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# Effect of Meditation on Cardiovascular and Respiratory Parameters

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**Abstract**

*Aim:* The aim of present study was to study the effect of Anapanasati meditation on cardiovascular and respiratory parameters among short term meditators (practicing meditation for less than 6 months), long term meditators (practicing meditation for 6months to 5 yrs) and nonmeditators. *Method:* The study included 30 short term, 30 long term meditators & 30 non meditators. Systolic blood pressure & diastolic blood pressure were recorded using diamond sphygmomanometer, Heart rate was measured using 108 Cardiodart ECG mahine. Pulmonary function tests: FVC, FEV1, FEV1/FVC, FEF 25-75%, PEFR were measured using Helios 401 medspiror (spirolyser)- A. computerised spirometer. One way ANOVA was used for simultaneous multiple group comparison followed by Post-hoc Tukey's test for group-wise comparisons. *Results & Conclusion*: On analysis of results, it was found that there was statistically significant decrease in heart rate, systolic blood pressure & diastolic blood pressure in long term meditators when compared to short meditators and nonmeditators ($p < 0.001$). There was also statistically significant decrease in heart rate in short term meditator when compared to nonmeditators ($p < 0.01$). There was statistically significant increase in both actual and % predicted values of FVC, FEV1, FEV1/FVC in long term meditators and short term meditators compared to non meditators ($p < 0.001$). There was also statistically significant increase in both values of FVC, FEV1, FEV1/FVC in long term meditators when compared to short term meditators ($p < 0.001$). Long term meditators showed highly statistically significant increase in both actual and % predicted values of $FEF_{25-75\%}$, PEFR when compared to short term meditators and non meditators ($p < 0.001$). Study concludes that meditation provides significant improvement on cardiovascular and respiratory parameters. Improvement continues further by increasing the duration of meditation.

**Keywords:** Meditation; Cardiovascular Parameters; Pulmonary Function Tests.

## Introduction

Modern man is the victim of stress and stress related disorders. As stress is unavoidable, these days a simple, inexpensive yet powerful age-old technique, meditation is being increasingly used and studied [1-5]. Documented scientific evidences strongly indicates that meditation has promotive, preventive as well as curative potential as a non-pharmaco therapeutic and safe modality. It can be used as an effective life style adjunct to medical treatment to improve quality of life of the patients [1,3]. Although much research work has been done on meditation most of them are on diseased condition and on few specific types of meditations like-Trancedental meditation [3], Rajayoga meditation [5] and OM meditation [6]. Other forms of meditation are not extensively studied.

Most of the studies on meditation are on diseased states [3,6]. There are less studies to see effect on healthy individuals. And also most studies are on yoga where meditation will be coupled with practice of set of asanas and pranayamas [9]. There are less studies to see effect of meditation alone without

incorporating asanas and pranayamas.In Anapanasati meditation, meditator sits in comfortable sitting posture, with eyes closed, legs crossed and arms clasped. Meditator consciously concentrates on his breath. So it is simple form of meditation on breath [7,8]. Hence, present study is undertaken to study the effect of Anapanasati meditation oncardiorespiratory parameters among healthy meditators and to compare the above parameters with that of non meditators, with a strong hope that early precaution can be taken to reduce the incidence of stress-related diseases of mind and body by bringing ancient technique-meditation to modern clinic.

*Objectives*

- To assess the following parameters in meditators (long term and short term) and nonmeditators.
- Cardiovascular parameters - systolic blood pressure, diastolic blood pressure and heart rate.
- Respiratory parameters- FVC, $FEV_1$, $FEV_1$/FVC, $FEF_{25-75\%}$, PEFR.
- To study the relation between effect of Anapanasati meditation on above mentioned parameters and duration of practice of meditation.
- To compare all the parameters between short term meditators, long term meditators and nonmeditators.

**Methodology**

The present study was conducted in Department of Physiology, JJM Medical College. It was carried out from April 2011 to March 2012. The study was undertaken to study the effect of Anapanasati Meditation on lipid profile and lipid peroxides among short term meditators and long term meditators and to compare with that of non meditators.

*Study Group*

In this study, 60 meditators were taken from Karnataka Pyramid DyanaPrachara Trust ®. Davangere Branch. This group was divided into 30 each based on duration of practice Anapanasati meditation. Short term meditators: meditating for 6 months to 5 years Long term meditators: meditating for more than 5 years.

*Control Group*

Thirty normal age & sex matched subjects from general population who were not exposed to any meditation or relaxation technique were included and were labelled as nonmeditators. Dietary habits and physical exercise were matched between study and control groups.

*Inclusion Criteria*

- Healthy males and females in the age group of 45 to 60 years.
- Short term meditators were those who had been practicing meditation from 6 months to 5 years.
- Long term meditators were those who had been practicing meditation for more than 5 years.
- Age and sex matched healthy individuals not exposed to any meditation or relaxation technique were included as controls.

*Exclusion Criteria*

- Age below 45 years and above 60 years.
- Presence of obesity, hypertension, diabetes mellitus, ischemic heart disease, congestive heart failure.
- Chronic smokers and chronic alcoholics.

**Method**

Meditators practice Anapanasati meditation, in the meditation centre regularly for 1 hour everyday between 6.A.M. to 7A.M. ANA means-breath in, PANA means-breath out, SATI means-to be with. ANAPANASATI means–BE WITH THE BREATH [8,9]. A quiet place is chosen., any comfortable sitting position can be taken. Hands should be clasped, legs should be crossed and eyes should be closed.

Notice your breath …..Inhale slowly ……Exhale slowly …….Let your breath sink in and out ….Your breath is a rhythm of calm …..Follow your breath …..Be still ….Be your breath. Be still….be still….be still

The nature of test was explained to them and informed consent was obtained. The procedure was in accordance with the ethical standards of committee of the institute. Collection of data was done between 9.00 am to 12.00 pm. Sufficient time was given (15 min) for the subjects to mentally and physically relax before doing the test. Abriefhistory, general physical examination and clinical examination of all the systems were done to exclude medical problems and to prevent confounding of results.

Recording of Anthropometrical Parameters, like height, weight, BMI (Body mass index)- calculated as Weight (kg)/Height$^2$ (m).

*Recording of Cardiovascular parameters*

- Blood pressure was recorded using mercury Sphygmomanometer (Diamond) in supine position in the right upper limb by auscultatory method. Similarly three readings were taken at interval of 15 minute and average of three readings was calculated.
- In the same resting condition, an electrocardiogram was recoded in Lead II (using CARDIART 108T, J8A,14901) and the average R-R interval of ten complexes was taken and the heartrate (HR=1500/ R-R interval) was calculated.

*Pulmonary Function Tests*

Pulmonary Function tests were carried out using a computerized spirometer, HELIOS 401 MEDSPIROR (SPIROLYSER). The subject was motivated prior to the initiation of manoeuvre. He was made sit on a stool, then place the mouth piece firmly in his mouth. He was instructed to take a full breath through nostrils, then close the nose with nose clip and then close lips around the mouth piece and blow out as hard and fast as possible and was followed by a maximum forced deep inspiration. and expiration once begins should be continued without a pause. A minimum exhalation time of 6 seconds was applied to obtain maximal FVC (Forced Vital Capacity) results. A minimum of three acceptable Forced Vital Capacity (FVC) manoeuvreswere obtained. The PFT with the best manoeuvre was selected.

*Statistical Analysis*

The results were expressed as Mean±Standard deviation for continuous data , and Number and Percentage for discrete data. One way ANOVA was used for simultaneous multiple group comparison followed by Post-hoc Tukey's test for group-wise comparisons. Categorical data was analysed by Chi-square test.

SPSS version 16 software was used for all the analysis.

1. p Value > 0.05 is taken as ' not Significant' .
2. p Value < 0.05 is taken as 'Significant' .
3. p Value < 0.001 is taken as 'Highly Significant'

## Results

Analysis of the basic characteristics of 90 subjects, showed no statisticallysignificant difference in age, sex distribution, BMI, physical activity, diet. when values of all three group were compared (Table 1,2). None of them were smokers or consumed alcohol.On analysis of results, it was found that there was statistically significant decrease in heart rate, systolic blood pressure & diastolic blood pressure in long term meditators when compared to short meditators and nonmeditators (p <0.001). There was also statistically significant decrease in heart rate in short term meditator when compared to nonmeditators (p <0.01) (Table 3).

**Table 1:** Comparison of AGE and Physical characteristics of Long term, Short term and Non meditators

| Groups | Age (yrs) | Ht(mts) | Wt(Kgs) | BMI (kg/ m$^2$) |
|---|---|---|---|---|
| Long term med. | 52.8± 4.9 | 1.67± 0.05 | 64.5± 7.3 | 23.0± 2.3 |
| Short term med. | 51.5± 4.4 | 1.64± 0.05 | 62.9± 4.8 | 23.4± 1.6 |
| Non – med. | 52.9± 5.0 | 1.65± 0.07 | 65.2± 7.1 | 23.7± 2.0 |
| Anova | | | | |
| F | 0.85 | 1.64 | 0.99 | 0.92 |
| P | 0.43 NS | 0.20 NS | 0.38 NS | 0.40 NS |
| Groupwise comparisons (P - values) | | | | |
| 1 – 2 | NS | NS | NS | NS |
| 1 – 3 | NS | NS | NS | NS |
| 2 – 3 | NS | NS | NS | NS |

All the values are expressed as Mean ± SD
Multiple group comparision: One way ANOVA , F-Test
Groupwisecomparision: Post – hoc Tukey's test
* p < 0.05 S-Significant, ** p < .001 HS- highly significant p > 0.05 NS Not Significant

There was statistically significant increase in both actual and % predicted values of FVC, FEV1, FEV1/FVC in long term meditators and short term meditators compared to non meditators (p <0.001) There was also statistically significant increase in both values of FVC, FEV1, FEV1/FVC in long term meditators when compared to short term meditators (p <0.001) (Table 4).

Long term meditators showed highly statistically significant increase in both actual and % predicted values of $FEF_{25-75\%,}$ PEFR when compared to short term meditators and non meditators (p <0.001). There was

**Table 2:** Comparison of Gender distribution, Physical activity & diet between Long term, Short term and Non meditators

| Variables | Long term Meditators n (%) | Short term Meditators n (%) | Non meditatorsn (%) | P |
|---|---|---|---|---|
| Gender | | | | |
| Male | 15 (50) | 15 (50) | 15 (50) | 0.43 |
| Female | 15 (50) | 15 (50) | 15 (50.7) | |
| Physical exercise | | | | |
| Sedentary | 24 (80) | 24 (80) | 20 (83.3) | 0.98 |
| Non – sedentary | 6 (20) | 6 (20) | 5 (16.7) | |
| Diet | | | | |
| Veg | 19 (63.3) | 17 (56.7) | 15 (50) | 0.56 |
| Mixed | 11 (36.7) | 13 (43.3) | 15 (50) | |

p > 0.05 NS Not Significant

**Table 3:** Comparison of Cardiovascular parameters between Long term, Short term and Non meditators

| Group | HR(bpm) Mean± SD | SBP(mm Hg) Mean± SD | DBP(mm Hg) Mean± SD |
|---|---|---|---|
| Long term med. | 66.0± 3.9 | 110.1± 4.2 | 70.1± 2.5 |
| Short term med. | 81.5± 4.9 | 126.8± 6.9 | 78.1± 5.0 |
| Non – med. | 86.0±5.4 | 131.4± 6.2 | 82.5± 6.3 |
| Anova | | | |
| F | 140.4 | 110.2 | 50.4 |
| P | <0.001 | <0.001 | <0.001 |
| Groupwise comparisons (P - values) | | | |
| 1 – 2 | ** | ** | ** |
| 1 – 3 | ** | ** | ** |
| 2 – 3 | 0.01* | 0.01* | 0.01* |

All the values are expressed as Mean ± SD
Multiple group comparision: One way ANOVA , F-Test
Groupwisecomparision: Post – hoc Tukey's test
* p < 0.05 S-Significant, ** p < .001 HS- highly significant p > 0.05 NS Not Significant

**Table 4:** Comparison of FVC, $FEV_1$ and $FEV_1$/FVC between Long term, Short term and Non meditators

| Group | FVC(L) | | FEV 1(L) | | FEV 1 / FVC | |
|---|---|---|---|---|---|---|
| | Actual | Pred. (%) | Actual | Pred (%) | Actual | Pred (%) |
| Long term med. | 3.65± 0.31 | 105.7± 6.9 | 3.63± 0.35 | 125.5± 6.1 | 99.7± 7.7 | 118.7± 8.9 |
| Short term med. | 3.17± 0.51 | 91.8± 4.1 | 2.64± 0.38 | 90.0± 3.0 | 83.6± 4.1 | 98.2± 5.0 |
| Non – med. | 2.58± 0.34 | 77.7± 6.3 | 1.86± 0.32 | 67.1± 5.5 | 72.3± 8.8 | 86.7± 9.1 |
| Anova | | | | | | |
| F | 54.45 | 169.37 | 191.63 | 1029.0 | 110.57 | 127.42 |
| P | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Group wise comparisons (P - values) | | | | | | |
| 1 – 2 | ** | ** | ** | ** | ** | ** |
| 1 – 3 | ** | ** | ** | ** | ** | ** |
| 2 – 3 | ** | ** | ** | ** | ** | ** |

All the values are expressed as Mean ± SD
Multiple group comparision: **One way ANOVA , F-Test**
Groupwisecomparision: **Post – hoc Tukey's test**
* p < 0.05 S-Significant ** p < .001 HS- highly significant, p > 0.05 NS Not Significant

**Table 5:** Comparison of $FEF_{25-75\%}$, PEFR between Long term, Short term and Non meditators

| Group | FEF 25 – 75 %(L/sec) | | PEFR(L/sec) | |
|---|---|---|---|---|
| | Actual | Pred. (%) | Actual | Pred. (%) |
| Long term med. | 5.01± 0.51 | 118.7± 8.5 | 10.73± 1.07 | 119.6± 8.5 |
| Short term med. | 3.80± 048 | 91.2± 6.9 | 8.04± 0.65 | 92.7± 6.6 |
| Non – med. | 3.71± 0.41 | 88.5± 7.7 | 7.73± 0.98 | 88.3± 10.7 |
| Anova | | | | |
| F | 70.97 | 142.0 | 96.8 | 111.91 |
| P | <0.001 | <0.001 | <0.001 | <0.001 |
| Groupwise comparisons (P - values) | | | | |
| 1 – 2 | ** | ** | ** | ** |
| 1 – 3 | ** | ** | ** | ** |
| 2 – 3 | 0.73 NS | 0.37 NS | 0.42 NS | 0.13 NS |

All the values are expressed as Mean ± SD
Multiple group comparision: One way ANOVA , F-Test
Groupwisecomparision: Post – hoc Tukey's test
* $p < 0.05$ S-Significant, ** $p < .001$ HS- highly significant, $p > 0.05$ NS Not Significant

increase in both values of $FEF_{25-75\%}$ in short term meditators when compared to non meditators, but the increase was not statistically significant p (>0.05) (Table 5).

## Discussion

*Cardiovascular parameters* Meditation is described as wakefulhypometabolic state by Herbert Benson [4,9]. Meditation produces relaxation response - a self induced reduction in activity of sympathetic nervous system. It is opposite of the hyperactivity of nervous system associated with fight- flight response [2]. The above results could be due to hypometabolic state obtained by meditation [9].

In meditation, d slowly a new balance between the sympathetic and parasympathetic systems is achieved. So meditation brings greater autonomic stability [10]. Shift in the balance towards parasympathetic system will lead to decrease in heart rate and blood pressure [5].

During meditation, the eye are closed so that one of the most powerful sensory input is cut off which may otherwise provoke the thought process. The subject shifts his attention on breathing process. Thus his awareness turns inward and gets diverted from external objects. The analytical activity of the cortex is not given scope and thus anxiety or tension as well as psychological accompaniments are reduced. The meditator experience complete relaxation [11]. This could be another reason for above results.

Meditation produces specific neural activation patterns involving decreased limbic and arousal in brain [12]. During stress there is activation of hypothalamic- pituitary- adrenocartical (HPA) axis which leads to secretion of several hormones, including adrenalin, cortisol [13]. Studies have shown reduction in hormonal levels like adrenalin, cortisol, lactate, dopamine with practice of meditation [14]. Decrease in release stress-related hormones could also be another reason for reduction in heart rate, systolic and diastolic blood pressure in our study.

Increasing the duration of meditation further causes improvement in physiological process involved . This improvement has been seen in our study, as long meditators (more than 5 years) have maximum reduction in the heart rate and blood pressure.

*Pulmonary Function Test*

Our study is consistent with following studies Vyas R et al. [5], Biju B et al. [15], Sayyed A et al. [16] With practice of meditation for few weeks the bulbopontine complex is adjusted to new pattern of breathing which is slower than its basal rhythm [15]. Which prolong the phase of inspiration and expiration by stretching lungs to their fullest extent.

During slow breathing the duration of inspiration and expiration, in turn the tidal volume will increase, increasing vital capacity. This could be one of the reason for increase in the pulmonary function test parameters in our study and also during meditation there will be greater relaxation of respiratory muscles induced by supraspinal mechanisms which

increases expiratory reserve volume contributing to rise in vital capacity. Relaxation of respiratory muscles could also be another reason for improvement in lung function test in our study [5,16].

Lung inflation to near total lung capacity, as it occurs in meditation is a major physiological stimulus for release of surfactant into alveolar spaces which increases lung compliance. The elastin and collagenfibers elongate to a greater extent, thus increasing the compliance of lung. Release of prostaglandins during lung inflation decreases bronchial smooth muscle tone. Meditation, by its relaxing effects, reduces the blood levels of adrenalin and nor-adrenalin and increases levels of opiod neuropeptides, thereby withdraws the bronchoconstrictor effect and modulates the bronchial smooth muscle tone [17]. This could be one more reason increase in respiratory functions in our study especially $FEF_{25-75\%}$ and PEFR. Improvement in these parameters in long term meditators indicate continued alteration of the physiological processes involved and emphasize the effect of duration of meditation.

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