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Effect of Buteyko Breathing Exercise Combined with Postural Stability Exercises on Oxygen Saturation in Young Adult Smokers

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ABSTRACT

Purpose: The purpose of the study was to examine the effect of Buteyko breathing exercise combined with postural stability exercises on oxygen saturation in young adult smokers.

Methods: Forty male smokers were recruited from Nahda university. Their age ranged between 18-30 years. They were randomly allocated into two equally sized groups.

Study Group: They participated in 6 weeks training with Buteyko breathing exercise combined with postural stability exercises (3 sessions per week)

Control group: They weren't exposed to any intervention. Both groups were assessed by using pulse oximeter to measure oxygen saturation (Spo2).

Results: The mean ±SD values of the oxygen saturation levels among study group and control group at the conclusion of the study were 98.40±0.68 and 98.50±0.76 respectively. After-treatment oxygen saturation showed no appreciable statistical variation (P>0.05), according to the statistical analysis, between the study group and the control group P=0.664. The study group improved by 0.20%; the control group improved by 0.05%.

Conclusion: It was found that there is minimal improvement but insignificant of Buteyko breathing exercise combined with postural stability on oxygen saturation in young adult smokers.

Keywords: *Buteyko breathing. Postural stability, Oxygen saturation, young adult smokers.*

1. INTRODUCTION

Smoking is widely regarded as one of the most critical and severe public health issues facing populations worldwide in contemporary society [1]. Smoking is responsible for a startling 9 percent of all fatalities worldwide, according to the World Health Organization's (WHO) extensive Global report on the changes in tobacco use incidence from 2000 to 2025. [2]. Smoking contains over 7,000 chemical compounds, with more than 250 classified as toxic or carcinogenic. These harmful elements include various aldehydes and nitrides that can severely irritate and damage the sensitive respiratory tract[3]. Smoking can cause serious damage to the lungs and airways, impacting overall health. Lung function tests typically show lower lung volumes, increased mucus, respiratory inflammation, reduced cilia activity, and the destruction of alveolar attachments, essential for gas exchange [4].

Oxygen is essential for life, enabling the body to generate energy for various activities. Low oxygen levels can hinder metabolic processes and affect vital organs, including the brain. Normally, hemoglobin should be 95–98% saturated with oxygen; lower levels may signal respiratory problems [5]. Smoking negatively impacts oxygen saturation (SpO_2) by impairing oxygen transport and gas exchange in the lungs. When smoking occurs, carbon monoxide (CO) is inhaled, competing with oxygen for hemoglobin binding, leading to carboxyhemoglobin (COHb) formation. This decreases oxygen delivery to tissues. Additionally, smoking induces chronic airway inflammation, mucus buildup, and alveoli damage, which all reduce pulmonary function and oxygen diffusion capacity [6].

The Buteyko breathing exercise is a technique that emphasises the regulation and reduction of respiration to improve health and well-being. Konstantin Buteyko, a Ukrainian physician, developed this technique in the 1950s to aid individuals with respiratory conditions, such as COPD, or chronic obstructive pulmonary disease, and asthma). [7]. The Buteyko Breathing Exercise aims to improve respiratory efficiency by encouraging regulated nasal breathing and minimizing hyperventilation, which results in elevated levels of carbon dioxide (CO_2) in the bloodstream. This rise in CO_2 is thought to aid in the dissociation of oxygen from hemoglobin to body tissues, referred to as the Bohr effect, which may contribute to enhanced oxygen saturation (SpO_2) levels [8].

Postural stability means being able to keep your balance and manage your body position while moving or standing still.. This skill relies on the coordinated activities of the musculoskeletal, nervous, and respiratory systems [9].

Postural stability is crucial for enhancing oxygen saturation (SpO_2) by refining respiratory mechanics, promoting lung expansion, and enabling effective gas exchange. The preservation of proper posture contributes to improved diaphragm functionality, decreases airway resistance, and facilitates superior oxygen absorption. Conversely, inadequate posture, including slouching, exerts pressure on the lungs and diaphragm, thereby limiting alveolar ventilation and resulting in diminished tidal volume and oxygen absorption [10].

2. SUBJECTS AND METHODS

Design

Randomized controlled trial conducted on a group of young adult smokers

Setting

This study recruited 40 smokers from Nahda university

Ethics

The Ethical Committee of the Faculty of Physical Therapy at October 6 University has granted permission with the designation (O6U.P.T.REC/024/003002). In order to carry out this comparative analysis, it was necessary for the participation of smokers to be contingent upon their provision of written consent, following the comprehensive understanding of the study's aims and protocols. Helsinki recommendations were followed during the application of this trial on smokers

Participants

Forty male smokers were recruited from Nahda University in Beni-Suef, Egypt. The inclusion criteria consisted of smokers with a smoking duration of 3 to 7 years, aged between 18 and 30 years, exclusively male participants, the capability to engage in exercise, a body mass index ranging from 18.5 to 29.9, and a status of medical stability. The exclusion criteria included patients diagnosed with chronic diseases, mental disorders, hepatitis, cirrhosis, those currently undergoing treatment for cancer or with active infections, as well as obese individuals, athletes, and participants in activities such as prolonged walking and swimming.

Interventions

The study group received this intervention (Buteyko breathing exercise combined with postural stability exercise) Three sessions weekly for a duration of six weeks. The control group didn’t receive any intervention.

Buteyko Breathing Exercise

The therapist instructed the patient to sit comfortably, breathing naturally through the nose. They should hold their breath until the need to inhale arises, then exhaled through the nasal passage. The patient maintained a straight back with feet shoulder-width apart, eyes closed, breathing calmly. After 20-30 seconds, they repeated the exercises for 3 minutes, followed by another pause and repetition. This was done for another 3 minutes, ending with a 2-minute rest before the next session. [11]. Duration: 15 minutes. Frequency: Three sessions per week for a period of 6 weeks. [12].

Postural Stability Exercise:

Warming up phase: shoulder circles and twist torso during walking for 5 minutes [13]. Training phase include 10-15 reps per set, 2-4 sets per exercise,30-60 seconds rest period between sets [14]. Cooling down phase includes hold each stretch for 15-30 seconds, 2-4 repetitions per side and rest for 15-30 seconds between repetitions [15]

Bridging exercise: subject was lying on his back with his knees bent, feet flat, head supported, and heels in close proximity to his buttocks. The subject contracted his glutes and engaged his core to lift his hips, aligning them with his knees and shoulders. He then gently lowered his hips by pressing through his heels [16].

Straight leg raising (SLR): The subject was lying on his back with one knee bent and his foot on the ground, while the other leg was erect and his arms were at his sides. The subject ensured stability by lifting his straight leg to 45 degrees and then gently lowering it while engaging his core. [17].

Side-lying leg raise: The subject was lying on his side with his legs extended and his head resting on either an arm. Subject maintained his pelvis in a stacked position by engaging his core. He raised the upper leg to a 45-degree angle, with the toes facing either forward or downward. He then lowered the limb, pausing above the ground before switching sides. [18].

Wall push-ups: While standing one foot away from a wall, the subject maintained their palms at shoulder height and breadth. He maintained his body alignment and kept his feet together while engaging his core. The subject controlled his return to the beginning position by flexing his elbows and leaning toward the wall, then pushing back with his forearms. [19].

Lateral trunk flexion: The subject stood with their feet shoulder-width apart and their hands on their shoulders or sides. Your hand was guided down the subject's thigh as he bent his midsection to one side and engaged his core. He maintained the stability of his pelvis and employed his obliques to return to the starting position. Repeated on the opposite side [20].

Single leg stance: The subject stood with his feet hip-width apart, evenly distributing his weight, and engaged his core for stability. Subject lifted one leg while keeping the knee slightly bent and hips level, balanced on the stationary leg for 10 to 30 seconds, then he lowered the elevated foot and repeated on the other side [21].

Chin tuck: The subject maintained a straight spine, relaxed shoulders, and a forward gaze while engaging his core for stability. He either stood or sat. subject retracted his chin toward his chest to create a double chin while maintaining a horizontal gaze, held the position for 5-10 seconds to experience a mild neck stretch, and then progressively returned to a neutral position. [22].

Stretching pectoralis major muscle: The subject stood in a corner, with his arms at shoulder height, his forearms against the walls, and his ankles shoulder-width apart. To extend his torso for 15 to 30 seconds, he leaned in and took a single step forward. Before leaning, he extended his arms to a point just above shoulder height in order to reach his lower torso. He returned to the starting position so he completed the task. [23]

Stretching upper trapezius: The subject sat with his back straight, shoulders relaxed, and gaze forward while engaging his core. He inclined his head to one side, bringing his ear toward his shoulder without lifting it. Gently, he pulled his head with the same-side hand while placing the opposite hand behind his back. He maintained the position for 15 to 30 seconds, breathing deeply, before reverting to the initial position and repeating the stretch on the opposite side. [24].

Stretching sternocleidomastoid: The subject sat with his spine aligned, shoulders relaxed, and head neutral, gazing forward. Engaging his core for stability, he tilted his head to the opposite side, bringing his ear toward his shoulder without raising it. He then rotated his head upward slightly, tilting it back for a deeper neck stretch. Using his hand, he gently deepened the stretch, holding the position for 15 to 30 seconds before returning to the starting position. [25].

Outcome measures

Measurements and evaluations were conducted before to the commencement of the program and immediately following its completion. (after 6 weeks for both groups). Pulse oximeter was used to assess and continuously monitor oxygen saturation (SpO2) [26].

Practical Application of the Pulse Oximeter: The therapist instructed the patient to warm their hand and rest for at least five minutes before obtaining a reading. The patient placed their hand on their chest at heart level and keeps it still. The therapist then attached a pulse oximeter to the patient's middle or index finger, avoiding the ear. The reading should stabilize, so the patient must keep the oximeter in place for at least one minute. After a consistent reading for five seconds, the highest value was recorded. [27].

Sample size calculation

Radom participants allocation into present trial equal groups number (20) for each one based on G*POWER statistical software 3.1.9 (G power program version 3.1, Heinrich-Heine-University, Düsseldorf, Germany). Type I error (α) = 0.05, power (1-β error probability) = 0.80, effect size f2 (V) = 0.3997294, and Pillai V = 0.5711524.

Statistical analysis:

Data were assessed for normality and homogeneity of variance. The Shapiro-Wilk test was employed to assess the normality of the data, indicating a normal distribution ($P>0.05$) following the removal of outliers identified through box and whisker plots. Levene's test for homogeneity of variance indicated no significant difference ($P>0.05$). The data follows a normal distribution, and parametric analysis has been conducted. The statistical analysis utilized the SPSS Package program version

25 for Windows (SPSS, Inc., Chicago, IL). Quantitative data are presented as mean and standard deviation for the demographic characteristics of smokers and O2 saturation variables. The paired t-test was employed to compare O2 saturation before and after treatment within the study and control groups. An independent t-test was employed to compare demographic data and O2 saturation between two groups before and after treatment. All statistical analyses achieved significance at a probability level of $P \leq 0.05$.

3. RESULTS

The eligible number of smokers at the start of this study was 46 male smokers. Authors excluded two smokers who did not meet the exclusion criteria. They had orthopedic problems that prevented them from doing postural stability exercises. The final number of smokers who received the interventions was 44 smokers (Figure 1). There were four smokers who dropped out due to their final exams so they weren't able to attend to the sessions. No significant differences ($P<0.05$) between study group and control group in demographic data (Table 1) for smokers age ($P=0.068$) and BMI ($P=0.752$).

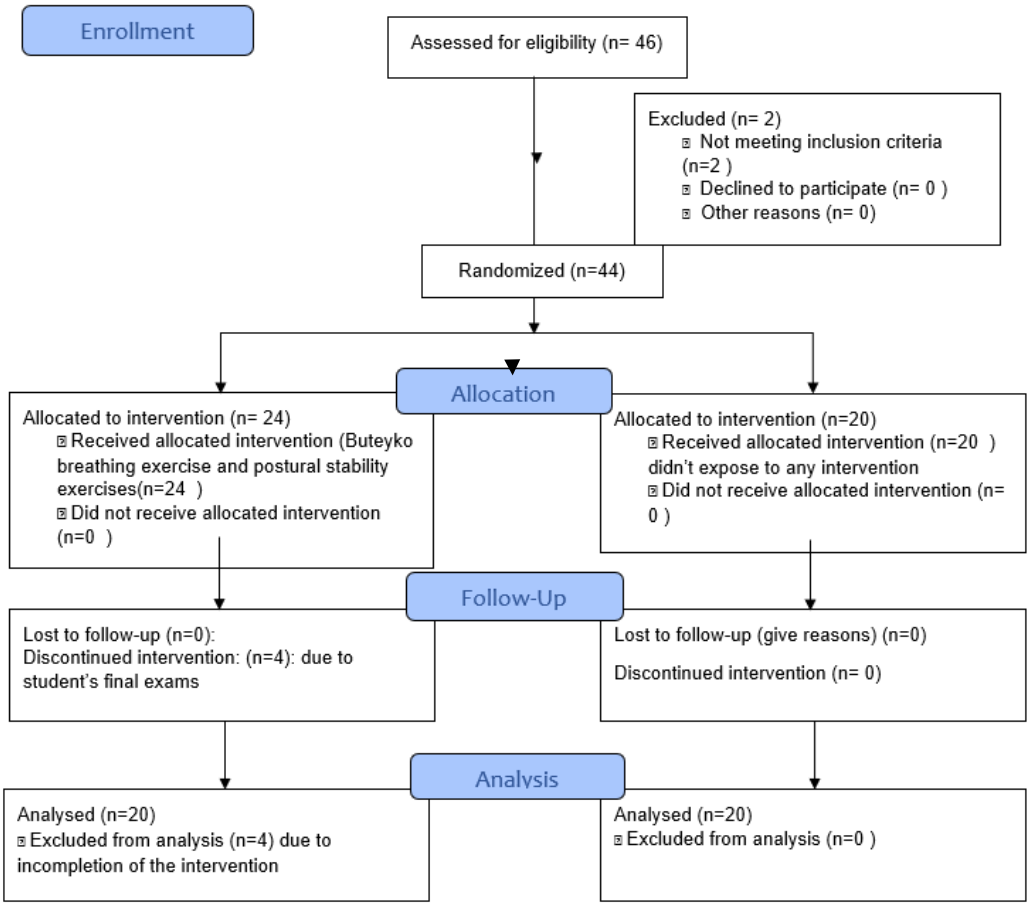

Figure 1. Consort flow chart of this study

Table 1. Demographic data for young adult smokers

Items	Groups (Mean ±SD)		P-value
	Study group (n=20)	Control group (n=20)	
Age (year)	22.25 ±3.46	20.60 ±1.84	0.068
BMI (kg/m^2)	23.25 ±1.87	23.45 ±1.99	0.752

Data are expressed as mean ±standard deviation and compared by independent t test. P-value: probability value P-value>0.05: no significant

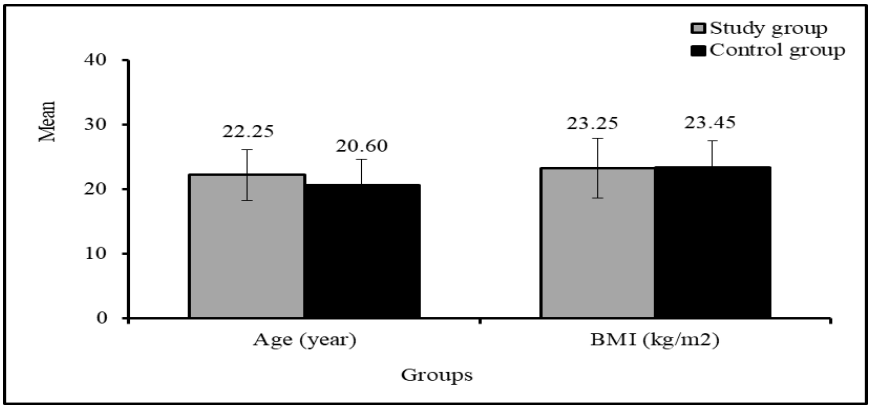

Figure 2: Mean values of age (year) and BMI (kg/m2) in both groups.

The statistical analysis of O2 saturation in each group (Table 2 and Figure3) indicated no significant difference (P>0.05) between pre- and post-treatment O2 saturation in the study group (P=0.258) and the control group (P=0.789).

The statistical analysis of O2 saturation between the two groups (Table 2 and Figure 3) indicated no statistically significant variations (P>0.05) in O2 saturation between the study group and the control group both before treatment (P=0.284) and after treatment (P=0.664).

Table 2: Within and between group comparisons for O2 saturation

Items	Groups (Mean ±SD)		Change (MD)	Effect size (η^2)	*P*-value[2]
	Study group (n=20)	Control group (n=20)			
Before-treatment	98.20 ±0.76	98.45 ±0.68	0.25	0.02	0.284
After-treatment	98.40 ±0.68	98.50 ±0.76	0.10	0.00	0.664
MD (Change)	0.20	0.05			
95% CI	-0.15 – 0.55	-0.33 – 0.43			
Improvement %	0.20%	0.05%			
Effect size (η^2)	0.00	0.01			
***P*-value[1]**	0.258	0.789			

Data are expressed as mean ±standard deviation MD: Mean difference CI: confidence interval η2: Eta square P-value: probability value * Significant (P<0.05) P-value1: Probability value within each group; P-value2: Probability value between both groups

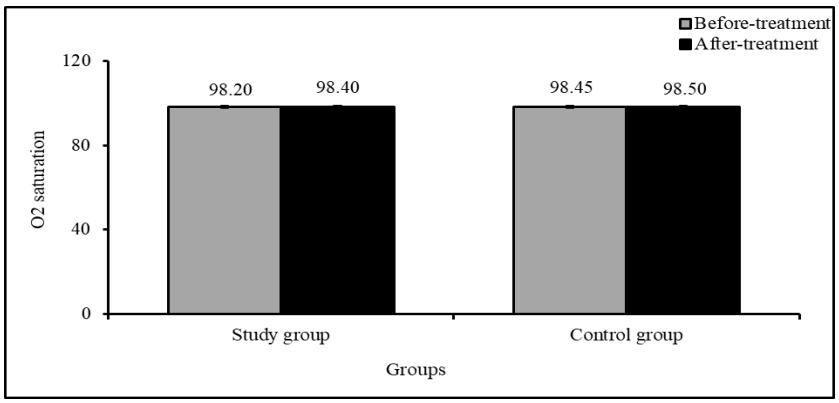

Figure 3: Mean values pre- and post-treatment of O_2 saturation

4. DISCUSSION

The objective of our study was to examine the effect of Buteyko Breathing Exercise Combined with Postural Stability Exercises on Oxygen Saturation (SpO2) in Young Adult Smokers. Forty subjects were allocated randomly into control and study groups.

Our findings showed that there is positive improvement but not significant of Buteyko breathing exercise combined with postural stability on oxygen saturation (SpO2) in young adult smokers in study group more than control group.

This study's findings are consistent with those of Sathe et al. (2020), who conducted a randomized controlled trial with 42 patients diagnosed with hypertension. In this trial, participants who engaged in Buteyko breathing exercises for four weeks demonstrated positive enhancements; however, the alterations in oxygen saturation (SpO_2) were statistically insignificant. This finding may be due to SpO_2 levels in narrow range (95-100) so any change in spo2 is minimal but not significant [28].

Güngör et.al (2021) conducted a randomized control trail on 30 cystic fibrosis patients. The group who received chest physiotherapy combined with postural stability exercises showed minimal improvement but in significance on oxygen saturation (SpO_2) [29]. This result may be due to small sample size and spo2 baseline levels in narrow range. This finding agrees with the results of the current study.

In 2022, a research study conducted by Endiyono and his colleagues examined a group of 62 individuals diagnosed with COVID-19. The study discovered that participants who practiced Buteyko breathing exercises twice each day over the course of a week experienced a significant increase in their oxygen saturation (SpO2) levels. This improvement in oxygen levels can likely be attributed to their daily adherence to the breathing techniques [8]. These findings don't align with the results observed in our study.

In 2018, Karthikeyan conducted a randomized control trial involving 30 sedentary men. The participants who underwent core stabilization exercises three times weekly for a period of 12 weeks. exhibited a significant increase in their maximal oxygen consumption (VO2 max), which subsequently led to a notable improvement in oxygen saturation levels. This increase may be attributed to the extended duration of the intervention [30]. However, these results contradict the findings of the current study.

The non-significant results may be due to Buteyko breathing which focuses on normalizing breathing and enhancing carbon dioxide (CO_2) retention by avoiding hyperventilation. Oxygen saturation (SpO_2) mainly depends on hemoglobin availability and lung function, not breathing rate control. Oxygen saturation (SpO_2) does not directly measure Carbon dioxide (CO_2) management or lung ventilation, which may clarify why oxygen saturation (SpO_2) levels remain unchanged even with better carbon dioxide (CO_2) tolerance [31]. So further studies are needed to measure arterial blood gas analysis.

On the other hand, persistent low-grade inflammation and diminished pulmonary function may obscure any possible advantages derived from breathing exercises such as the Buteyko method. Consequently, any anticipated enhancement in oxygen saturation levels may be overshadowed by the existing injury to the lungs and pulmonary impairment resulting from smoking [32].

The primary objective of postural stability exercises is to enhance muscle coordination and balance, rather than to improve lung function or oxygen delivery. While it is acknowledged that better posture and alignment may positively influence respiratory function over time—by promoting enhanced lung expansion and relieving diaphragm restrictions—these exercises are not anticipated to lead to significant alterations in blood oxygen levels [33].

The practice of smoking produces harmful effects on the alveolar-capillary membrane, resulting in a reduced efficiency of gas exchange. This decline may result in lower oxygen absorption and impede the diffusion of oxygen into the bloodstream, potentially overshadowing any positive effects linked to Buteyko breathing methods or exercises designed to enhance postural stability in relation to oxygen saturation [34].

Oxygen saturation (SpO_2) is a basic metric for assessing respiratory and circulatory function, but it may lack sensitivity to detect subtle changes in carbon dioxide (CO_2) tolerance or pulmonary function, which can be improved through Buteyko breathing techniques. More accurate assessments, like arterial blood gas analysis or pulmonary function testing, offer deeper insights into physiological effects [35].

The intervention's duration and frequency may have been inadequate to yield noticeable changes. The benefits of breathing exercises and postural stability techniques typically require weeks or months to become evident. A brief intervention period may not sufficiently facilitate the necessary adaptations, particularly in smokers with impaired lung function. [36].

5. CONCLUSION

The minimal positive impact but not significant of Buteyko breathing exercise combined with postural stability exercises on oxygen saturation (SpO2) in young adult smokers may be explained by different variables such as the physiological impact of smoking, the nature of the interventions, and potential methodological limitations. Further research is needed to examine how longer-term interventions, more intensive exercise regimens, or different measures of respiratory function might

influence oxygen saturation and overall health outcomes in young smokers.

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Conflict of interest: The authors deny any financial interest or advantages associated with this research, as well as do they disclose any conflict of interest.

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