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Effectiveness of yoga on respiratory efficiency in patients suffering from asthma

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Abstract
Asthma is a chronic respiratory disorder characterized by reversible airway obstruction, allergic inflammation and airway hyper-responsiveness. In susceptible individuals, this inflammation causes symptoms that are usually widespread and variable such as airflow obstruction that is often reversible, either spontaneously or with treatment, and causes an associated increase in airway responsiveness to a variety of stimuli. Yoga has been considered the best complementary and alternative medicine by the National Institute of Health. Regular practice of yoga provides strength, endurance, and flexibility; facilitates characteristics of friendliness and compassion; and helps develop greater self-control, while cultivating a sense of calmness and well-being. Hence based on above reported findings the present study was planned for Effectiveness of Yoga on Respiratory Efficiency in Patients Suffered from Asthma.
The present study was planned in Department of Physiology, Patna Medical College, Patna, Bihar from April 2019 to September 2019. Total 20 cases of asthma were enrolled in the present study. The 10 patients were enrolled in study group as undergone the specific yoga mudras. The remaining 10 patients were not done any yoga were evaluated in control group.
Lung specific hasta mudras significantly increased PEFR, BHT, EBT, RET immediately after 30 minutes of practice. This simple, easy to practice anytime, anywhere, cost effective technique must be practiced regularly to produce beneficial effects. The yoga is an effective tool to improve the pulmonary functions, and it can be practiced as an adjuvant therapy with standard medical treatment of asthma with better outcome.

Keywords: yoga mudras; respiration; asthmatics, Bihar region, etc

1. Introduction
Asthma is a common long-term inflammatory disease of the airways of the lungs. It is characterized by variable and recurring symptoms, reversible airflow obstruction, and easily triggered bronchospasms. Symptoms include episodes of wheezing, coughing, chest tightness, and shortness of breath. These may occur a few times a day or a few times per week. Depending on the person, asthma symptoms may become worse at night or with exercise [1].
Asthma is thought to be caused by a combination of genetic and environmental factors. Environmental factors include exposure to air pollution and allergens. Other potential triggers include medications such as aspirin and beta blockers. Diagnosis is usually based on the pattern of symptoms, response to therapy over time, and spirometry lung function testing. Asthma is classified according to the frequency of symptoms, forced expiratory volume in one second (FEV1), and peak expiratory flow rate. It may also be classified as atopic or non-atopic, where atopy refers to a predisposition toward developing a type 1 hypersensitivity reaction [2].
There is no cure for asthma. Symptoms can be prevented by avoiding triggers, such as allergens and irritants, and by the use of inhaled corticosteroids. Long-acting beta agonists (LABA) or antileukotriene agents may be used in addition to inhaled corticosteroids if asthma symptoms remain uncontrolled. Treatment of rapidly worsening symptoms is usually with an inhaled short-acting beta-2 agonist such as salbutamol and corticosteroids taken by mouth. In very severe cases, intravenous corticosteroids, magnesium sulfate, and hospitalization may be required [3].
In 2015, 358 million people globally had asthma, up from 183 million in 1990. It caused about 397,100 deaths in 2015, most of which occurred in the developing world. Asthma often begins in childhood, and the rates have increased significantly since the 1960s. Asthma was recognized as early as Ancient Egypt. The word "asthma" is from the Greek ásthma, which means "panting" [4].
Asthma is characterized by recurrent episodes of wheezing, shortness of breath, chest tightness, and coughing. Sputum may be produced from the lung by coughing but is often hard to bring up. During recovery from an asthma attack (exacerbation), it may appear pus-like due to high levels of white blood cells called eosinophils. Symptoms are usually worse at night and in the early morning or in response to exercise or cold air. Some people with asthma rarely experience symptoms, usually in response to triggers, whereas others may react frequently and readily and experience persistent symptoms [5].
A number of other health conditions occur more frequently in people with asthma, including gastro-esophageal reflux disease (GERD), rhinosinusitis, and obstructive sleep apnea. Psychological disorders are also more common, with anxiety disorders occurring in between 16–52% and mood disorders in 14–41%. It is not known whether asthma causes psychological problems or psychological problems lead to asthma. Those with asthma, especially if it is poorly controlled, are at increased risk for radiocontrast reactions [6].
Asthma is caused by a combination of complex and incompletely understood environmental and genetic

interactions. These influence both its severity and its responsiveness to treatment. It is believed that the recent increased rates of asthma are due to changing epigenetics (heritable factors other than those related to the DNA sequence) and a changing living environment. Asthma that starts before the age of 12 years old is more likely due to genetic influence, while onset after age 12 is more likely due to environmental influence. Many environmental factors have been associated with asthma's development and exacerbation, including, allergens, air pollution, and other environmental chemicals] Smoking during pregnancy and after delivery is associated with a greater risk of asthma-like symptoms. Low air quality from environmental factors such as traffic pollution or high ozone levels has been associated with both asthma development and increased asthma severity. Over half of cases in children in the United States occur in areas when air quality is below the EPA standards. Low air quality is more common in low-income and minority communities [7].

Exposure to indoor volatile organic compounds may be a trigger for asthma; formaldehyde exposure, for example, has a positive association. Phthalates in certain types of PVC are associated with asthma in both children and adults. While exposure to pesticides is linked to the development of asthma, a cause and effect relationship has yet to be established.

The majority of the evidence does not support a causal role between acetaminophen (paracetamol) or antibiotic use and asthma. A 2014 systematic review found that the association between acetaminophen use and asthma disappeared when respiratory infections were taken into account [8]. Acetaminophen use by a mother during pregnancy is also associated with an increased risk of the child developing asthma. Maternal psychological stress during pregnancy is a risk factor for the child to develop asthma.

Asthma is associated with exposure to indoor allergens. Common indoor allergens include dust mites, cockroaches, animal dander (fragments of fur or feathers), and mold. Efforts to decrease dust mites have been found to be ineffective on symptoms in sensitized subjects. Weak evidence suggests that efforts to decrease mold by repairing buildings may help improve asthma symptoms in adults [5,8]. Certain viral respiratory infections, such as respiratory syncytial virus and rhinovirus, may increase the risk of developing asthma when acquired as young children. Certain other infections, however, may decrease the risk [9].

The hygiene hypothesis attempts to explain the increased rates of asthma worldwide as a direct and unintended result of reduced exposure, during childhood, to non-pathogenic bacteria and viruses. It has been proposed that the reduced exposure to bacteria and viruses is due, in part, to increased cleanliness and decreased family size in modern societies. Exposure to bacterial endotoxin in early childhood may prevent the development of asthma, but exposure at an older age may provoke bronchoconstriction. Evidence supporting the hygiene hypothesis includes lower rates of asthma on farms and in households with pets.

Use of antibiotics in early life has been linked to the development of asthma. Also, delivery via caesarean section is associated with an increased risk (estimated at 20–80%) of asthma – this increased risk is attributed to the lack of healthy bacterial colonization that the newborn would have acquired from passage through the birth canal. There is a link between asthma and the degree of affluence which may be related to the hygiene hypothesis as less affluent individuals often have more exposure to bacteria and viruses [10].

Asthma is the result of chronic inflammation of the conducting zone of the airways (most especially the bronchi and bronchioles), which subsequently results in increased contractability of the surrounding smooth muscles. This among other factors leads to bouts of narrowing of the airway and the classic symptoms of wheezing. The narrowing is typically reversible with or without treatment. Occasionally the airways themselves change. Typical changes in the airways include an increase in eosinophils and thickening of the lamina reticularis. Chronically the airways' smooth muscle may increase in size along with an increase in the numbers of mucous glands. Other cell types involved include: T lymphocytes, macrophages, and neutrophils. There may also be involvement of other components of the immune system including: cytokines, chemokines, histamine, and leukotrienes among others [9].

While asthma is a well-recognized condition, there is not one universal agreed upon definition. It is defined by the Global Initiative for Asthma as "a chronic inflammatory disorder of the airways in which many cells and cellular elements play a role. The chronic inflammation is associated with airway hyper-responsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness and coughing particularly at night or in the early morning. These episodes are usually associated with widespread but variable airflow obstruction within the lung that is often reversible either spontaneously or with treatment".

There is currently no precise test for the diagnosis, which is typically based on the pattern of symptoms and response to therapy over time [9]. A diagnosis of asthma should be suspected if there is a history of recurrent wheezing, coughing or difficulty breathing and these symptoms occur or worsen due to exercise, viral infections, allergens or air pollution. Spirometry is then used to confirm the diagnosis. In children under the age of six the diagnosis is more difficult as they are too young for spirometry.

Spirometry is recommended to aid in diagnosis and management. It is the single best test for asthma. If the FEV1 measured by this technique improves more than 12% and increases by at least 200 milliliters following administration of a bronchodilator such as salbutamol, this is supportive of the diagnosis. It however may be normal in those with a history of mild asthma, not currently acting up. As caffeine is a bronchodilator in people with asthma, the use of caffeine before a lung function test may interfere with the results. Single-breath diffusing capacity can help differentiate asthma from COPD. It is reasonable to perform spirometry every one or two years to follow how well a person's asthma is controlled [11].

The methacholine challenge involves the inhalation of increasing concentrations of a substance that causes airway narrowing in those predisposed. If negative it means that a person does not have asthma; if positive, however, it is not specific for the disease.

Other supportive evidence includes: a ≥20% difference in peak expiratory flow rate on at least three days in a week for at least two weeks, a ≥20% improvement of peak flow following treatment with either salbutamol, inhaled corticosteroids or prednisone, or a ≥20% decrease in peak flow following exposure to a trigger. Testing peak expiratory flow is more variable than spirometry, however, and thus not recommended for routine diagnosis. It may be useful for daily self-monitoring in those with moderate to severe disease and

for checking the effectiveness of new medications. It may also be helpful in guiding treatment in those with acute exacerbations [11].

The evidence for the effectiveness of measures to prevent the development of asthma is weak. The World Health Organization recommends decreasing risk factors such as tobacco smoke, air pollution, chemical irritants including perfume, and the number of lower respiratory infections. Other efforts that show promise include: limiting smoke exposure in utero, breastfeeding, and increased exposure to day care or large families, but none are well supported enough to be recommended for this indication.

Early pet exposure may be useful. Results from exposure to pets at other times are inconclusive and it is only recommended that pets be removed from the home if a person has allergic symptoms to said pet.

Dietary restrictions during pregnancy or when breast feeding have not been found to be effective at preventing asthma in children and are not recommended. Reducing or eliminating compounds known to sensitive people from the work place may be effective. It is not clear if annual influenza vaccinations affects the risk of exacerbations. Immunization, however, is recommended by the World Health Organization [12]. Smoking bans are effective in decreasing exacerbations of asthma.

Asthma is a chronic respiratory disorder characterized by reversible airway obstruction, allergic inflammation and airway hyper-responsiveness. In susceptible individuals, this inflammation causes symptoms that are usually widespread and variable such as airflow obstruction that is often reversible, either spontaneously or with treatment, and causes an associated increase in airway responsiveness to a variety of stimuli. Yoga has been considered the best complementary and alternative medicine by the National Institute of Health. Regular practice of yoga provides strength, endurance, and flexibility; facilitates characteristics of friendliness and compassion; and helps develop greater self-control, while cultivating a sense of calmness and well-being.Hence based on above reported findings the present study was planned for Effectiveness of Yoga on Respiratory Efficiency in Patients Suffering from Asthma.

Methodology

The present study was planned in Department of Physiology, Patna Medical College, Patna, Bihar from April 2019 to September 2019. Total 20 cases of asthma were enrolled in the present study. The 10 patients were enrolled in study group as undergone the specific yoga mudras. The remaining 10 patients were not done any yoga were evaluated in control group.

All the patients were informed consents. The aim and the objective of the present study were conveyed to them. Approval of the institutional ethical committee was taken prior to conduct of this study.

The following were the mudras practiced in order, using both the hands [10]:

- Atmanjali mudra: Join the palms together in Namaste position (5 min)
- Bronchial mudra: Place the little finger at the base of the thumb, the ring finger on the upper thumb joint, and the middle finger on the pad of the thumb. Extend the index finger (5 min)
- Asthma mudra: Press the fingernails of both the middle fingers with other fingers extended (5 min)
- Bhramara mudra: Place the index finger on the base of the thumb. Place tip of your thumb on the side of your middle fingernail. Extend your ring and little finger (7 min)
- Linga mudra: Place both palms together and clasp your fingers. One thumb should remain upright; encircle it with the thumb and index finger of your other hand (8 min). Mudra was practiced in standing up position coordinating inhalation and exhalation.

Respiratory efficiency tests include BHT, EBT, ST, RET, and PEFR. PEFR was measured with the help of Mini Wright Peak Flow Meter (Ishneel Healthcare Private Limited) and EBT, RET with sphygmomanometer (Diamond agencies).All the parameters were measured in the following method [13]:

Bht: The subject was asked to sit quietly for a few minutes breathing normally. Ask the subject to pinch his nostrils with the thumb and index finger and to hold the breath after a normal inspiration and start the stopwatch. The time duration for which the subject was able to hold the breath was noted. Three such observations at an interval of 5 min were recorded. Similarly, record the BHT safer quiet expiration, deep inspiration, and deep expiration.

Ebt: BP apparatus is required for this test. The rubber tube leading from the mercury reservoir to the cuff is disconnected. The subject was asked to take a deep inspiration and blow into the tube to raise the mercury column to the highest level possible. A normal subject can raise the mercury column to 55–100 mmHg or more during a single forceful expiration.

ST: A normal adult should be able to blow out a burning matchstick or candle held at a distance of30 cm in front of his face, with a single forceful expiration.

Ret: The subject was instructed to take a deep breath, close his nostrils, and blow into the rubber tubing to raise the mercury column to 40 mmHg level in the manometer. He was instructed to maintain the mercury level at 40 mmHg as long as possible. Normal person can hold it at the same level for 40–70 s or more.

Pefr: The subject was instructed to take a deep breath and then to blow hard into the mouth piece of the flow meter forcefully with his nostrils closed.

Results and Discussion

Asthma is a chronic respiratory disorder characterized by reversible airway obstruction, allergic inflammation and airway hyper-responsiveness. In susceptible individuals, this inflammation causes symptoms that are usually widespread and variable such as airflow obstruction that is often reversible, either spontaneously or with treatment, and causes an associated increase in airway responsiveness to a variety of stimuli [13]. Yoga has been considered the best complementary and alternative medicine by the National Institute of Health [14]. Regular practice of yoga provides strength, endurance, and flexibility; facilitates characteristics of friendliness and compassion; and helps develop greater self-control, while cultivating a sense of calmness and well-being [15-16]. The process of exhalation by the Buteyko method is an important technique in managing asthma. It reduces the frequency and intensity of asthma attacks and involves both physical and psychological factors [17].

Since bronchial asthma is an important cause of morbidity and mortality especially in resource limited areas where the long term use of multiple drugs is costly, it is wise to think

alternative way to treat such an illness with better economic safety and avoid adverse effect of the drugs. The study therefore tries to look into the applicability of yoga as an alternative approach in the treatment of asthma.

Table 1: Comparison of pre- and post-intervention (after 6 weeks) values in the control group

Parameters	Duration	Control group	Study Group
No. of Cases		10	10
Pair 1 (PEFR)	Pre-value	131.5 – 273.4	98.1 –218.5
	After 6 weeks	125.4 – 267.8	168.5 – 311.7
Pair 2 (BHT-QI)	Pre-value	10.4 – 28.5	6.4 – 22.9
	After 6 weeks	10.6 – 27.3	21.4 – 39.5
Pair 3 (BHT-QE)	Pre-value	7.4 – 22.4	6.7 – 21.5
	After 6 weeks	9.4 – 22.6	19.4 – 35.8
Pair 4 (DI)	Pre-value	12.4 – 48.3	7.4 – 23.8
	After 6 weeks	16.1 – 44.7	32.1 – 46.7
Pair 5 (BHT-DE)	Pre-value	12.1 – 22.4	7.4 – 21.9
	After 6 weeks	11.4 –23.2	24.4 – 40.5
Pair 6 (EBT)	Pre-value	21.5 – 52.9	15.2 – 48.7
	After 6 weeks	22.7 –52.3	43.7 – 69.4
Pair 7 (RET)	Pre-value	0.1 – 9.9	0.2 – 8.5
	After 6 weeks	2.4 –15.7	17.8 – 39.5

Scientific basis of using yoga as an adjunct therapy in various respiratory disorders such as chronic obstructive pulmonary disease is well established with improvements in lung function, quality of life indices, and bronchial provocation responses coupled with decreased need for regular and rescue medicinal usage.

However, few studies have assessed the effects of yoga therapy on pulmonary functions in patients of diabetes that reported decline in lung parameters [18-19] which were attributed to nonenzymatic glycosylation that altered lung connective tissue and led to pulmonary fibrosis and dysfunction.

One of the newer mechanisms postulated for the benefit yoga is that its practices induce a cyclic loading and unloading of body tissues, thus helping maintain health of the extracellular matrix (ECM) that is made up of various proteins, water, and glycosaminoglycans including hyaluronic acid. It has been suggested that yogic practices may be able to temporarily transform the gel-like ground substances of the ECM into a fluid state, thus helping cells, nutrients, and other components of the matrix to move about freely while removing toxins and waste products through the blood or lymphatic system. Physical techniques of yoga as done in this study may induce optimal levels of compression in the ECM and thus help maintain the number and function of fibroblasts which keep the matrix hydrated, open, and strong [20].

In this study, we found that patients who received adjuvant yoga therapy showed significant improvements in FEV1 and FVC. FEV1/FVC ratio showed appreciable improvement though it was not statistically significant. We also found positive improvement in control group in FVC because of which FEV1/FVC ratio decreased significantly.

Intergroup comparison of the delta and delta% changes showed greater improvement in yoga group in FEV1 and FVC between groups which may be attributed to nonspecific broncho protective or broncho relaxing effect as reported by Singh *et al*. who also postulated that pranayama and yoga postures may be used to increase respiratory stamina, relax chest muscles, expand lungs, raise energy levels, and calm the body [21].

Tandon observed improved exercise tolerance following yoga therapy in patients of chronic severe airway obstruction [22]. Bernardi *et al*. reported that slow yogic breathing maintained better blood oxygenation without increasing minute ventilation and also found reduced sympathetic activation during altitude-induced hypoxia [23].

Improvement of all lung function parameters in yoga group may be attributed to the regular practice of the Hathenas that are specialized yoga techniques aimed at increasing respiratory muscle stamina, lung expansion as well as conscious breath work to relax respiratory process improving lung elasticity and compliance. Pulmonary functions in diabetes patients are usually compromised. Yoga has improved these by various mechanisms which include reduction of obesity, increased oxygenation, opening of airspaces, and recruitment of alveoli. Our results are collaborated by earlier studies reporting similar changes after yoga training in healthy volunteers as well as in those suffering from different conditions [24-25].

Conclusion

Lung specific hasta mudras significantly increased PEFR, BHT, EBT, RET immediately after 30 minutes of practice. This simple, easy to practice anytime, anywhere, cost effective technique must be practiced regularly to produce beneficial effects. The yoga is an effective tool to improve the pulmonary functions, and it can be practiced as an adjuvant therapy with standard medical treatment of asthma with better outcome.

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