to retain carbon dioxide. Therefore, correcting hyperventilation can help reduce bronchospasm, leading to more stable symptom control.^[19] Lung hyperinflation causes the diaphragm to become shortened and flattened, impairing its ability to lift and expand the lower rib cage, often resulting in difficulty taking deep breaths. Reducing hyperinflation by any means allows the respiratory muscles to function more efficiently, significantly alleviating breathlessness.^[21] In the 90/90 Ball and Balloon Breathing Exercise, hyperinflation is reduced by maintaining the zone of apposition (ZOA) of the diaphragm, which helps restore its optimal length. Blowing into a balloon during exhalation activates both the internal and external intercostal muscles, while the bridge position enhances abdominal muscle activation and promotes chest wall expansion.^[11] On the other hand, the Buteyko Method teaches individuals to reduce their breathing volume by increasing abdominal muscle tone while relaxing other respiratory muscles, particularly those in the shoulders and chest.^[10]

Both interventions significantly reduced exertion levels as measured by the Borg scale. This suggests that both the 90/90 ball and breathing exercise and Buteyko breathing exercise contribute to improved respiratory efficiency and reduced dyspnea perception during exertion. The Buteyko method, which focuses on reducing hyperventilation and improving carbon dioxide tolerance, likely contributed to

improved breathing efficiency and reduced respiratory discomfort. On the other hand, the 90/90 ball and breathing exercise, which promotes diaphragmatic engagement and controlled breathing patterns, may have enhanced respiratory muscle endurance and efficiency, leading to a similar reduction in exertion perception.

CONCLUSION

The findings showed a significant improvement in FEV₁ and FEV₁/FVC post-intervention in both exercise groups, indicating enhanced lung function. However, when comparing both the interventions, the 90/90 Ball and Balloon Breathing Exercise demonstrated greater effectiveness in improving FEV₁ and FEV₁/FVC values, suggesting its superiority in optimizing respiratory mechanics and airflow limitation in Chronic Obstructive Lung Disease.

Both breathing exercises were equally effective in enhancing functional capacity and reducing exertion levels, the 90/90 Ball and Balloon Breathing Exercise proved to be more beneficial in improving FEV₁ and FEV₁/FVC values. These findings highlighted the importance of targeted breathing exercises in respiratory rehabilitation and suggest that the 90/90 Ball & Balloon Breathing Exercise is a preferred choice for individuals aiming to improve lung function parameters.

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