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Original Research Article

To Study the Effect of Buteyko Breathing Technique in Patients with Obstructive Airway Disease

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ABSTRACT

Background: The Buteyko Method, a breathing technique, has been found to be effective in individuals with asthma and a range of other conditions. In the present study, an attempt was made to compare the effect of Buteyko Breathing Technique in patients with obstructive airway disease.
Aim: To study the effect of Buteyko Breathing Technique in Obstructive Airway Disease
Objectives:
To assess the pre and post changes on outcome measures in control group & in experimental group respectively.
To compare the effect on outcome measures in both the groups.
Methodology: The subjects were screened to select 28 patients. The Control group received conventional Physiotherapy and Experimental group received Conventional Physiotherapy with Buteyko breathing technique. The treatment was given thrice a week for both the groups for 4 weeks. All the outcome measures i.e. Single Breath Count Test (SBCT), Resting Respiratory Rate (Resting RR) , Breath Holding Time (BHT), Percent Predicted Value of 6 Minute Walk Distance (%PV of 6MWD) & Peak Expiratory Flow Rate (PEFR)were recorded at baseline and post treatment in both the groups.
Result: In control group, there was statistically significant increase in SBCT (p=0.001), BHT (p=0.000), PEFR (p=0.000), % PV 6MWD (P=0.006), reduction Resting RR (p=0.000) & Resting HR% (p=0.275). In Experimental Group, there was a statistically significant increase in SBCT (p=0.000), BHT (p=0.001), % PV 6MWD (p=0.001), PEFR (p=0.008), reduction Resting RR (p=0.000) & Resting HR% (p=0.000). On comparing the differences between both groups, statistically significant increase was found in BHT (p= 0.002), SBCT (p= 0.014), % PV 6MWD (p=0.097), PEFR (p=0.098) & significant reduction was found in Resting HR% (p=0.000) & Resting RR (p=0.005).
Conclusion: Buteyko Breathing was effective in improving breathing control, breath holding and reducing the work of breathing in subjects with Obstructive Airway disease.

Keywords: Obstructive Airway Disease, Bohr Effect, Buteyko Breathing Technique

INTRODUCTION

Obstructive lung disease is a category of respiratory disease characterized by airway obstruction. Many obstructive diseases of the lung result from narrowing of the smaller bronchi and larger bronchioles, often because of excessive contraction of the smooth muscle itself (V.K. VIjayan, 2013). It is generally characterized by inflamed and easily collapsible airways, obstruction to airflow, problems exhaling and frequent medical clinic visits and hospitalizations. Types of obstructive lung diseases are asthma, COPD, bronchiectasis, obliterative bronchiolitis (OB) (Shilpa P. Karande er al., 2016).

According to World Health Organization estimates, 65 million people have moderate to severe COPD. More than 3 million people died of COPD in 2005 corresponding to 5% of all deaths globally and it is estimated to be the third leading cause of death by 2030.Airflow limitation is usually progressive and is associated with an abnormal inflammatory response of lungs to noxious particles or gases. Patient complains primarily of incapacitating dyspnoea and reduced Functional Capacity, leading to hyperventilation (Diagnosis and Assessment, updated 2013 & Christine milelsons, 2008).

The Buteyko Method, one of many health-promoting breathing techniques to originate from Russia, made its way to Australia, Europe, and the United States in the 1990s. The technique has been found to be effective in individuals with asthma and a range of other conditions from anxiety to sleep apnea (Ameisan, 1997; Stalmatski, 1999; Stark & Stark, 2002). The method is named after its originator, Dr. Konstantin Pavlovich Buteyko, who claimed that his program of breathing retraining could cure a large number of the chronic ailments affecting modern society. His early work in the 1960s centered on the use of breathing retraining for diseases of the circulatory system and the respiratory system. Over time, doctors working in Buteyko's clinics in Moscow, Siberia, and the Ukraine also claimed success in treating diabetes, psychological disorders, immune and metabolic disorders, and reproductive disorders.

Buteyko's method rests very much on his carbon dioxide theory of disease, and the primary aim of the breathing techniques is to raise carbon dioxide levels. Buteyko claimed chronic hyperventilation to be a widespread, important, and generally unrecognized destabilizer of physiological systems and psychological states. It is known that low carbon dioxide affects many systems of the body either directly or through subsequent depletion of bicarbonate, pH disturbance, and reduced tissue oxygen levels (Folgering, 1999; Gardner, 1995; Hardonk& Beumer, 1979). However, Buteyko and his Russian colleagues elaborated on the conventionally accepted effects of hypocapnea. They argued that depletion of carbon dioxide affected the core processes of energy production (Krebs cycle within the cell), vital chemical reactions requiring carbon compounds and other key homeostatic processes. In Buteyko's view, because carbon dioxide was so vital, the body created a series of defence mechanisms to retain carbon dioxide, including constriction of airways and blood vessels, and gave rise to conditions such as asthma and hypertension (Buteyko, 1990; Stark & Stark, 2002). According to the physiological response of body, blood uses carbon dioxide to improve oxygen distribution to cells (The Bohr Effect) (Bohr et al., 1997 & Olson JS et al., 1972)

In case of hyperventilation there is a proportionate exhalation of carbon dioxide as to the inhalation of oxygen, leading to a decline in the net amount of carbon dioxide in blood. Thus, there is less oxygen supply leading to weak health and chronic disease.

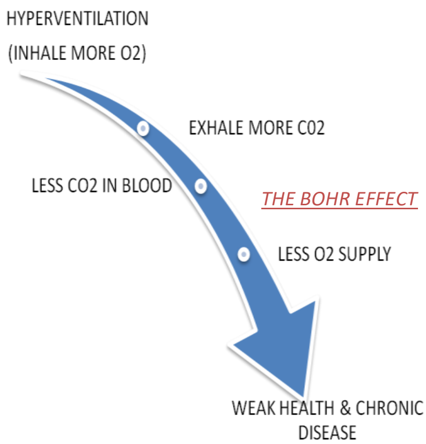


Figure 1: Illustration of Bohr Effect.

METHODOLOGY

Research Design: Experimental, parallel group, prospective study

Sample Population: Patients with moderate to severe airflow limitation.

Type Of Sampling: Purposive sampling. Patients were randomly assigned to experimental & control group with the help of block randomization using block of four

Source Of Sampling: Chest medicine OPD of tertiary health care hospital

Place of Study: Physiotherapy OPD

Duration of Study: 18 Months (May 2016 TO October 2017)

Sample size:

The sample size was calculated using the previous study titled "Effect of singing classes on quality of life and functional capacity in subjects with mild to moderate airflow limitation- A prospective experimental study", the mean difference and SD of primary outcome measure (Single Breath Count Test) in intervention group was 4±1.7 with a large effect size.

Conventional Physiotherapy showed no change in Single Breath Count Test.

Considering that Buteyko Technique will produce similar effect, minimal clinical effect size is calculated as

$N = 2(Z_\alpha + Z_{1-\beta})^2 \sigma^2 / d^2$

The Sample size came as 28 including the samples for dropouts.

So, the Sample size for each group (n) = N/2 = 28/2 = 14

Inclusion criteria:

- Patients with FEV1/FVC ratio < 0.7
- 30% ≤ FEV1 < 79% of predicted.
- Resting Respiratory Rate ≥ 24.
- Patients willing to participate.

Exclusion criteria:

- Admission in any hospital due to acute exacerbation in the last 4 weeks
- Myocardial complications like acute Hypertension & recent History of any cardiac disease
- Musculoskeletal pain

OUTCOME MEASURES:

- **Single Breath Count Test (SBC)**

Score was taken as the number of count spoken in 1 breath

- **Resting Respiratory Rate (Resting RR)**

The number of breaths taken in a single minute at rest was recorded against the sound of a metronome

- **Breath Holding Time (BHT)**

The time for which a single breath can be held after complete exhalation was recorded.

Percentage Predicted Value of 6 Minute walk distance (% PV of 6MWD) :

a) 6MWD

b) Reference equation was used to calculate PV of 6 MWD (Ramanathan Palaniappan, 2014)

Male = 561.022 - (2.507 × age (yr)) + 1.505 × weight (kg)) - (0.055 × height (cm))

Indian female = -30.425-(0.809×age(yr)) - (2.074×weight(kg)) + (4.235×height(cm))

c) Percentage PV of 6MWD

$$\% \text{ PV OF 6MWD} = \frac{\text{6MWD}}{\text{Predicted value}} \times 100$$

- **Peak Expiratory Flow Rate (PEFR)**

In the upright sitting position the subjects were given the cartoon mouth piece that was adjusted to the mouth piece of the peak expiratory flow meter. The pointer is switched to zero. Instruction is given to the subjects to hold the peak flow meter level (horizontally) and to keep their fingers away from the pointer. The subjects are asked to take a deep breath and close the lips firmly around the cartoon mouthpiece & blow as hard as they can as if blowing out candles. The reading over the peak flow meter is measured and the pointer is switched back to zero. The procedure is repeated for 3 times and highest reading is recorded.

PROCEDURE

The approval for the study was sought from the local institution ethics committee. Block randomization method using block of four was used for random allocation of patients to experimental (Buteyko and conventional) and control group (conventional). It was done prior to commencement of the study by an independent person and sealed in separate, opaque, numbered envelops.

40 patients with airflow limitation coming to Chest Medicine OPD were screened out of which 28 were recruited. 8 patients did not meet the inclusion criteria & 4 patients refused to give consent to participate in the study. There were 3 dropouts in the study, 2 in control group and 1 in the experimental group, due to loss of follow up.

Study procedure was explained and written consent was taken from the participants. The basic personal information, anthropometric measures, vital parameters, recent PFT parameters, co-morbidities and information regarding current medication of the participant was taken.

As the participants were recruited, the sealed numbered envelops were opened and accordingly the participants were allocated to Control and Experimental groups.

The Control group received conventional chest Physiotherapy and Experimental group received Conventional Physiotherapy with Buteyko breathing technique.

The treatment was given thrice a week for both the groups for a duration of 4 weeks & the number of sessions in both the groups were recorded. The experimental group subjects were called on Mondays, Wednesdays & Fridays & the control group subjects were called on Tuesdays, Thursdays & Saturdays to ensure no interaction of subjects between the groups.

All the outcome measures ie single breath count test, resting respiratory rate, breath holding time, 6 MWT (as per American Thoracic Society or ATS guidelines) and peak expiratory flow rate (PEFR) were recorded pre and post treatment sessions in both groups by an independent assessor. The PEFR was tested thrice and the best score was taken.

CONTROL GROUP: The control group received Conventional Chest Physiotherapy thrice a week for 4 weeks. The session included-

- Nebulization
- Postural drainage
- Breathing control exercise

Breathing control exercise included diaphragmatic breathing exercises with pursed lip breathing exercises. In this the subjects placed their hands on the anterior costal margins and upper abdomen to feel the movement occurring. This was followed by breathing in gently and concentrating on allowing the abdominal wall to swell gently not forcibly, under the slight pressure of their hands. On breathing out with slightly pursing the lips, they felt the abdomen slowly sinking back to rest. The upper chest and shoulder muscles remained relaxed. The session lasted for 15-20 minutes.

EXPERIMENTAL GROUP: The experimental group practiced Buteyko breathing technique through a video for 20 minutes in addition to the conventional physiotherapy with total session duration varying from 35 – 40 minutes.

Buteyko Breathing consisted of nasal breathing & the subjects inhaled through nose keeping the mouth closed & exhaled through nose to remove air from lungs. Then the subjects were instructed to hold the breath until they felt the urge to inhale. This cycle of nasal breathing was repeated with a rest period varying from 30 seconds to 2 minutes in between each cycle. During the breathing sessions participants' oxygen saturation was continuously monitored for patient safety. The technique would be discontinued if there was a fall in oxygen saturation. However, during the treatment sessions, no participant complained of any discomfort nor was there a drop in oxygen saturation. Two to three sessions were required for the participants get familiarized with the breathing technique.

After 4 weeks, the outcome measures of both the groups were recorded. In experimental group, there was one loss of follow up and 13 patients completed the study. In control group, there were 2 loss of follow up and 12 patients completed the study. The data of 13 & 12 patients were recorded and analysed.

Schematic Representation of Methodology

After collection of data, data sheet was prepared and statistically analysed.

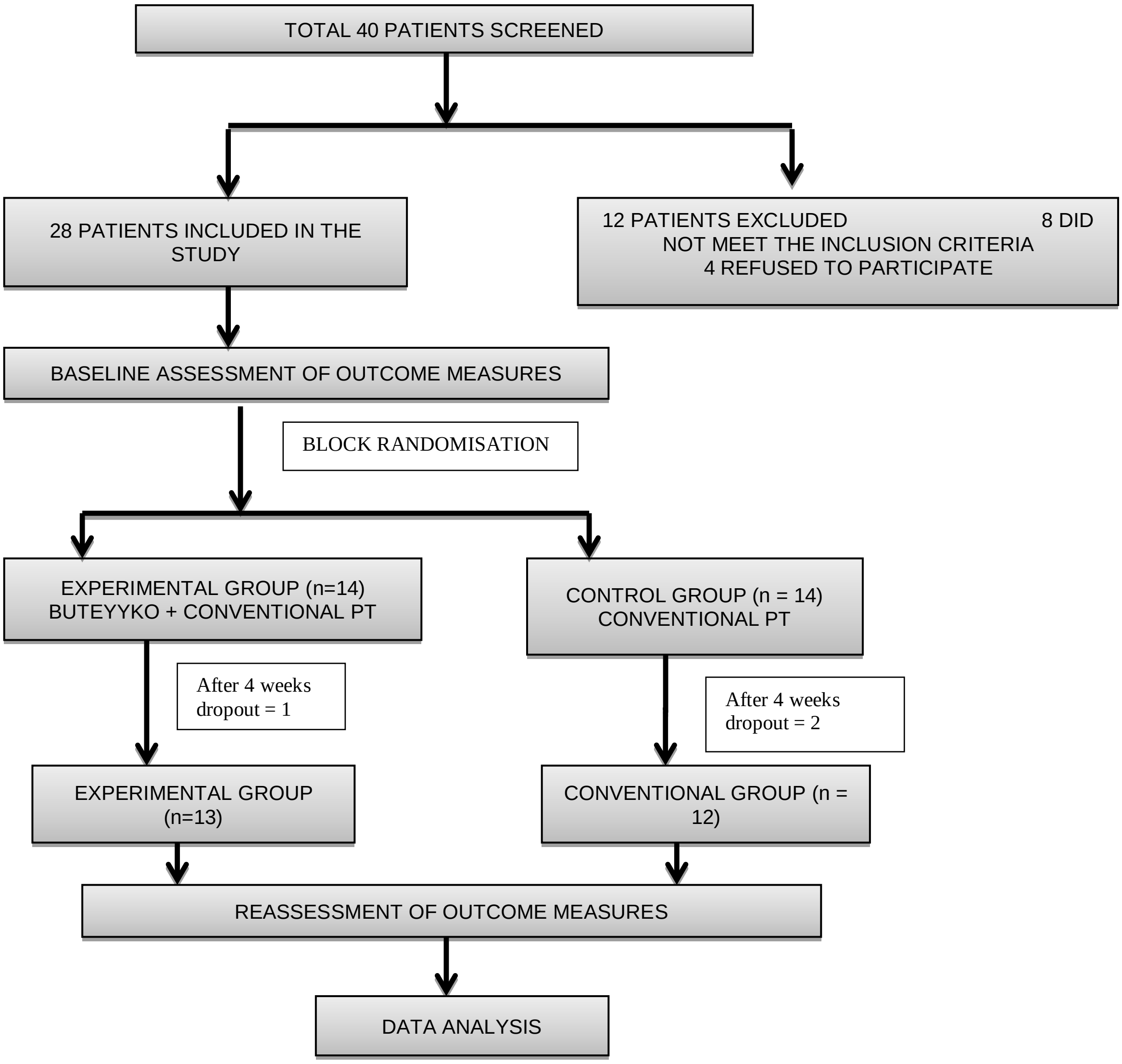


Figure 2: Flow chart of study

RESULTS

SPSS 16 software was used to analyse the data. Data analysis was segregated into
(a) Demographic & Baseline analysis(b) Control Pre & Post analysis
(c) Experimental Pre & Post analysis (d) Differences in the analysis

The outcome measures were SBCT, Resting RR, BHT, %PV 6MWD & PEFR. Also, in this study, it was found that Resting HR was lower in experimental group than in control group after the respective interventions. Resting HR% was taken instead of Resting HR to nullify the confounding factor of the age. So, the Resting HR% was statistically analysed. It was calculated as

Resting HR% = Resting HR / HR max * 100

Where, HR max = 206.9 - (0.67 * Age) (American College of Sports Medicine, Guidelines for Exercise Testing and Prescription, 8th edition)

40 patients with airflow limitation coming to Chest Medicine OPD were screened out of which 28 were recruited. 8 patients did not meet the inclusion criteria & 4 patients refused to give consent to participate in the study. There were 3 dropouts in the study, 2 in control group and

1 in the experimental group, due to loss of follow up.

In each group, descriptive analysis of data was done using Mean, Median & 95% CI.

Data was tested for normality using the Shapiro Wilk test. The test for significance was set at 0.05 for 95% CI.

At baseline, unpaired t test was used to compare Age, Resting HR% and Resting RR between experimental and control group and Mann Whitney U was used to compare BMI, Gender, severity of obstruction, SBCT, BHT, %PV 6MWD & PEFR.

In control group, for within group analysis, paired t test was used for Resting RR, BHT, % PV of 6MWD, Resting HR% & PEFR whereas Wilcoxon Signed Rank test was used for SBCT.

In experimental group, for within group analysis, paired t test was used for SBCT, Resting RR, Resting HR whereas Wilcoxon Signed Rank test was used for % BHT, % PV of 6MWD, & PEFR.

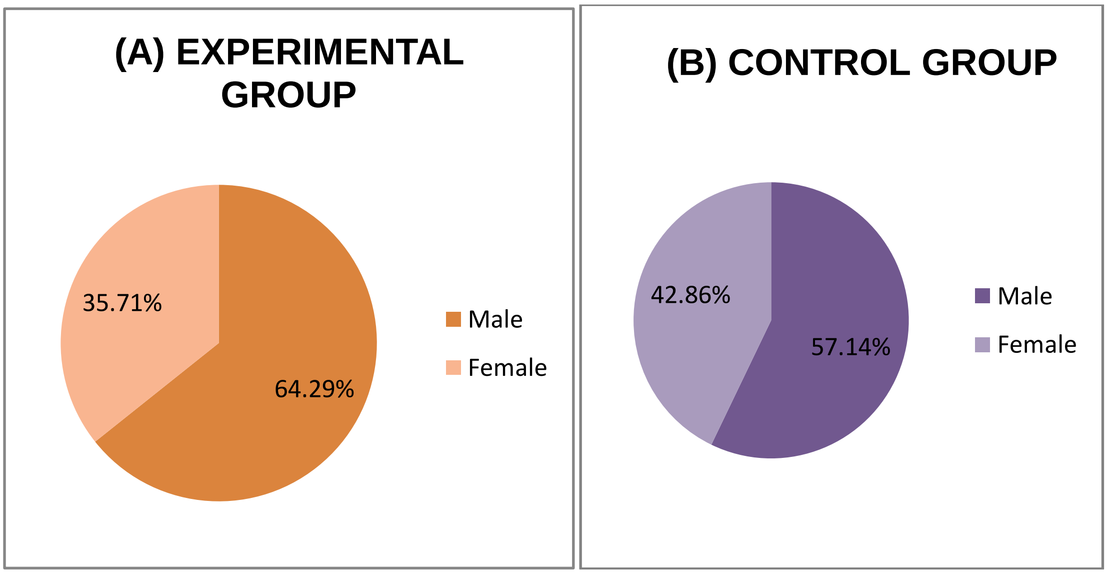
In comparison of differences between experimental and control group, Wilcoxon Signed Rank test was used for SBCT, Resting RR, BHT, PEFR & Resting HR% whereas paired t test was used for %PV 6MWD.

DEMOGRAPHIC DATA

Table 1: Gender distribution in experimental and control groups

GENDER	FREQUENCY		TEST USED	Sig
	CONTROL GROUP	EXPERIMENTAL GROUP	Man Whitney U test	0.704
MALE	8 (57.14%)	9 (64.29%)		
FEMALE	6 (42.86%)	5 (35.71%)		
TOTAL	14 (100%)	14 (100%)		

Table 1 shows the gender distribution in the groups. In the experimental group, the number of subjects were 14, of which 9 (64.29%) were males and 5 (35.71%) were females. In the control Group, the number of subjects were 14, of which 8 (57.14%) were males and 6 (42.86%) were females.



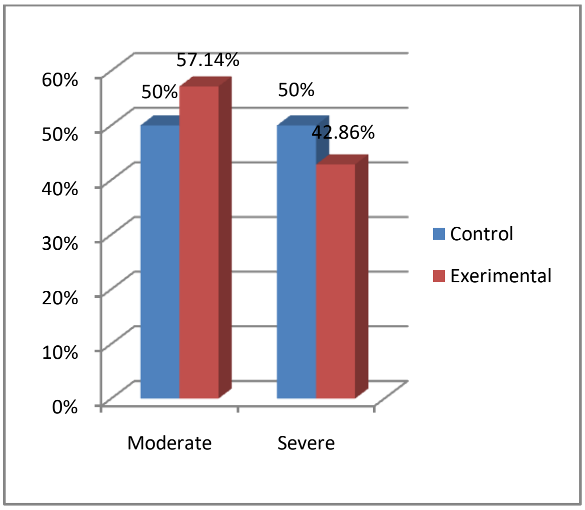
Graph 1: Gender Distribution

GRAPH 1 (A) and 2 (B) shows gender distribution in Control and Experimental Groups respectively.

Table 2: Severity Grading in Control and Experimental groups

GRADES	FREQUENCY		TEST USED	Sig
	CONTROL GROUP	**EXPERIMENTAL GROUP**	Man Whitney U test	0.710
MODERATE	7 (50%)	8 (57.14%)		
SEVERE	7 (50%)	6 (42.86%)		
TOTAL	14 (100%)	14 (100%)		

Table 2 shows frequency of grades of severity of airway obstruction in the groups. In control group, 50% had moderate and 50% patients had severe airway obstruction. In experimental group, 57.14% subjects had moderate and 42.86% subjects had severe airway obstruction. (In this study, severe grade was considered as 1 and moderate grade as 2.)



GRAPH 2: Distribution of Severity

GRAPH 2 Shows distribution of severity in Control and Experimental groups.

BASELINE COMPARISON BETWEEN THE GROUPS

Table 3: Baseline Characteristics in Both Groups

DATA		CONTROL GROUP	EXPERIMENTAL GROUP	TEST USED	Sig.
AGE	MEAN ± SD	47.36 ± 13.698	48.86 ± 14.114	Unpaired t test	.778
	MEDIAN	47.50	51.00		
	CI	39.45 – 55.27	40.71 – 57.01		
	SE	3.661	3.772		
BMI	MEAN ± SD	23.31 ± 4.865	21.76 ± 3.675	Man Whitney U test	0.382
	MEDIAN	22.50	21.40		
	CI	20.50 – 26.12	19.63 – 23.88		
	SE	1.300	0.982		
SBCT	MEAN ± SD	10.86 ± 1.027	11.29 ± 1.684	Man Whitney U test	0.400
	MEDIAN	10.00	11.50		
	CI	10.26 – 11.45	10.31 – 12.26		
	SE	0.275	0.450		
RESTING RR	MEAN ± SD	29.36 ± 2.134	29.07 ± 1.979	Unpaired t test	.716
	MEDIAN	29.00	29.00		
	CI	28.12 - 30.59	27.93 - 30.21		
	SE	0.570	0.529		
RESTING HR%	MEAN ± SD	49.99 ± 2.605	49.11 ± 3.470	Unpaired t test	.458
	MEDIAN	49.70	49.78		
	CI	48.48 - 51.49	47.11 - 51.12		
	SE	0.696	0.927		
BHT	MEAN ± SD	12.2857 ± 2.33464	12.7143 ± 2.33464	Man Whitney U test	0.411
	MEDIAN	12.5000	13.5000		
	CI	10.9377-13.6337	11.3663 - 14.0623		
	SE	0.62396	0.62396		
PEFR	MEAN ± SD	145.00 ± 21.394	174.29 ± 76.532	Man Whitney U test	0.364
	MEDIAN	140.00	150.00		
	CI	132.65 - 157.35	130.10 - 218.47		
	SE	5.718	20.454		
%PV 6MWD	MEAN ± SD	70.55 ± 24.301	79.33 ± 15.477	Man Whitney U test	0.854
	MEDIAN	78.72	77.68		
	CI	56.52 - 84.58	70.39 - 88.26		
	SE	6.495	4.137		

TABLE 3 shows the baseline characteristics in both, the control and the experimental groups.

CONTROL GROUP ANALYSIS

Table 4: Descriptive statistics of SBCT, Resting RR, BHT, % PV 6MWD, PEFR and Resting HR%

DATA		PRE	POST	TEST USED	Sig
SBCT	MEAN ± SD	11.00 ± 1.04447	12.2500± 1.21543	Wilcoxon Signed Rank Test	.001
	MEDIAN	11.0000	12.5000		
	CI	10.3364 – 11.6636	11.4778 –13.0222		
	SE	.30151	.35086		
Resting RR	MEAN ± SD	29.2500 ± 2.13733	26.6667 ±1.92275	Paired t test	.000
	MEDIAN	29.0000	26.0000		
	CI	27.8920 – 30.6080	25.4450 –27.8883		
	SE	.61699	.55505		
BHT	MEAN ± SD	12.7500 ± 1.60255	14.2500 ±1.35680	Paired t test	.000
	MEDIAN	12.5000	14.0000		
	CI	11.7318 – 13.7682	13.3879 –15.1121		
	SE	.46262	.39167		
%PV 6MWD	MEAN ± SD	78.9258 ± 1.21130	82.4675 ±1.23006	Paired t test	.006
	MEDIAN	79.6950	85.4800		
	CI	71.2296 – 86.6221	74.6521 –90.2829		
	SE	3.49673	3.55088		
PEFR	MEAN ± SD	1.4583 ± 2.31432	1.4833 ± 2.36771	Paired t test	.000
	MEDIAN	1.4000	1.4500		
	CI	1.3113 – 1.6054	1.3329 1.6338		
	SE	6.68086	6.83500		
Resting HR%	MEAN ± SD	49.6392 ± 2.60406	47.9215 ± 2.10062	Paired t test	.275
	MEDIAN	48.5921	47.4872		
	CI	47.9846 – 51.2937	46.5868 – 49.2561		
	SE	.75173	.60640		

Table 4 shows descriptive statistics of SBCT, Resting RR, BHT, % PV 6MWD, PEFR and Resting HR%

EXPERIMENTAL GROUP ANALYSIS

Table 5: Descriptive statistics of SBCT, Resting RR, BHT, % PV 6MWD, PEFR and Resting HR%

DATA		PRE	POST	TEST USED	Sig.
SBCT	MEAN±SD	11.2308 ± 1.73944	13.3846 ± 1.70970	Paired t test	.000
	MEDIAN	11.0000	13.0000		
	CI	10.1796 – 12.2819	12.3515 – 14.4178		
	SE	.48243	.47419		
Resting RR	MEAN±SD	28.8462 ± 1.86396	24.5385 ± 2.56955	Paired t test	.000
	MEDIAN	29.0000	24.0000		
	CI	27.7198 – 2.9725	22.9857 – 26.0912		
	SE	.51697	.71266		
BHT	MEAN±SD	12.6154 ± 2.39925	16.7692 ± 5.21462	Wilcoxon Signed Rank Test	.001
	MEDIAN	13.0000	15.0000		
	CI	11.1655 – 14.0652	13.6181 – 19.9204		
	SE	.66543	1.44628		
%PV 6MWD	MEAN±SD	79.6369 ± 1.60639	85.2985 ± 1.70443	Wilcoxon Signed Rank Test	.001
	MEDIAN	80.0800	84.4600		
	CI	69.9296 – 89.344	74.9987 – 95.5982		
	SE	4.45533	4.72724		
PEFR	MEAN±SD	1.7615 ± 7.93241	1.8462 ± 8.45198	Wilcoxon Signed Rank Test	.008
	MEDIAN	1.5000	1.6000		
	CI	1.2822 – 2.2409	1.3354 – 2.3568		
	SE	22.00054	23.44156		
Resting HR%	MEAN±SD	49.0457 ± 3.60235	44.7607 ± 2.49002	Paired t test	.000
	MEDIAN	49.5888	44.3747		
	CI	46.8689 – 51.2226	43.2560 – 46.2654		
	SE	.99911	.69061		

Table 5 shows descriptive statistics of SBCT, Resting RR, BHT, % PV 6MWD, PEFR and Resting HR%

EXPERIMENTAL V/S CONTROL GROUP ANALYSIS

Table 6: Descriptive statistics of SBCT, Resting RR, BHT, % PV 6MWD, PEFR and Resting HR%

DATA		CONTROL GROUP	EXPERIMENTAL GROUP	TEST USED	Sig.
SBCT	MEAN ±SD	1.2500±.45227	2.1538 ±1.06819	Wilcoxon signed rank test	.014
	MEDIAN	1.0000	2.0000		
	CI	.9626 - 1.5374	1.5083 – 2.7993		
	SE	.13056	.29626		
Resting RR	MEAN ±SD	-2.5833±.66856	-4.3077 ± 1.75046	Wilcoxon signed rank test	.005
	MEDIAN	-2.5000	-4.0000		
	CI	-3.0081- -2.1586	-5.3655 - -3.2499		
	SE	.19300	.48549		
BHT	MEAN ±SD	1.5000 ±.67420	4.1538 ± 3.84808	Wilcoxon signed rank test	.002
	MEDIAN	2.0000	3.0000		
	CI	1.0716 – 1.9284	1.8285 – 6.4792		
	SE	.19462	1.06726		
%PV 6MWD	MEAN ±SD	3.5417±3.63741	5.6608 ± 2.40710	Paired t test	.097 .105
	MEDIAN	2.4950	4.8200		
	CI	1.2306 –5.8528	4.2062 – 7.1154		
	SE	1.05003	.66761		
PEFR	MEAN ±SD	2.5000±7.53778	8.4615 ± 8.98717	Wilcoxon signed rank test	.098
	MEDIAN	.0000	10.0000		
	CI	-2.2893–7.2893	3.0306 – 13.8924		
	SE	2.17597	2.49259		
Resting HR%	MEAN± SD	-1.7177±.95485	-4.2850 ± 1.78257	Wilcoxon signed rank test	.000
	MEDIAN	-1.3929	-3.6284		
	CI	-2.3244 - -1.1110	-5.3622 - -3.2078		
	SE	.27564	.49440		

Table 6 shows descriptive statistics of differences of SBCT, Resting RR, BHT, % PV 6MWD, PEFR and Resting HR% between experimental and control group after intervention

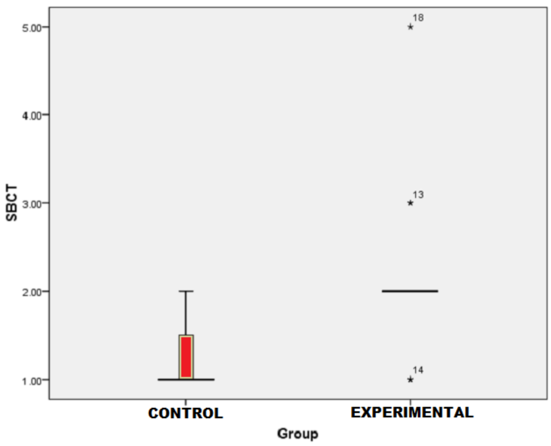


Fig 2: SBCT comparison

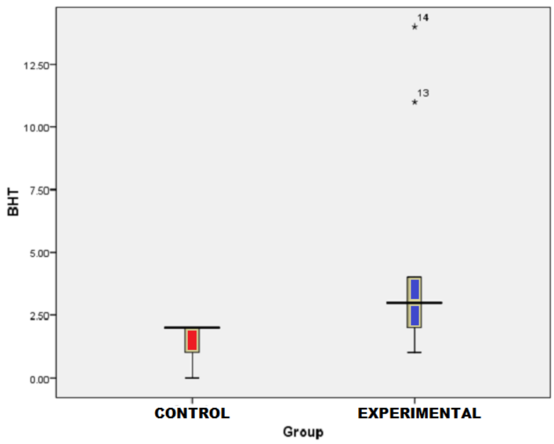


Fig 4. BHT comparison

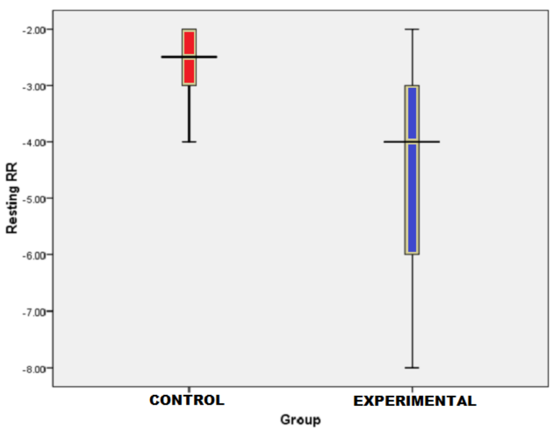


Fig 3. Resting RR comparison

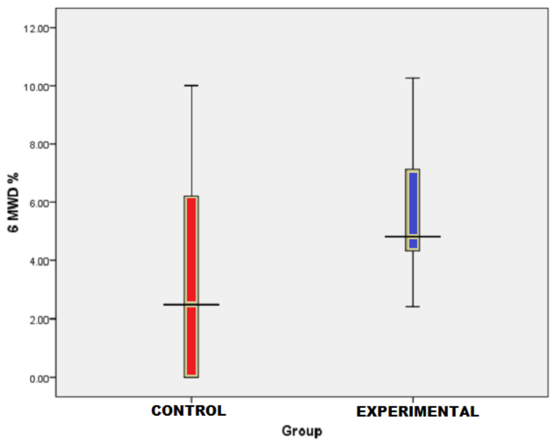


Fig 5. %PV 6MWD comparison

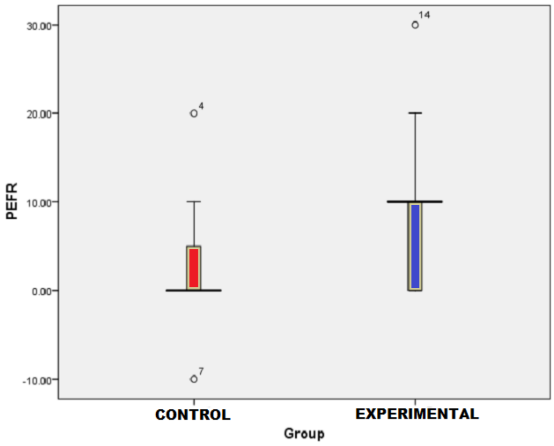


Fig 6. PEFR comparison

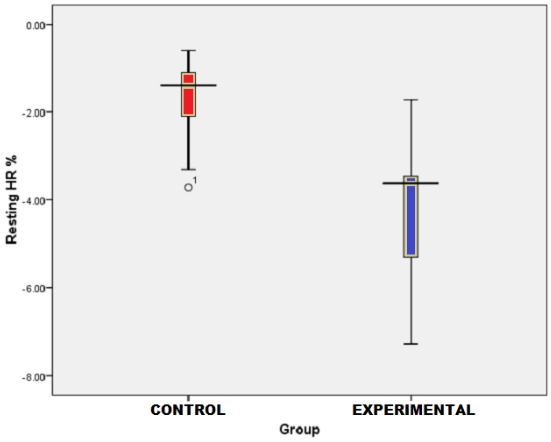


Fig 7. Resting HR% comparison

DISCUSSION

Table 1 & Graph 1 shows that, in control group, there were 8 male & 6 female subjects corresponding to 57.14% & 42.86% respectively whereas, in experimental group, there were 9 male & 5 female subjects corresponding to 64.29% & 35.71% respectively. There was no difference in the percentage of males and females in both groups (p=0.704) indicating that the male and female subjects were distributed homogeneously in both the groups at the baseline.

Table 2 & Graph 2 show the severity of airway obstruction graded according to GOLD's Classification. In control group, 50% had moderate obstruction & 50% had severe obstruction. In experimental group, 57.14% had moderate obstruction & 42.86% had severe obstruction. On comparison there was no difference in severity in both the groups (p=0.710).

Table 3 shows the baseline characteristics of both the groups i.e. it shows the comparison in age, BMI, SBCT, Resting RR, Resting HR%, BHT,PEFR,% PV 6MWD at baseline between the groups. Unpaired t test was used to analyse the significance level in Age, Resting HR% & Resting RR whereas, Man Whitney U test was used to analyse the significance level in BMI, SBCT, BHT, PEFR & %PV 6MWD. There was no statistically significant difference in Age (p=0.778), BMI (p=0.382), SBCT (p=0.4000), Resting RR (p=0.716), Resting HR% (p=0.458), BHT (p=0.411), PEFR (p=0.364), % PV 6MWD (p=0.854). Thus, it was seen that there was no statistically significant difference between the groups at baseline suggesting that both the groups were homogenous.

Table 4 shows the pre post analysis of outcome measures in control group. Wilcoxon Signed Rank test was used to analyse SBCT whereas Paired t test was used to analyse Resting RR, BHT, % PV 6MWD, PEFR & Resting HR%. There was a statistically significant increase in BHT (p=0.000), PEFR (p=0.000), SBCT (p=0.001), % PV 6MWD (p=0.006), reduction in Resting RR (p=0.000) post intervention in control group. Thus, following 4 weeks of conventional physiotherapy in control group, there was a statistically significant increase in breath holding, peak expiratory flow rate, breathing control, functional capacity and a reduction in work of breathing (Resting RR).

Table 5 shows the pre post analysis of outcome measures in experimental group. Paired t test was used to analyse SBCT, Resting RR & Resting HR% whereas Wilcoxon Signed Rank test was used to analyse BHT, % PV 6MWD & PEFR. There was a statistically significant increase in SBCT (p=0.000), BHT (p=0.000), % PV 6MWD (p=0.001) and PEFR (p=0.008), reduction in Resting RR (p=0.000) and Resting HR% (p=0.000) post intervention in experimental group. Thus, following 4 weeks of Buteyko intervention in experimental group, there was a statistically significant improvement in breathing control, breath holding, functional capacity and a reduction in work of breathing (Resting RR) and Resting Heart Rate.

Table 6 shows the comparison of differences of SBCT, Resting RR, BHT, % PV of 6MWD, PEFR and Resting HR% between both the groups. Wilcoxon Signed Rank Test was used to analyse SBCT, Resting RR, BHT, PEFR & Resting HR% whereas, Paired t test was used to analyse %PV 6MWD. There was a statistically significant increase in BHT (p=0.002) SBCT (p=0.014), statistically significant decrease in Resting HR% (p=0.000) & Resting RR (p=0.005) between the groups at the end of intervention whereas there was no statistical difference in PEFR (p=0.098) and %PV 6MWD (p=0.1).Thus, there was a significant improvement in breathing control [(SBCT) (p= 0.0014) and Breath holding (BHT) (p= 0.002)] and a significant reduction in work of breathing [Resting RR (p= 0.002)] in experimental group than control group. This is suggestive that Buteyko breathing brought about an effect in breathing control & breath holding. There was a significant reduction in Resting HR% (p= 0.000) in experimental group than control group suggesting that Buteyko breathing had an effect in lowering of heart rate. There was no statistically significant difference in PEFR & functional capacity (%PV 6MWD) suggesting that both conventional physiotherapy and Buteyko Breathing did not bring about an improvement in PEFR & functional capacity.

In this study, there was no statistically significant difference in Functional capacity between both the groups. This could be explained as follows. At the onset of the study, the sample size was calculated using the effect size in SBCT (effect size = 4). Hence, the sample size was sufficient to produce a significant difference in SBCT and probably a larger sample size would have brought about a significant difference in functional capacity. Furthermore, the duration of the study was 4 weeks which was probably not sufficient enough to produce a significant improvement in functional capacity.

The Buteyko Method's comprehensive and plausible CO2 - deficiency model helps reattribution of symptoms to a controllable cause with clear instructions about how to fix the problem (i.e., breathe less and hold your breath). The Buteyko Method teaches subjects to voluntarily pursue a slight lack of air sensation during breathing practice, and this may result in a positive change in the person's response to breathlessness when it arises spontaneously during exercise or an exacerbation attack. It is not known whether the Buteyko Method would make these individuals more sensitive to symptoms because of improved body awareness or less sensitive because of a blunting of sensitivity to dyspnea. These effects, sometime called nonspecific effects, may be an important part of how the Buteyko Method works.

Traditionally, deep breathing is considered as the best as it is thought to provide the more oxygen. We inhale oxygen and exhale carbon dioxide and the conclusion that is drawn is that oxygen is good for us and carbon dioxide is harmful. When Professor Buteyko was first analysing his patients he discovered that those who were sick breathed much more than those who were healthy; that is, their tidal volume, depth and frequency was greater.

When we over-breathe or hyperventilate, we lose valuable carbon dioxide. According to Professor Buteyko, "hidden hyperventilation" often goes undiagnosed. When a person is acutely hyperventilating, it's obvious and the implications to the organism are disastrous.

The Buteyko method is based on the concept that hyperventilation is the underlying cause of numerous medical conditions (Rosalba Courtney, 2008). It is known that hyperventilation can lead to low carbon dioxide levels in the blood (or hypocapnea), which can subsequently lead to disturbances of the acid-base balance in the blood and lower tissue oxygen /levels. Advocates of this method believe that the effects of chronic hyperventilation include widespread bronchospasm, disturbance of cell energy production via the Krebs cycle, as well as disturbance of numerous vital homeostatic chemical reactions in the body. The Buteyko technique is a purported technique of "retraining" the body's breathing pattern to correct for the presumed chronic hyperventilation and hypocapnea, and thereby treat or cure the body of these medical problems.

One possible biochemical mechanism of Buteyko may be through its influence on nitric oxide (NO). NO is involved in a large number of physiological responses including bronchodilation, vasodilatation, tissue permeability, immune response, oxygen transport, neurotransmission, insulin response, memory, mood, and learning. Buteyko practitioners' insistence on nasal breathing at all times is likely to affect NO levels, as a large percentage of the body's NO levels are made in the paranasal sinuses (Lundberg & Weitzbergb, 1999). Also, the long breath holds interspersed with reduced volume breathing used by the Buteyko Method produce a mild fluctuating hypoxia, another mechanism known to influence NO and its functions (Malyshev et al., 2001).

Interestingly, breathing at both the low lung volumes, taught by Buteyko and the higher lung volumes commonly used by Yoga practitioners and those teaching resonant frequency breathing, can have a bronchodilating effect (Douglas, Drummond, & Sudlow, 1981; Lehrer et al., 2004; Shen, Gunst, & Tepper, 1997; Slader et al., 2006). The mechanisms behind the symptom-attenuating effects of breathing repeatedly above or below tidal volumes have not been well researched. There is some evidence that the pattern of breathing affects the composition of surfactant (Doyle et al., 1994). Surfactant is known to be a smooth muscle relaxant, with beneficial effects on lung immunity, allergy, and inflammation (Koeztler et al., 2006). These physiological effects of changing breath volume could be additive to the observed nonspecific effect that merely controlling the pattern of breathing has in making people with asthma more comfortable with their symptoms (Slader et al., 2006).

People practicing the Buteyko Method are taught to reduce their volume of breathing by using a combination of increased abdominal muscle tone and relaxation of all the other muscles of breathing, particularly the shoulders and chest. Low-volume breathing often reduces the effort of breathing, leads to relaxation of respiratory muscles, and improves the function of the diaphragm. It can reduce the amount of hyperinflation or trapping of air in the lungs, which is very common in asthmatics, people with chronic obstructive pulmonary disease, and others with unexplained breathlessness (Muller, Bryan, & Zamel, 1981; O'Donnell, 2006; Wolf, 1994).

It may seem paradoxical that breathing less could make a person less breathless, as this is generally not the case; however, if the lungs are hyperinflated, increasing the volume of breathing with deep abdominal breathing will make a person more breathless (Cahalin, Braga, Matsuo, & Hernandez, 2002). Hyperinflation of the lungs makes the diaphragm shorten and flatten so that it loses its ability to lift and widen the lower rib cage; understandably, this contributes to feelings of not being able to take a deep breath (Finucane, Panizza, & Singh, 2005). Reduction of hyperinflation by any means makes the muscles of breathing function more efficiently and significantly decreases the symptom of breathlessness (Casaburi & Porszasz, 2006).

Breath holding is a technique shared by yoga and Buteyko. Few studies have been done on the therapeutic effects of breath holding, and further research could be fruitful. During a long breath hold such as the Maximum Pause, one can see oxygen saturation dropping and then often reaching maximum saturation of 100% when the first breath is taken. The face flushes, tight diaphragms relax, and people feel their breathing become free. One effect of long breath holds is that they enable the body to reverse carbon dioxide gas exchange so that the body reabsorbs carbon dioxide (Hong, Rahn, Kang, Song, & Kang, 1963). Repeated use of extended breath holds increases the body's production of endogenous antioxidants and raises the anaerobic threshold, thus increasing capacity to exercise at higher levels of exertion, an effect similar to altitude or hypoxic training (Joulia et al., 2003). Stopping breathing and then restarting when respiratory impulses intensify may help to reset abnormal breathing rhythms in a similar way to stopping the heart to reset cardiac arrhythmias. The cerebral vasodilation that results from a drop in O_2 or rise in CO_2 after breath holding may also help to reset the breathing pattern by changing the input to the central and peripheral chemoreceptors.

Cooper S et al (2003) in a study titled Effect of two breathing exercises (Buteyko and pranayama) in asthma: a randomised controlled trial, conducted a randomised control trial in which ninety patients with asthma taking an inhaled corticosteroid were randomised after a 2 week run in period to Eucapnic Buteyko breathing, use of a Pink City Lung Exerciser (PCLE) to mimic pranayama, or a PCLE placebo device. The study concluded that the Buteyko breathing technique (twice a day for six months) can improve symptoms and reduce bronchodilator use but does not appear to change bronchial responsiveness or lung function in patients with asthma. No benefit was shown for the Pink City Lung Exerciser.

Cowie RL et al (2008) in a study titled, A randomised controlled trial of the Buteyko technique as an adjunct to conventional management of asthma, conducted a randomised control trial in patients with asthma on conventional therapy including inhaled corticosteroid. The outcome measure was Asthma control, defined by a composite score based on the Canadian asthma consensus report, 6 months after completion of the intervention. The study concluded that, six months after completion of the interventions, a large majority of subjects in each group displayed control of their asthma with the additional benefit of reduction in inhaled corticosteroid use in the Buteyko group (p=0.02).

CONCLUSION

Buteyko Breathing was effective in improving breathing control, breath holding and reducing the work of breathing in subjects with Obstructive Airway disease.

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