ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Cardio-Respiratory Changes in Response to Short Term Practice of Yoga.

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ABSTRACT

Yoga is an ancient way of life devised to improve the quality of life of an individual. Practice of yoga is proposed to benefit the cardio- respiratory health. This study was intended to assess the influence of short term practice of yoga for a month on Heart rate variability (HRV) and pulmonary function test. Twenty two healthy female volunteers in the age group of 30-60 years who practiced yoga for a month were included in the study. Heart rate variability was assessed by using HRV device (RMS Vagus, India) and pulmonary functions were assessed by computerized spirometry (Respmed Spirobank G, MIR SRL, Italy). Pre interventional assessment of HRV and spirometry was done in these subjects. Practice of yoga that included a set of physical postures (*asanas*), breathing techniques (*pranayama*) and meditation (dhyana) done for duration of one month under the guidance of a certified yoga instructor. Post interventional assessment of HRV and spirometry was done. Statistical analysis was done to compare the changes using paired t test and Wilcoxan sign ranked test. There was a significant reduction in low frequency (LF) component of HRV from 31.25 (20.5-39.28) to 26.15 (17.57 - 29.30) and increase in Forced Vital Capacity (FVC), Forced expiratory volume in one second (FEV_1) and Peak expiratory flow rate (PEFR) from 94.46 ± 13.55 to 96.31 ± 14.27 , 93.46 ± 15.32 to 95.73 ± 16.48 and 79.96 ± 15.5 to 85.38 ± 18.45.($p<0.05$).
Yoga on regular practice for a month improves Cardio-respiratory health in healthy females.

Keywords: Yoga, Heart rate variability, pulmonary functions

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ISSN: 0975-8585

INTRODUCTION

Yoga is a way of life known to mankind from the days of ancient civilization. It has 8 components *Yama, Niyama, Asana, pranayama, Prathyahara, Dharana, Dhyana* and *Samadhi* [1]. Practice of Asanas (Physical postures of yogic exercise)*, pranayama* (Breathing exercises) and *Dhyana* (meditation) have been reported to produce beneficial effect on Cardio-respiratory system. Regular practice of yoga reduces stress resulting in beneficial effect on autonomic function [2, 3] and an improvement in the pulmonary functions [4].

Evaluation of HRV is one of the simple tools to evaluate the autonomic modulation of the heart. There are time domain and frequency domain parameters in HRV which analyze variation in time and frequency of the consecutive heart beats. HRV studies have shown beneficial effect of yoga on cardiac autonomic balance and reduction of the stress level in individuals [5].

The time domain parameters analyzed are SDNN (Standard deviation of normal to normal) indicating over all variability of heart rate. RMSSD (Root mean square of standard deviation), NN50 (Number of normal to normal wave with difference of more than 50 millisecond) and PNN50 (Percentage of wave with the difference of more than 50 millisecond) which are markers of parasympathetic activity on heart.

The frequency domain parameters are include LF (Low frequency) a marker of sympathetic activity, HF (High frequency) a marker of parasympathetic activity, LF/HF ratio is a marker of autonomic balance [6]. The earlier studies have reported conflicting results about the perceived benefits of short term practice of yoga.

Muralikrishnan K et.al demonstrated significant change in both time domain and frequency domain parameters in people practicing yoga for 8 weeks suggestive of improvement in parasympathetic tone [7]. Paap ME et.al have reported no significant alteration in frequency domain parameters after 8 weeks practice of yoga [8].

Spirometry was used to assess parameters namely FVC (Forced vital capacity), FEV_1 (Forced Expiratory volume in 1^{st} second), ratio of FEV_1/FVC and PEF (Peak Expiratory Flow Rate). Earlier studies have shown improvement in lung functions in people practicing yoga. Birkel DA et.al have demonstrated an improvement in vital capacity following practice of yoga in smokers [4]. Singh S et.al, have shown an improvement in FVC, FEV_1 and PEF in asthma patients [9]. Fulambarker A et.al showed improvement in vital capacity and peak expiratory flow rate in COPD patients after practice of yoga for 6 weeks [10].

This study is undertaken to assess the effect of short term practice of yoga for duration of one month on HRV and lung functions in clinically healthy females.

ISSN: 0975-8585

MATERIALS AND METHODS

The study was performed in Department of Physiology, M S Ramaiah Medical College, Bangalore. The study protocol was approved by the institutional scientific and ethics committee.

Healthy female volunteers willing to practice yoga regularly for a month in the age group of 30-60 years were recruited for the study. They had no previous experience of practice of yoga. Subjects with cardio-vascular, metabolic diseases, smokers, alcoholics, on treatment with drug having potential to modify autonomic functions, and who had practiced yoga earlier were excluded from the study.

The recording protocol was explained and informed consent was obtained from all the subjects. Detailed medical history was taken from all the participants and a detailed clinical examination was done. Subjects were trained under the guidance of certified yoga instructor. Subjects practiced yoga for one hour daily for a period of one month.

Pre-intervention HRV and spirometry recording of the subjects were done after the recruitment.

The practice of yoga included 5 minutes of stretching exercises and prayer, 20 minutes of set of asanas, 20 minutes of *pranayama*, 15 minutes of meditation and relaxation. Post-interventional recording was done in subjects who successfully completed one month practice of yoga.

ECG was recorded in Lead II for 15 minutes in supine position after a rest of 15 minutes.

The ECG was analyzed using RMS Vagus HRV software (RMS, India). The analysis from the HRV software provided information about time domain (SDNN, RMSSD, NN50, PNN50) and frequency domain parameters (LF, HF, LF/HF ratio).

Spirometry was done to assess the pulmonary functions using Respmed Spirobank G, MIR SRL, Italy. The subjects were asked to perform three trials with at least two reproducible results (differences between the two highest recorded values were not more than 5%) according to the recommendations of American thoracic society. The parameters assessed were FVC, FEV_1, ratio of FEV_1/FVC and PEFR.

Statistical Analysis

The statistical analysis was done using SPSS17. The pre and post-intervention values of HRV and spirometry were tabulated, co-efficient of variation was calculated to evaluate pattern of distribution. The values following normal distribution were expressed as Mean ± SD. Parametric test was used to analyze the data by paired t test. The values following skewed

ISSN: 0975-8585

pattern were expressed as median and inter quartile range (IQR), and non-parametric test was used to analyze data by Wilcoxan signed rank test.

RESULTS AND DISCUSSION

Thirty volunteers were recruited for the study out of which 22 completed training sessions successfully. The age, height, weight and BMI were 43.6 ± 9 years, 152 ± 3.9 cm, 64 ± 11 kg, 27.6 ± 4.3 respectively. After practice of yoga for a month, there was a significant decrease in the frequency domain in LF component of HRV ($p<0.05$). There was an increase in RMSSD value. However there was no significant change in the time domain parameters, and other frequency domain parameters like HF and LF/HF ratio. (Table-1)

Table 1: Comparison of HRV parameters before and after yoga training

HRV parameters	Before yoga training Median (IQR)	After yoga training Median (IQR)	P value
SDNN(ms)	29.57 (22.78 - 39.14)	35.79 (22.14 - 47.17)	0.18
RMSSD(ms)	17.71 (12.79 - 32.31)	26.11 (18.66 - 39.35)	0.08
NN50	19.0 (6.0 - 78.0)	66.50 (3.50 - 207.25)	0.23
PNN50 (%)	1.4 (0.50 - 11.95)	6.45 (0.42 - 20.60)	0.27
LF($ms^{2)}$	31.25 (20.50 - 39.28)	26.15 (17.57 - 29.30)	0.049 *
HF($ms^{2)}$	17.10 (8.30 - 24.62)	21.05 (12.2 - 33.27)	0.28
LF/HF	1.77 (1.14 - 3.13)	1.2 (0.7 - 1.9)	0.37

Further, there was a statistically significant improvement in values of FVC, FEV_1 (Table 2) and PEFR ($p < 0.05$). (Fig 1)

Table 2: Comparison of pulmonary functions before and after yoga training.

PFT parameters	Before yoga training (Mean± SD)	After yoga training (Mean± SD)	P value
FVC (L)	94.46 ± 13.55	96.31 ± 14.27	0.049*
FEV_1 (L)	93.46 ± 15.32	95.73 ± 16.48	0.01*
FEV_1/FVC	104.54 ± 8.77	103.0 ± 11.81	0.27

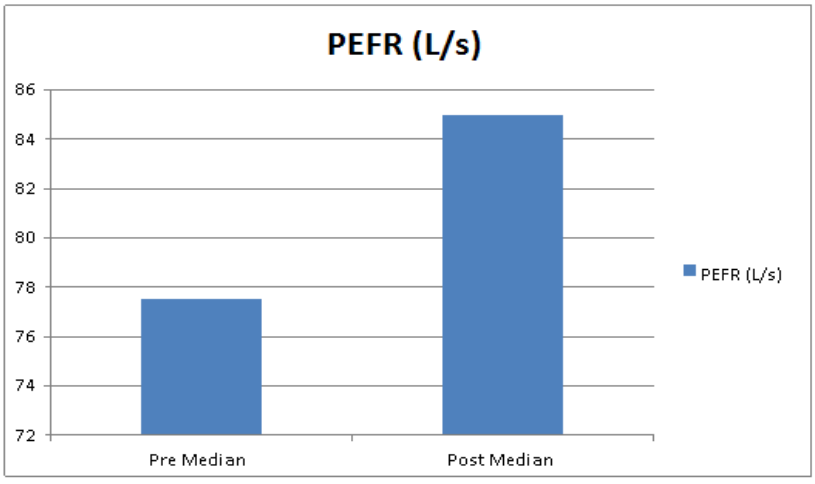

Figure 1: Comparison of PEFR before and after yoga training.

ISSN: 0975-8585

DISCUSSION

In the present study, practice of yoga for a month showed a significant decrease in sympathetic activity. Further, there was a trend towards increase in parasympathetic activity and overall change in heart rate variability. These changes suggest that frequency domain parameters more likely to change compared to time domain parameters during the short term practice of yoga. Thus practice of yoga produced positive benefits on cardiac autonomic tone. Earlier study has reported 8 weeks practice of yoga had bought about changes in frequency domain parameters with significant decrease in LF and increase in HF value suggesting parasympathetic dominance. There was an increase in time domain parameters suggesting increase in overall variability of heart [7]. P*ranayama* is a breathing technique which is based on modulating the breathing pattern this reduces the stress by focusing the attention of the subject on breathing and reducing cortical activity in the brain. Pranayama and dhyana helps to achieve emotional balance, inhibits the areas in amygdala responsible for fear, aggression and rage. It stimulates the reward or pleasure centers in the median forebrain and other areas leading to a state of bliss and pleasure. This in turn lowers anxiety, respiratory rate, heart rate and blood pressure [11,12]. The regular practice of yoga is known to elevate mood and relieve the stress by increasing serotonin levels. It reduces monoamine oxidase which breaks down serotonin, thus maintaining serotonin for longer duration in the brain [13]. The practice of pranayama increases parasympathetic dominance thereby reducing the stress on heart.

In the present study, there was increase in FVC, FEV_1 and PEFR following practice of yoga for a month. The improvement in pulmonary function can be attributed to practice of *asanas*, *pranayama* like *kapalabati*, *khumbhaka.* These practices increase muscular strength and endurance of muscles in the thoracic cage, in turn improving the lung performance [14,15]. Practice of yoga helps in reducing the heart rate and blood pressure. It improves blood supply to organs, thereby increasing oxygenation, and removing the metabolic waste from the body [13]. The reduced heart rate and blood pressure are due to the decreased sympathetic activity with a shift in the autonomic balance towards parasympathetic dominance. Decreased sympathetic tone causes vasodilation and increases the blood supply to various tissues in the body. Pranayama increases oxygen saturation, enhances the aerobic metabolism in the body [13]. Due to increased blood flow, body is able to remove the metabolic waste more effectively. Practice of asanas enhances the efficiency of skeletal muscles [14,15]. They perform better with effective utilization of the oxygen and nutrients. Thus the load on the heart and respiratory systems are reduced. These physiological adaptations improve the work performance of the individual practicing yoga.

CONCLUSION

Short term practice of yoga helps in reducing the sympathetic tone and shift of autonomic balance towards parasympathetic dominance.

It improves the functioning ability of lungs. The early, significant cardio-respiratory benefits are observed even with one month of practice of yoga.

ISSN: 0975-8585

ACKNOWLEDGEMENT

The authors thank yoga teachers Mr. Raghu H G and Mrs. Geetha for training the participants for this work

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