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Research Article

Effect of integrated yoga module on respiratory pressures and pulmonary functions in children

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ABSTRACT

Background: Very often adults turn to practice of yoga when physical ailment is developed. Many research studies show effects of yoga in adults. Since childhood health forms a foundation for adult health, present work was planned to study the effects of yoga in children on pulmonary functions like forced expiratory volume in first second (FEV1), and peak expiratory flow rate (PEFR) and respiratory pressures like maximum expiratory pressure (MEP), maximum inspiratory pressure (MIP).
Methods: 50 school children in the age group of 12 to 15 years were selected as cases. 50 age and gender matched students as control group. Students of study group were subjected to training of Integrated Yoga Module for 45 minutes a day for six days a week over a period of four months. Pulmonary function parameters were measured in both groups at the outset and at the end of study. Results were analyzed by Student's paired 't' test.
Results: Yoga training produced statistically significant ($p < 0.05$) increase in MEP (52.14 to 53.54 mmhg), MIP (-61.04 to -61.98 mmhg), FEV1 (1.74 - 1.78 l) and PEFR (4.04 - 4.18 l/sec). In contrast, the increase in these parameters in the control group was statistically insignificant.
Conclusions: From our study we conclude that yoga training for four months improves lung functions, strength of inspiratory and expiratory muscles in children. We also conclude if yoga is practiced since childhood, it can form a strong foundation for healthy adult life.

Keywords: Yoga, Children, FEV1, PEFR, MIP, MEP

INTRODUCTION

World is now ready for yoga. People are accepting yoga for wellness. Interest and belief of people in yoga must be enhanced by providing them scientific observations associated with yoga and scientific explanation for it. Majority of studies of effect of yoga are carried out in adults. There are many studies on effects of yoga training on pulmonary functions like forced expiratory volume, forced expiratory volume in first second (FEV1) and peak expiratory flow rate (PEFR) in adults.1,2,3,4 Very few are on maximum inspiratory pressure (MIP) and maximum expiratory pressure (MEP) in adults. Since wellness of adult life is dependent on how childhood is nurtured, it is the need of hour to perform studies on children also. Very few reports are available on effects of yoga in children on pulmonary function tests and respiratory pressures i.e. MIP and MEP.

With this point of view, we aimed to study the impact of four months yoga training on pulmonary functions and respiratory pressures in children and to observe whether yoga training was beneficial in improving respiratory functions of children which would support to make yoga as a part of education.

METHODS

It was pre and post- test control group design study. The study was carried out on the students of 7th & 8th standard. 100 students between the age group 12 to 15 years with 50 boys and 50 girls were selected. They were enquired about regular practice of any sports. Daily formal playing was taken into consideration. Detail history was taken and clinical examination was done.

Inclusive criteria were applied as follows.

- No previous exposure to yoga training.
- No regular practice of any sports
- Absence of Cardio-Respiratory diseases,
- Absence of congenital anomalies and
- Absence of malnourishment

These students were divided into two equal groups. One study group of 50 students with 25 boys and 25 girls and other control group of 50 students with 25 boys and 25 girls.

Informed consent was taken from the subjects and their guardian after explaining the study design. The protocol of project was submitted to institutional ethics committee and the project was started after approval.

At the outset of study, students of both the groups were subjected to measurement of anthropological parameters like height in cm & weight in kg. Both the groups were subjected to measurement of pulmonary function tests like forced expiratory volume in first second (FEV1), peak expiratory flow rate (PEFR) and maximum inspiratory pressure (MIP) & maximum expiratory pressure (MEP).

Recording of Respiratory pressures

MEP and MIP were measured by using instrument MedGraphics Breezesuite ultima pfx (M/s Biotronics Equipment Pvt. Ltd, 401, Bangashree Tower, Daji Ramchandra Road, Charai, Thane, Maharashtra, India 400601) .Procedure was explained and demonstrated to students. They were made familiar with instrument and procedure for performing the test. Procedure was done with the subject in sitting position and breathing was done through mouthpiece connected to machine. Maximum inspiratory pressure (MIP) was recorded by asking the subject to breathe in voluntarily with maximal efforts from the end of maximal and forceful expiration against a mouthpiece valve system that was occluded at residual volume. Maximum expiratory pressure (MEP) was recorded by asking subject to breath out voluntarily with maximal efforts from the end of maximal and complete inspiration (i.e. total lung capacity) against a mouthpiece valve system that was occluded at total lung capacity. Values of MIP and MEP were recorded in mmHg. The procedure was done in three attempts and the best of three attempts was selected. The enough recuperation was provided between attempts to avoid short term fatigability of the respiratory muscle.

Recording of pulmonary function tests

Pulmonary function tests were recorded by using computerized spirometer (MIR spirolab). All the subjects were given the demonstration of tests. They were made familiar with the instrument and the procedure for performing the test. The tests were performed in sitting position. The subject was asked to take full inspiration which was followed by as much rapid and forceful expiration as possible in the mouthpiece with the nostrils closed. Three consecutive readings were taken and the best reading among three was selected and noted. One single expiratory effort gives readings about many parameters. Out of these FEV1, PEFR were selected.

Students of study group were put to yoga session for 45 minutes duration from 4.00 pm to 4.45 pm in their school hours from Monday to Saturday for four months. Students of control group did not receive any yoga training. They were asked to study in a classroom while students of study group were undergoing yoga training.

Students of study group were put to Integrated Yoga Module as prescribed by Swami Vivekananda Yoga Anusadhana Samsthana (SVYASA), Bangalore.[5] It was done under supervision. Module included following practices; (a) Breathing practice 5 min, (b) Instant Relaxation technique 1 min, (c) Loosening exercises 5 min, (d) Quick relaxation technique 2 min, (e) *Asana* 15 min, (f) Preparation for *Pranayam* i.e. Sectional breathing 2 min, (g) *Kapalbhati* 30 sec-1min, (h) *Pranayam (Nadi-shuddhi)* (6 rounds) 4 min and (i) deep relaxation technique for 10 min.

At the end of four months both the groups were again subjected to measurement of anthropometric parameters and pulmonary function tests i.e. FEV1 and PEFR and respiratory pressures i.e. MIP and MEP.

Ethics

It was non-invasive study. The approval of Institutional Ethical Committee was taken.

Statistical analysis

Continuous variables (FEV1, PEFR, MEP and MIP) were presented as Mean ± S.D. Pre and Post training data was compared by performing paired t- test for normalized data. Wilcoxon rank sum test was performed to compare mean changes in different study parameters between study and Control group. $P < 0.05$ was considered as statistical significance. Statistical software STATA version 13.0 was used for data analysis.

RESULTS

Table 1 shows anthropological observations of study subjects and control subjects before study and at end of study. This table shows study and control groups were age, height and weight matched.

Table 2 shows values of MEP, MIP, FEV1, and PEFR before and after yoga training for months in study and control group. Training with Integrated Yoga module for four months produced highly significant increase in PEFR, MEP, MIP and significant increase in FEV1 in Study group subjects (Table 2). In contrast, the changes in these parameters in the control group subjects were statistically insignificant.

Table 3 shows comparison of effect of yoga on different parameters between study and control group. Training with Integrated Yoga module for four months produced highly significant increase in MEP and significant increase in PEFR, MIP and FEV1 in study group subjects as compared to control group.

Table 1: Baseline characteristics of study subjects.

Parameter	Study group	Control group	p-value
Age in years	12.96±0.78	12.96 ± 0.92	1.0000,NS
Height in cm	145.86±6.73	148.58 ±8.05	0.0700,NS
Weight in kg	33.0± 4.86	33.74 ±5.04	0.4575,NS

NS: Not Significant

Table 2: Comparison of Mean, MEP, MIP, FEV1 and PEFR before and after yoga training for four months in study and control group.

Parameters	Study group			Control group		
	Before Training	After Training	p- value	Before training	After Training	p-value
MEP (mmHg)	52.14± 8.20	53.54± 7.31	0.0015,HS	56.86± 9.34	56.787± 8.03	0.9047, NS
MIP (mmHg)	- 61.04± 7.54	-61.98± 6.76	0.0001,HS	- 57.02± 11.73	- 56.08± 11.74	0.0646,NS
FEV_1 (L)	1.74±0.31	1.78±0.30	0.0208, S	1.85±0.43	1.856± 0.43	0.8607, NS
PEFR (L/s)	4.04±1.10	4.18±1.04	0.0026,HS	4.33±1.19	4.34± 1.17	0.1736, NS

N.S:Not Significant; S-Significant; HS:Highly Significant.

Table 3: Comparison of effect of yoga on different parameters between study and control group.

Parameters	Study group	Control group	p-value
MEP(mmHg)	1.4± 2.94	-0.34± 1.27	0.0003,HS
MIP (mmHg)	-0.94±1.55	-0.10± 2.46	0.0445,S
FEV_1 (L)	0.04± 0.12	-0.004±0.016	0.0225,S
PEFR (L/s)	0.14± 0.31	0.01± 0.053	0.0101,S

S-Significant; HS:Highly Significant.

DISCUSSION

In the present study MEP and MIP increased significantly following four months of yoga training in study group subjects. The present findings are consistent with Mandanmohan et al who reported that, six months yoga training causes significant increases in MEP& MIP values in subjects of 12-15 age groups. [6] De Godoy DV et al reported that yoga does cause improvement in maximal inspiratory pressure.[7]

Maximum respiratory pressures are simple and accurate indices of strength of respiratory muscles.[8] The increases in MIP and MEP in our yoga group indicate yoga training improves the strength of expiratory as well as inspiratory muscles. Kapalbhati included in our present training program involves powerful strokes of exhalation which trains the subjects to make full use of diaphragm and abdominal muscles. Slow, deep and full inspiration and expiration in pranayama also trains the respiratory muscles and increases the strength of respiratory muscle. Respiratory pressures are specific and sensitive indices of respiratory muscle strength. Black and Hyatt9 have demonstrated that values of MIP and MEP are altered even before there is alteration in other commonly used pulmonary function tests. Hence evaluation of respiratory muscle strength is important for physiological as well as clinical point of view.

Present study shows significant improvement in FEV1, PEFR after yoga training. In accordance to our findings, Joshi et al and Madanmohan et al showed statistically significant increase in FEV1, PEFR after yoga training which were statistically significant.[4,6] Makwana K et al concluded that practice of yoga seems to be beneficial for respiratory efficiency.[3] He found, significant increases in FEV1 after yoga training of 10 weeks. Behera D et al also found improvement in lung function parameters after the practice of yoga.[10] Bhole et al had reported a significant increase in vital capacity after three weeks of yoga training.[1] Candy S et al in his study, found that there was improvement in FEV1 and PEFR after yoga training in asthmatic patients.[11] Nagarathna R et al also studied the effects of pranayama and yoga on asthmatic patients and found that there were significant changes in these parameters at the end of 12 weeks of yoga training.[12]

Most of the effects could be explained on the following basis.[13-16]

- By asana 'squeezing and soaking' process occurs in which a respiratory organ is constricted (squeezed) during an asana and then upon coming out of position, subsequently released, upon which body 'soaks' it with an excess fresh, nutrient rich blood.
- Asanas have additional respiratory benefit of stretching and massaging diaphragm, a primary muscle of respiration.
- There occurs strengthening of respiratory musculature incidental to regular practice of pranayamic breathing during which the lungs and chest inflate and deflate to fullest possible extent and muscles are made to work to maximal extent.
- Lung inflation near to total lung capacity is a major physiological stimulus for release of lung surfactants and prostaglandin into alveolar spaces which increases lung compliance and decreases bronchiolar smooth muscle tone and airway resistance.[13,14]
- PEFR depends on elastic recoil of lungs, airway resistance and strength of expiratory muscles.15 Yoga influences on elastic recoil of lung and airway resistance. Yoga may increase the strength of expiratory muscle and increase in peak expiratory flow rate seen.
- By practicing pranayama, the various reflex mechanisms that control the respiratory center may get altered or modified by producing a strong cortical force which in turn alters the autonomic nervous system so that it shifts towards the parasympathetic dominance and has favorable effects on respiratory system.
- By Deep Relaxation technique the sympathetic nervous system calms down which help in decreasing bronchiolar smooth muscle tone and airway resistance.
- Yogic practices cause one to take slower and deeper breath with full awareness, it directly and indirectly benefit the respiratory system. All the systems of body are closely related and much of the beneficial effect of yogic practices comes from their holistic effect on the body as a unified organism.

All above results show that yoga has positive impact on pulmonary functions, respiratory pressure and proved that yoga is beneficial in improving physiological function.

CONCLUSION

From our study we conclude that yoga training for four months improves lung functions, strength of inspiratory and expiratory muscles in children. We also conclude if yoga is practiced since childhood, it can form a strong foundation for healthy adult life

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