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Effect of Buteyko Breathing Exercises versus Yoga Training on Pulmonary Functions and Functional Capacity in Children with Bronchial Asthma: a randomized controlled trial

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ABSTRACT

Background: *Although Buteyko breathing exercises and yoga training controls the rate of breathing and alters various physiological variables, but there are no available data about its effect on management of children with bronchial asthma.* ***Objective:*** *To compare between the effects of buteyko breathing exercise versus yoga training on pulmonary functions and functional capacity in children with bronchial asthma.* ***Methods:*** *Forty asthmatic children, their age from 7 to 12 years old, and there body mass index from 15 to 18 kg/m^2, were divided into two groups equal in number: group I underwent buteyko breathing exercise and group II underwent yoga training. Subjects in the Buteyko and yoga groups were trained for 3 days and instructed to practice the exercises for 15 minutes twice daily. Forced Expiratory Volume in one second (FEV1), forced Vital Capacity, ratio between FEV$_1$ and FVC (FEV$_1$ /FVC), residual volume (RV) and 6MWT were measured before and after three months.* ***Result****: Both groups had shown that there were a significantly increase in FEV1, FVC, FEV1 /FVC ($p<0.05$), But no significant difference was found in RV ($p>0.05$) in both groups. There was significant difference in 6MWT in both groups ($p<0.05$). Conclusion: there were improvements in pulmonary functions and functional capacity in asthmatic children after buteyko breathing technique and yoga training, both having the same effect.*

Key words: *Asthma, buteyko breathing, yoga training, pulmonary functions, functional capacity .*

INTRODUCTION

Asthma (AZ-ma) is a chronic lung disease which inflames and narrows the airways. [1] Asthma results in repeating times of wheezing (a whistling sound when you breath), chest tightness, shortness of breath, and cough. The cough mostly occurs at night or early in the morning. Sometimes the symptoms are mild and go away on their own or after quit treatment with asthma medicine. Other times, symptoms continue to get worse. Untreated asthma can lead to severe respiratory distress and in rare cases, sudden death. Asthma affects people at any age, but it most often starts during childhood.[1,2] There are many causes of asthma include genetic , Environmental factor , exposure to allergens ,occupational irritant , tobacco smoke , respiratory infection ,exercises , strong emotional expression , chemical irritant ,and drug[3]. Asthma is the most common chronic disease affecting children; it affects about 12.5 % of children all over the

world [2]. However, the prevalence among Egyptian school-aged children is 7.7%. [4]

Early and forceful asthma treatment is key for calming symptoms and preventing asthma attacks. Asthma treatment can fluctuate from anti-inflammatory and bronchodilator asthma inhalers to oral medications to asthma drugs conveyed in an asthma nebulizer or breathing machine. [5]

The Buteyko Breathing Method is a breathing therapy that uses breath control and breath-holding exercises to treat varieties of health conditions associated with hyperventilation and low carbon dioxide. [4] There are many reasons that the breathing techniques used by the Buteyko method work. These reasons include change in symptom feelings and improved sense of control, improved biomechanics of breathing, beneficial effects of low-volume breathing. [6]

Yoga breathing activities utilized in conjunction with standard pharmacological treatment significantly improves pulmonary functions and functional capacity. Yoga breathing exercises can reduce medication as it readjusts the autonomic imbalance, controls the rate of breathing and subsequently adjusts different physiological variables. [7,8]

The clinical trials show that individuals taking in the Buteyko Method and yoga treatment can generously lessen medicine with no weakening in their lung capacity or asthma control, although no studies have exhibited target changes in lung function. [9]

Although the benefits of the respiratory techniques, the use of these exercise modes in the treatment of children with bronchial asthma is currently insufficient and its clinical effects not yet identified. So that, the current study aimed to compare between the effect of buteyko breathing exercise versus yoga training on pulmonary function and functional capacity in children with bronchial asthma.

METHODS

Before starting the first assessment, caregivers were requested to sign a consent form if they accepted to let their children participate in this study. This consent has been approved by the Ethics Committee of the Faculty of Physical Therapy, Cairo University, Egypt.

Study Design:

Study was a randomized controlled trial with pretest and post-test group design. The present study was conducted at outpatient clinic of Faculty of Physical Therapy, Cairo University, Egypt.

Subjects:

Forty children with mild to moderate bronchial asthma, their ages ranged from 7 to 12 years old, and their body mass index from 15 to 18 kg/m2, [it is calculated using the same formula as adult BMI (weight(kg)/[height (m)]^2).[10]] .They were selected from Abu- El-Rish Hospital, Cairo University. To be included in this study, the children had to visit the clinic at 6 months intervals for at least 1 year (three visits). Also, child with rapid respiratory rate, breathing through pursed lips, lifting the shoulders up toward the ears during inhalation and wheezing or cough were included. Children who had previous history of breathing retraining, suffering from any other chronic disease or given any asthma anti-inflammatory medications three months prior to this study and obese children were excluded. Also, they had neither associated congenital heart abnormalities, nor musculoskeletal problems.

Procedures:

The primary outcome measure of this study was the ventilatory function; the ventilatory function was measured by utilizing the electronic spirometer. Spirometr is the best method for the diagnosis and management of asthma. It is the most frequently used procedure to assess lung capacity.[11,12] The following parameters were recorded: forced expiratory volume in the first second (FEV1), forced vital capacity (FVC), (FEV1/FVC) and Residual volume (RV). [13]

Constrained vital capacity (FVC) can be tested by asking the child to take the most profound breath he can and after that breathe out into the sensor as hard as possible, for as long as possible, ideally at least 6 seconds. It is sometimes directly followed by a rapid inhalation (inspiration), during the test, soft nose clips may be used to counteract air getting away through the nose. Filter mouthpieces may be used to counteract the spread of microorganisms. [14]

The forced expiratory procedures (FET) which measure FEV1, and FEV1/FVC started after 2-minute break from the past test. After a demonstrating the procedure to the kid, he or she was placed in a standing position and requested to use the mouthpiece and nose clip comparatively to the VC technique. Then, after 3 cycles of quit breathing the child was asked to inspire as much air as he can and then to expire as forcefully and rapidly all the amount of air and to keep expiring until he felt that there was no air in the lungs. After finishing the forced expiration, a forced inspiration followed without hesitation. FEV1 and FVC were reported. FEV1/FVC was calculated from these values, the duration of this technique was about 5-10 minute. [15]

The secondary outcome measures was Six minute walk test, It is a straight forward and viable strategy to evaluate the Functional Capacity (FC), which gives data about functional status, oxygen utilization, exercise tolerance, and patient survival according to test performance. [16]

Firstly, the child was asked to sit very still in a seat, situated close to the beginning position, for no less than 10 minutes before the test begins. Amid this time, check for contraindications, measure heartbeat and pulse, and ensure that dress and shoes are proper. Complete the primary part of the work sheet, after that patient was stand set the lap counter to zero and the clock to 6 minutes. The child was instructed that “The object of this test is to walk as far as possible for 6 minutes. [17]

All outcome measures were assessed for the two groups at entry (before treatment) and after 3 consecutive months (post-treatment).

Treatment:

The participants were allocated to either the Buteyko group or Yoga group, both groups received the program for three successive months (15 min twice daily , 3dyas/week).**Buteyko breathing technique:** The “Control pause” breathing test: the child was asked

to sit in an upright chair and takes a good posture. The child was asked to Relax his/her shoulders and rest his/her lower back against the back of the chair. Take a little breath in (2 s) and a little breath out (3 s). Hold his/her nose on the “out” breath, with empty lungs but not too empty. Holding his/her nose is necessary to prevent air entering into the airways. Count how many seconds he/she can comfortably last before he/she needs to breathe in again. Hold his/her breath until he/she feels the first need to breathe in. Release his/her nose and breathe in through it. his/her first intake of breath after the CP should be no greater than his/her breath prior to taking measurement; he /she should not hold your breath for too long as this may cause you to take a big breath after measuring the CP. [18] Shallow breathing: the child was requested to sit up straight. Monitor the amount of air flowing through nostrils by putting his/her finger under the nose in a horizontal position. The finger should lie just above his/her top lip, close enough to his/her nostrils so that he/she can feel the airflow, but not so close that the air-flow is blocked. Now, inhale air slightly into the tip of his/her nostrils. Then he/she exhale gently. When he/she breathe out, the more warm air he/she feel, the bigger he/she are breathing. Focus on quitting his/her breath to reduce the amount of warm air he/she feels on his/her finger. As he/she reduces the amount of warm air onto his/her finger, he/she will begin to feel a need or want for air. Try to maintain the need for air for about 4 min. [19]

Yoga training: Sukha Purvaka Pranayama: the child was requested to sit comfortably with his/her eyes closed and spine straight. Permit the child to breathe normally for a few minutes, letting go of any tension in his/her body and calming his/her mind. In this yoga breathing technique, breathing occurs only through the nose. One full round consists of the following: inspire slowly for a 6-count, Hold the breath in for a 6-count, Exhale slowly for a 6-count and Hold the lungs empty for a 6-count. Perform 6 to 9 times. Relax the breath for a few moments, and then repeat another 6 to 9 rounds again if able. Then lying down for 5 to 10 minutes, relaxing the breath and letting go of all tension. [20]Dirgha Pranayama: The child was asked to sit comfortably with eyes closed and spine straight. The child breathes naturally for a few minutes; remove any tension in the body and calming the mind. In the beginning breathe in and out deeply through the nose many times to remove the air that might have been stagnating in the respiratory tracts. After several ventilating breaths, expire the air through the mouth, trying to empty the lungs. Maintain the lungs empty for a moment; inspire slowly and uniformly through the nose, filling his/her lungs with as much air as possible. Hold breath with lungs filled with air for a moment, but not for too long. By time, the child will manage to hold breath for longer intervals. Expire through the mouth slowly, Relax and take a few comfortable breaths and then try again three times. When complete, lie down and breathe in a relaxed fashion. [18]Yoga chair breathing: The child was asked to sit on a chair facing the back of another chair. The child placed the arms on the back of the chair he or she was facing, to lift and open the ribcage. Inspire while gradually lifting the head and spine and opening the chest. Then exhale while moving the spine, chest, and neck into gentle flexion. repeat five times. Then repeat the sequence producing the sound "ah" while exhaling five times, then the sound "mmm" five times while exhaling. Engaging the voice teaches smooth, continuous, and complete exhalation, and also encourages complete engagement of the accessory abdominal muscles. This supports fuller emptying of the remaining air before the next inhale, increasing breathing efficiency. [17]

Statistical analysis:

The mean values of (FEV1), (FVC), (FEV1/FVC) and (RV) obtained before and after three months in both groups were compared using the paired"t" test. An independent "t" test was used for the comparison between two groups. P-value is considered significant if $p < 0.05$.

RESULTS

There were no significant differences in any of the presented variables between group I and group II before the intervention period. All participants were present in at least 85% of the 36 training sessions.

Table 1: Baseline characteristics of both groups :

Characteristics	Group I	Group II	P. value	SIG
Age (yr)	10.8 ± 1.6	10.1 ± 2.5	0.15*	NS
Weight(kg)	30 ± 3.2	31 ±4.1	0.126*	NS
Height(cm)	140 ± 1.5	138 ± 1.9	0.132*	NS
BMI(kg/m2)	15.3 ± 2.3	16.27 ± 1.8	0.16*	NS

There were no significant differences in baseline characteristics of both groups ($p>0.05$). Both groups are homogenous.

The finding of the present study was summarized and concluded as follows FVC, FEV1, FEV1/FVC were improved in both groups, on comparing group I and group II after 3 month of exercise. FVC, FEV1, FEV1/FVC PEFR, are improved in both groups $p<0.05$, while RV did not show significant improvement in both groups $p>0.05$. The result of 6MWT showed that there were significant difference between pre and post exercise in the first group $p<0.05$.

Table 2: Result of pulmonary function and 6MWT for group I :

	Pre	Post	P. value	SIG
FEV1(lt)	83.0 ± 10.3	90.2 ± 12.1	0.05	S
FVC(lt)	92.6 ± 10.1	98.8 ± 8.6	0.05	S
FEV_1/FVC(%)	89.6 ± 10.2	86.9 ± 10.3	0.05	S
RV(lt)	87.6 ± 16.1	88.3 ± 17.2	0.7	NS
6MWT(m)	412 ± 60.3	440 ± 66.2	0.05	S

FEV1: forced expiratory volume in the first second, **FVC:** forced vital capacity, **RV:** Residual volume, **6MWT:** Six minute walk test.

Table 3: Result of pulmonary function and 6MWT for group П :

	Pre	Post	P. value	SIG
FEV1(lt)	82.1 ± 9.8	89.2 ± 10.5	0.05	S
FVC(lt)	90.4 ± 11.3	96.7 ± 8.2	0.05	S
FEV_1/FVC(%)	87.6 ± 12.2	86.2 ± 10.8	0.05	S
RV(lt)	86.6 ± 15.6	87.3 ± 16.2	0.7	NS
6MWT(m)	410 ± 61.4	435 ± 65.2	0.05	S

FEV1: forced expiratory volume in the first second, **FVC:** forced vital capacity, **RV:** Residual volume, **6MWT:** Six minute walk test.

Table 4: comparing post mean value of both groups :

	Post group I	Post group П	P. value	**SIG**
FEV1(lt)	90.2 ± 12.1	89.2 ± 10.5	0.13	NS
FVC(lt)	98.8 ± 8.6	96.7 ± 8.2	0.17	NS
FEV_1/FVC (%)	86.9 ± 10.3	86.2 ± 10.8	0.11	NS
RV(lt)	88.3 ± 17.2	87.3 ± 16.2	0.12	NS
6MWT(m)	440 ± 66.2	435 ± 65.2	0.127	NS

FEV1: forced expiratory volume in the first second, **FVC:** forced vital capacity, **RV:** Residual volume, **6MWT:** Six minute walk test.

DISCUSSION

This study found similar improvements in both groups in subjects with mild to moderate asthma using buteyko exercise in group I and yoga training in group II . Importantly, these changes were achieved without impacting negatively on the disease control, as measured by lung function and airways responsiveness.

Both groups showed significant improvement in FEV1, FVC and FEV1/ FVC after treatment. But for RV, it showed no significant difference in both groups between pre and post exercise. Also, 6MWT as a measure of functional capacity showed significant increase in both groups after exercises.

The improvement in the Buteyko group could be a result of improvement in 'hidden hyperventilation' as explained by Buteyko that there was evidence of hyperventilation causing decreased CO2 levels,

resulting in asthma symptoms and also linked to a lower perceived general health. Also may be due to the Buteyko breathing technique involving a period of breath holding interspersed with periods of shallow breathing to increase the buildup of CO2. The increase in CO2 leads to dilatation of smooth muscles in the walls of the bronchi, bronchioles and alveolar ducts, and therefore optimizes ventilation perfusion matching. Similar improvements in asthma symptoms and activity have been reported by earlier studies investigating Buteyko breathing [10,11,12].

This is come in support with an old study by Buteyko et al [21] included 52 children (34 in-patients and 18 out-patients; 3– 15 years old). Observations in 1–3 months showed considerable improvements (cessation of heavy attacks or a total disappearance of the symptoms) in 83%, some improvement (less heavy attacks and considerable reduction in medication) in remaining 17% with significant increases in lung volume while Patrick McHugh et al [22] recorded no change in forced expiratory in his study. However, the trial recorded no adverse effects from the use of Buteyko program. In Cooper et al [23] study there was no difference seen between groups in FEV1, the study was between group used Buteyko breathing technique and the other group used Pink City Lung Exerciser (PCLE) to mimic paranayama.

David Holmes [24] study conducted to assess the Buteyko and chest physical therapy, the initial level of disease control was higher than expected as assessed by questionnaire. The study concluded that The Buteyko technique or an intensive program delivered by a chest physiotherapist appear to provide additional benefit for patients with bronchila asthma. Also the results of the present study come in support with a study by Robert Cowie [25] and Slader et al. [26] who applied Buteyko techniques for 6 months asthma control improved from 41% to 75%, Decrease of ICS (Inhaled corticosteroids) by 39% and Elimination of ICS was 21% .

The improvement in yoga group may be due to release of enkephalin during meditation. Yogic process has a great influence on the CNS. It helps a person to pick up control over the ANS, bringing about homeostatic working of the body. Yoga clearly relaxes the muscles, and this profound physical and mental relaxation associated with the physiological changes seen in patients after every day yoga appears to have a stabilizing effect on bronchial reactivity, thus making the vagal efferents less excitable [27,28].

The result of this study come in agreement with Cooper et al [29] who stated that Yoga exercises cause significant improvements in pulmonary functions and quality of life and reductions in airway hyperactivity, frequency of attacks, and medication use as yoga breathing exercises involve mental concentration to cause a reduction in breathing frequency. [29]

Some studies also have demonstrated that yoga practice can have an impact on stress management. Relaxation therapies help patients with asthma to deal with symptoms associated with anxiety and stress. [30] Two studies have reported that yoga may improve cardio respiratory parameters in children as a secondary effect of decreased anxiety. [31&32]

Also Clance et al [33] found that yoga may decrease stress and anxiety which is related to low body satisfaction or poor self image in children. Furthermore, the breathing techniques used in yoga enhance decreased anxiety. One study aimed to compare the effects of yoga and games on the same physiologic measurements. This study found that yoga practice may decrease levels of fear and anxiety more than physical activity alone. [34]

Conclusion

It was concluded that there were improvement in pulmonary function and functional capacity in asthmatic children after both buteyko breathing and yoga training. These data of the current study suggested that both interventions can be considered to be effective for treatment of asthmatic children.

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