Original Article

Impact of yoga on biochemical profile of asthmatics: A randomized controlled study

Shruti Agnihotri, Surya Kant, Santosh Kumar, Ranjeet K Mishra[1], Satyendra K Mishra[2]

Department of Pulmonary Medicine, King George's Medical University, Uttar Pradesh, Lucknow, [1]Department of Biochemistry, Lucknow University, Lucknow, Uttar Pradesh, [2]Department of Social Work, Naturopathic Science and Yoga Unit, Lucknow University, Lucknow, Uttar Pradesh, India

Address for correspondence: Dr. Surya Kant,
Department of Pulmonary Medicine,
King George's Medical University, Uttar Pradesh, Lucknow, India.
E-mail: dr.kantskt@rediffmail.com

ABSTRACT

Background: Asthma is a chronic inflammatory disorder of the airways. The chronic inflammation causes an associated increase in airway hyperresponsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness, and coughing at night or in the early morning. Most of the studies have reported, as the effects of yoga on bronchial asthma, significant improvements in pulmonary functions, quality of life, and decrease in medication use, but none of the studies has attempted to show the effect of yoga on biochemical changes.

Objective: To evaluate the effect of yoga on biochemical profile of asthmatics.

Materials and Methods: In the present study, 276 patients of mild to moderate asthma (FEV_1 > 60%) aged between 12 to 60 years were recruited from the Department of Pulmonary Medicine, King George's Medical University, U.P., Lucknow, India. They were randomly divided into two groups: Yoga group (with standard medical treatment and yogic intervention) and control group as standard medical treatment (without yogic intervention). At completion of 6 months of the study period, 35 subjects were dropped out, so out of 276 subjects, only 241 subjects completed the whole study (121 subjects from yoga group and 120 subjects from control group). Biochemical assessment was carried out at baseline and after 6 months of the study period.

Results: In yoga group, there was significant improvement found in the proportion of hemoglobin and antioxidant superoxide dismutase in comparison to control group and significant decrease was found in total leukocyte count (TLC) and differential leukocytes count in comparison to control group. There was no significant change found in TLC, polymorphs, and monocytes in between group comparison.

Conclusions: Yoga group got significantly better improvement in biochemical variables than control group. Result shows that yoga can be practiced as adjuvant therapy with standard inhalation therapy for better outcome of asthma.

Key words: Asthma; adjuvant; hyper- responsiveness; intervention; wheezing.

INTRODUCTION

Asthma is a chronic inflammatory disorder of the airways in which various cells and cellular elements play a role. The chronic inflammation causes an associated increase in airway hyper-responsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness, and coughing at night or in the early morning. About 300 million people are suffering from asthma globally[1-3] and about 10% of it belongs to India. Asthma is defined simply as reversible airway obstruction. Reversibility occurs either spontaneously or with treatment. The basic measurement is peak flow rates and the diagnostic criteria used by the British Thoracic Society.[4] Yoga is known for its beneficial effects on physiologic and psychologic functions and improves the quality of life of the patients.[5-12] During the last 3 decades, extensive physiologic research has been done on yogic practices. It has been reported that yoga can increase muscular efficiency, endurance time,[13] and aerobic capacity and can reduce perceived exertion after exercise.[14-16] Chronic inflammation plays a major role in the pathogenesis of asthma, and it has long been recognized that many of the inflammatory cells that are

Access this article online	
Website: www.ijoy.org.in	Quick Response Code
DOI: 10.4103/0973-6131.123473	

involved in mediating these processes reach the lung via the blood. In asthma, the dominant peripheral blood leukocyte found in the airway is the eosinophils[17-18] and the degree of eosinophils involvement is correlated with various markers of severity including symptoms,[19] loss of lung function,[20-21] and with airway hyperresponsiveness. In asthma, the presence of neutrophils and eosinophils in the airway is broadly reflected by increased numbers of these cells in peripheral blood.[22-24] Reactive oxygen species, released from eosinophils, alveolar macrophages, and neutrophils, seem to play a key role in asthma. They may directly contract airway smooth muscles; stimulate histamine release from mast cells and mucus secretion.[25] Asthma is, therefore, also associated with oxidative-antioxidative imbalance in the body and might have a psychosomatic origin. Attack of asthma involves both physical and psychological factors. By regular practice of yogasanas and pranayama, the constriction of bronchial tubes gets very much reduced. Slowly, the capacity of bronchial tubes increases to a great extent and subsequently gradually asthma can be cured from roots.

MATERIALS AND METHODS

Study design and setting

This study is a randomized controlled trial. Diagnosed cases of asthma (FEV_1 >60%) who attended the outpatient department (OPD) of the Department of Pulmonary Medicine, King George's Medical University, U.P., Lucknow, India were screened by a consultant for participation on the basis of inclusion and exclusion criteria. Eligible subjects were invited for the yoga and fulfilled the criteria to enroll in this study after getting their written consent. The study was approved by the institutional ethics committee.

Inclusion criteria

1. Mild to moderate persistent bronchial asthma severity according to GINA- 2009
2. Reversible airflow limitation measured by ≥12% increase and ≥200 mL absolute increase in FEV_1 after post bronchodilator
3. Nonsmokers or exsmokers with <10 pack/year who have not smoked for at least 6 months
4. Patient's age ranging from 12 to 60 years.

Exclusion criteria

1. Those who had a clinical diagnosis of asthma but did not satisfy the diagnostic criteria
2. Patients with severe airflow limitation or more (FEV_1 <60%)
3. Pregnant/lactating women
4. Associated chronic respiratory diseases such as pulmonary tuberculosis and autoimmune lung diseases.
5. Major psychiatric illnesses.

A total of 276 subjects were included in the study after randomization which was done by computer-generated random number table. Subjects were divided into two groups, yoga group who received yogic intervention for 6 months along with standard medical treatment and control group who received only standard medical treatment. Out of 276 subjects, 17 subjects from yoga group and 18 from control group dropped out during the study. A total of 121 subjects (67 males and 54 females) from the yoga group and 120 subjects (71 males and 49 females) from the control group completed the study.

Peripheral venous blood (5 mL) was taken for the study of biochemical changes occurred at baseline and after 6 months. A total of 3 mL blood was taken without using an anticoagulant and allowed the blood to clot for 30 min at 25°C, and then centrifuge the blood at 2,000 × g for 15 min at 4°C. Pipette off the top yellow serum layer without disturbing the white buffy layer. Serum was diluted 1:5 with sample buffer provided by Superoxide Dismutase Assay Kit (Item No. 706002) Cayman Chemical Company, USA before assaying for SOD activity, while left 2 mL blood was used for the determination of hemoglobin which was performed by hemoglobinometer; assessment of total leukocyte count (TLC) and DLC was done by Neubauer Chamber Cell Counting Method.

Yogic intervention

Subjects in the yoga group received yogic intervention for 30 min per day in the morning, 5 days in a week for a period of 6 months at the Department of Pulmonary Medicine, King George's Medical University, U.P., Lucknow, India [Table 1]. A qualified yoga trainer was selected by expert panel for this study to give the proper training of yoga to the yoga group.

Data analysis

Paired (dependent) *t*-test was used to test the mean difference score of the subjects at baseline and after 6 months in both groups, i.e., yoga/intervention and control group. The differences in pre and posttreatment scores were used for the analysis. Student's independent sample *t*-test was used to compare the differences in scores between two groups (yoga vs. nonyoga group). The statistical analysis was done by using GraphPad InStat (Version. 3.05 GraphPad software, Inc., California)

RESULTS

The socioeconomic or demographic, clinical and outcome variables of the subjects are given in Tables 2 and 3. As seen in Table 2, all the variables are similar and no significant difference was found in both groups but in Table 3, both groups are comparable at baseline in every respect except lymphocytes and superoxide dismutase (SOD). The values

of outcome measures are given in Tables 4 and 5. Since, there was significant difference found in lymphocytes count and SOD level; therefore, baseline was considered as a constant covariate for between group comparisons.

It has been observed in the pre-post comparison that hemoglobin increased significantly by 7.52% from 11.7 ± 1.43 to 12.58 ± 1.46 (g/dL) (P = 0.001), proportion of polymorphs decreased significantly by 2.57% from 70.70 ± 8.93 to 68.88 ± 7.68 (P = 0.016), eosinophils decreased significantly by 47.96% from 9.05 ± 1.62 to 4.71 ± 1.19% (P < 0.0001). Monocytes also decreased significantly by 63.0% from 5.24 ± 1.54 to 1.98 ± 1.09% (P < 0.0001). There was a significant increase of 4.85% found in SOD level from 10.32 ± 5.55 to 10.82 ± 5.84 U/mL (P < 0.0001) in yoga group in comparison to control group [Table 4]. TLC and proportion of lymphocytes also decreased significantly in both group but there was not much difference found in their percentage change. At postintervention, between group differences were found highly significant with better improvement in hemoglobin, lymphocytes, eosinophils, and SOD [Table 5].

Table 1: Yogic techniques practiced by yoga group

Yogic techniques	Duration (min)
Asanas	
Gomukhasana	2
Ardhamatsyendrasana	2
Paschimmottanasana	0.5
Bhujangasana	0.5
Dhanurasana	0.5
Naukasana	1
Parvatasana	1
Tadasana	0.5
Shavasana	5
Pranayama	
Nadishodhana	3
Bhastrika	2
Bhramari	2
Meditation	10
Total duration	30 min

Table 2: Socioeconomic-demographic profile

Factors	Cases (121)	Controls (120)	*P* value
Age (mean±SD)	37.03±11.46	38.69±10.54	0.25
Age range in years [*n* (%)]			
12-20	8 (6.61)	6 (5)	
20-8	17 (14.05)	12 (10)	
28-36	34 (28.1)	27 (22.5)	
36-44	28 (23.14)	32 (26.67)	
44-52	14 (11.57)	31 (25.83)	
52-60	20 (16.53)	12 (10)	
Sex [*n* (%)]			0.53
Male	67 (55)	71 (59.17)	
Female	54 (44.63)	49 (40.83)	
Weight (mean±SD)	53.12±10.49	54.35±8.44	0.32
Height (mean±SD)	161.31±7.9	161.89±9.97	0.08
Religion *n* (%)			0.15
Hindu	111 (91.74)	103 (85.83)	
Muslims	10 (8.26)	17 (14.17)	
Residence			0.08
Urban	117 (96.69)	111 (92.50)	
Rural	4 (3.31)	9 (7.50)	
Socioeconomic status [*n* (%)]			0.18
Upper	3 (2.48)	-	
Upper middle	25 (20.66)	12 (10)	
Lower middle	32 (26.45)	40 (33.33)	
Upper lower	44 (36.36)	44 (36.67)	
Lower	17 (14.05)	24 (20)	
Smoking [*n* (%)]			0.057
Exsmoker	43 (34.71)	25 (20.83)	
Nonsmoker	78 (64.46)	95 (79.17)	
Severity of disease [*n* (%)]			0.55
Mild	100 (82.64)	96 (80)	
Moderate	21 (17.36)	24 (20)	

SD = Standard deviation

DISCUSSION

The results of this study suggest that the levels of hemoglobin and antioxidant SOD were significantly increased in yoga group in comparison to control group and significant decrease was found in TLC and differential leukocytes count in comparison to control group. There was no significant change found in TLC, polymorphs, and monocytes in between group comparison.

Eosinophils has a crucial role in the pathogenesis and course of asthma, as most allergic and nonallergic asthmatic patients, including those with mild asthma, has a bronchial eosinophilia and there is significant association between eosinophils activation and asthma severity as well as bronchial hyperresponsiveness. Tissue eosinophilia was found to be significantly greater in fatal asthma than in patients with chronic asthma.[26] Although eosinophils protect us against parasites and other infectious agents, its high level is also responsible for the allergic reaction and worsen asthma state.[27] Lymphocytes play a crucial role in the inflammatory processes of allergic asthma.[28] Monocytes are inflammatory cells that accumulate in the airway in asthma. In a study, it has shown that low-density monocytes from subjects with asthma retain the ability to be activated *in vivo* and *in vitro* and may orchestrate immune reactions in mild asthma.[29] In a study, it was found that the number of monocytes was similar to that of healthy controls in nonattack stage of asthma. The number of monocytes in the peripheral blood may change in close relation to asthma attacks elicited by allergic reactions.[30]

A previous study has shown that there was a significant increase in the proportion of eosinophils, basophils, lymphocytes, and in the ECP level in induced sputum of occupational allergics after the specific provocation.[31] Other previous studies also support our findings. In a study after 6 weeks of yoga training, there was significant increase in hemoglobin %, decrease in leukocytes count and differential count showed decrease in lymphocyte, eosinophil, monocytes, and basophils, but it was statistically insignificant.[32]

Table 3: Baseline scores of case and control

Variables	Cases *n*=121, mean±SD	Controls *n*=120, mean±SD	Effect size	*P* value	*t* statistics
Hb	11.7±1.43	11.6±1.66	0.065	0.62	0.50
TLC	13299.67±2346.54	13880.83±1585.03	0.29	0.052	2.25
Polymorphs	70.70±8.93	69.33±4.78	0.20	0.14	1.48
Lymphocytes	32.36±4.89	29.49±3.00	0.73	<0.0001	5.49
Eosinophils	9.05±1.62	8.86±1.34	1.46	0.32	1.99
Monocytes	5.24±1.54	4.92±0.96	1.26	0.054	1.93
SOD	10.32±5.55	7.71±4.07	0.54	<0.0001	4.16

P value significant (5% level of significance), *P* value not significant (>0.05) for any of the parameter, Hb = Hemoglobin; TLC = Total leukocyte count; SD = Standard deviation; SOD = Superoxide dismutase

Table 4: Comparison of pre and post biochemical changes occurred in yoga group and control group

	Yoga group					Control group				
Variables	Baseline	After 6 month	% change	*t* statistics	*P* value	Baseline	After 6 month	% change	*t* statistics	*P* value
Hb	11.7±1.43	12.58±1.46	7.52	3.37	0.001**	11.6±1.66	12.06±1.36	3.97	2.51	0.014*
TLC	13299.67±2346.54	9797.93±1828.82	−26.33	12.95	<0.0001	13880.83±1585.03	9777.92±1816.48	−29.56	18.98	<0.0001
Polymorphs	70.70±8.93	68.88±7.68	−2.57	2.44	0.016*	69.33±4.78	68.18±5.62	−1.66	2.17	0.031*
Lymphocytes	32.36±4.89	31.48±5.98	−2.72	2.07	0.046*	29.49±3.00	28.68±3.76	−2.75	2.44	0.016*
Eosinophils	9.05±1.62	4.71±1.19	−47.96	22.39	<0.0001	8.86±1.34	5.12±1.5	−42.21	18.57	<0.0001
Monocytes	5.24±1.54	1.98±1.09	−63.0	32.9	<0.0001	4.92±0.96	1.88±1.04	−61.79	23.02	<0.0001
SOD	10.32±5.55	10.82±5.84	4.85	8.02	<0.0001	7.71±4.07	7.01±3.08	−9.08	3.87	0.0002**

Hb = Hemoglobin; TLC = Total leukocyte count; SOD = Superoxide dismutase; *$P<0.05$, **$P<0.01$, ***$P<0.001$ based on *post hoc* pair-wise comparison with baseline values. *P* value not significant (>0.05) for any of the parameter

Table 5: Results of all variables post-intervention (between groups)

Variables	Cases *n*=121, mean±SD	Controls *n*=120, mean±SD	Effect size	*P* value	*t* statistics
Hb	12.58±1.46	12.06±1.36	0.37	0.005*	2.86
TLC	9797.93±1828.82	9777.92±1816.48	0.01	0.93	0.09
Polymorphs	68.88±7.68	68.18±5.62	0.1	0.42	0.81
Lymphocytes	31.48±5.98	28.68±3.76	0.56	<0.0001	4.35
Eosinophils	4.71±1.19	5.12±1.5	0.3	0.02*	2.35
Monocytes	1.98±1.09	1.88±1.04	0.09	0.47	0.73
SOD	10.82±5.84	7.01±3.08	0.82	<0.0001	6.32

Hb = Hemoglobin; TLC = Total leukocyte count; SD = Standard deviation; SOD = Superoxide dismutase *P value significant (5% level of significance), P value not significant (>0.05) for any of the parameter

The free radicals increase asthma because they increase the consumption of oxygen, while antioxidants prevented the consumption of oxygen in the cells and helps in decreasing the symptoms of asthma. SOD is a scavenging enzyme, has the capacity to scavenge the oxygen radical. Hence, it helps in prevention of consumption of oxygen and cellular damage. A few studies also suggested that free radicals may be involved in the development of pulmonary disorders such as asthma.[33] However, probably none of the study has shown the impact of yoga on biochemical profile of asthmatics in India as done in the current study.

CONCLUSION

The current study shows that the yogic intervention significantly increased the level of hemoglobin, SOD, and significantly decreased the levels of eosinophils and monocytes in differential leukocytes count in the patients of bronchial asthma**.** Overall, this study shows that yoga is an effective tool for the improvement and can be practiced as an adjuvant therapy to standard inhalation therapy for better outcome of asthma.

ACKNOWLEDGEMENT

We are grateful to those patients who kept patience for 6 months up to the completion of study period and performed regular yoga practice. We are also thankful to yoga instructor and entire faculty of the Department of Pulmonary Medicine, King George's Medical University, Lucknow, U.P., India.

REFERENCES

1. Masoli M, Fabian D, Holt S, Beasley R, Global Initiative for Asthma (GINA) Program. The global burden of asthma: Executive summary of the GINA Dissemination Committee report. Allergy 2004;59:469-78.
2. Bateman ED, Jithoo A. Asthma and allergy-A global perspective. Allergy 2007;62:213-5.
3. Beasley R. The Global Burden of Asthma Report. Global Initiative for Asthma (GINA). Available from: http://www.ginaasthma.org 2011.
4. Tippets B, Guilbert TW. Managing asthma in children: Part 1: Making the diagnosis, assessing severity. Consultant for Pediatricians 2009;8:175-177.

5. Sharma H, Sen S, Singh A, Bhardwaj NK, Kochupillai V, Singh N. Sudarshan Kriya practitioners exhibit better antioxidant status and lower blood lactate levels. Biol Psychol 2003;63:281-91.
6. Brown RP, Gerbarg PL. Sudarshan Kriya yogic breathing in the treatment of stress, anxiety, and depression: Part I- neurophysiologic model. J Altern Complement Med 2005;11:189-201.
7. Jevning R, Wallace RK, Beidebach M. The physiology of meditation: A review. A wakeful hypometabolic integrated response. Neurosci Biobehav Rev 1992;16:415-24.
8. Wallace RK. Physiological effects of transcendental meditation. Science 1970;167:1751-4.
9. Shapiro D, Cook IA, Davydov DM, Ottaviani C, Leuchter AF, Abrams M. Yoga as a complementary treatment of depression: Effects of traits and moods on treatment outcome. Evid Based Complement Alternat Med 2007;4:493-502.
10. Telles S, Naveen KV, Dash M. Yoga reduces symptoms of distress in tsunami survivors in Andaman Islands. Evid Based Complement Alternat Med 2007;4:503-9.
11. Wallace RK, Benson H, Wilson AF. A wakeful hypometabolic physiologic state. Am J Physiol 1971;221:795-9.
12. Jorm AF, Christensen H, Griffiths KM, Rodgers B. Effectiveness of complementary and self-help treatments for depression. Med J Aust 2002;176 Suppl:S84-96.
13. Ray US, Hegde KS, Selvamurthy W. Improvement in muscular efficiency as related to a standard task after yogic exercises in middle aged men. Indian J Med Res 1986;83:343-8.
14. Sinha B, Ray US, Pathak A, Selvamurthy W. Energy cost and cardiorespiratory changes during the practice of Surya Namaskar. Indian J Physiol Pharmacol 2004;48:184-90.
15. Ray US, Sinha B, Tomer OS, Pathak A, Dasgupta T, Selvamurthy W. Aerobic capacity and perceived exertion after practice of Hatha yogic exercises. Indian J Med Res 2001;114:215-21.
16. Telles S, Desiraju T. Oxygen consumption during pranayamic type of very slow-rate breathing. Indian J Med Res 1991;94:357-63.
17. Azzawi M, Johnston PW, Majumdar S, Kay AB, Jeffery PK. T lymphocytes and activated eosinophils in airway mucosa in fatal asthma and cystic fibrosis. Am Rev Respir Dis 1992;145:1477-82.
18. Azzawi M, Bradley B, Jeffery PK, Frew AJ, Wardlaw AJ, Knowles G, *et al*. Identification of activated T lymphocytes and eosinophils in bronchial biopsies in stable atopic asthma. Am Rev Respir Dis 1990;142:1407-13.
19. Bentley AM, Menz G, Storz C, Robinson DS, Bradley B, Jeffery PK, *et al.* Identification of T lymphocytes, macrophages, and activated eosinophils in the bronchial mucosa in intrinsic asthma. Relationship to symptoms and bronchial responsiveness. Am Rev Respir Dis 1992;146:500-6.
20. Mensinga TT, Schouten JP, Weiss ST, Van der Lende R. Relationship of skin test reactivity and eosinophilia to level of pulmonary function in a community-based population study. Am Rev Respir Dis 1992;146:638-43.
21. Bousquet J, Chanez P, Lacoste JY, Barnéon G, Ghavanian N, Enander I, *et al*. Eosinophilic inflammation in asthma. N Engl J Med 1990;323:1033-9.
22. Schwartz J, Weiss ST. Prediction of respiratory symptoms by peripheral blood neutrophils and eosinophils in the First National Nutrition Examination Survey (NHANES I). Chest 1993;104:1210-5.
23. Tollerud DJ, O'Connor GT, Sparrow D, Weiss ST. Asthma, hay fever, and phlegm production associated with distinct patterns of allergy skin test reactivity, eosinophilia, and serum IgE levels. The Normative Aging Study. Am Rev Respir Dis 1991;144:776-81.
24. Troisi RJ, Willett WC, Weiss ST, Trichopoulos D, Rosner B, Speizer FE. A prospective study of diet and adult-onset asthma. Am J Respir Crit Care Med 1995;151:1401-8.
25. Guyatt G, Walter S, Norman G. Measuring change over time: Assessing the usefulness of evaluative instruments. J Chronic Dis 1987;40:171-8.
26. MacKenzie CR, Charlson ME, DiGioia D, Kelley K. Can the sickness impact profile measure change? An example of scale assessment. J Chronic Dis 1986;39:429-38.
27. Guill MF. Asthma update: Clinical aspects and management. Pediatr Rev 2004;25:335-44.
28. Zhao J, Takamura M, Yamaoka A, Odajima Y, Iikura Y. Altered eosinophil levels as a result of viral infection in asthma exacerbation in childhood. Pediatr Allergy Immunol 2002;13:47-50.
29. Tomita K, Tanigawa T, Yajima H, Fukutani K, Matsumoto Y, Tanaka Y, *et al*. Identification and characterization of monocyte subpopulations from patients with bronchial asthma. J Allergy Clin Immunol 1995;96:230-8.
30. Tanizaki Y, Hosokawa M, Goda Y, Akagi K, Takeyama H, Kimura I. Numerical changes in blood monocytes in bronchial asthma. Acta Med Okayama 1982;36:341-8.
31. Nadel JA, Busse WW. Asthma. Am J Respir Crit Care Med 1998;157:S130-8.
32. Krakowiak A, Krawczyk-Adamus P, Dudek W, Walusiak J, Pałczyński C. Changes in cellular and biochemical profiles of induced sputum after allergen-induced asthmatic response: Method for studying occupational allergic airway inflammation. Int J Occup Med Environ Health 2005;18:27-33.
33. Greene, LS. Asthma and Oxidant Stress: Nutritional, environmental, and genetic risk factors. J Am Coll Nutr 1995;14:317-24.

How to cite this article: Agnihotri S, Kant S, Kumar S, Mishra RK, Mishra SK. Impact of yoga on biochemical profile of asthmatics: A randomized controlled study. Int J Yoga 2014;7:17-21.

Source of Support: Indian Council of Medical Research, New Delhi, India, **Conflict of Interest:** None declared