

ORIGINAL RESEARCH

Comparison of Autonomic Function using Valsalva Ratio, Heart Rate, and Blood Pressure in Meditators and Nonmeditators

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ABSTRACT

Introduction: In recent years, the various health benefits of meditation have been acknowledged by the scientific community as well as by the public. Apart from its physiological benefits, it can also improve the psychological and spiritual well-being. A case-control study was planned to investigate the effect of Rajyoga Meditation on cardiovascular autonomic activity in meditators and nonmeditators.

Materials and methods: The study was conducted on 100 subjects, randomized into two groups: meditators (n=50; age 35.80±7.69 years) and nonmeditators (n=50; age 36.76±6.38 years). The meditator group practiced meditation for 30 minutes in the morning as well as in the evening. The control group did not practice any type of meditation or relaxation techniques. The cardiovascular parameters – heart rate (HR), systolic (SBP) and diastolic blood pressure (DBP), and Valsalva maneuver tests – were performed in both the groups in the same environmental conditions. The data were compiled and analyzed using unpaired t test.

Results: The mean values of HR in meditators and the control group were 77.08±5.39 and 80.68±5.71 respectively, and the difference was statistically significant (p<0.001). The mean values of SBP in meditators and nonmeditators were 124.60±5.39 and 129.56±4.30 mmHg respectively, while those for DBP were 77.84±4.65 and 80.80±4.78 mmHg respectively. The difference in both was statistically significant. In meditators, Valsalva ratio was 1.60±0.20, while in nonmeditators, it was 1.33±0.13, and the difference was highly significant.

Conclusion: Significant improvement is seen in physiological, cardiac, and parasympathetic parameters in Rajyoga meditators. A shift of the autonomic balance toward the parasympathetic side is seen. By purposefully energizing the parasympathetic system by meditation, we can combat the ill effects of stress and help heal many health conditions.

Keywords: Autonomic nervous system, Rajyoga meditation, Valsalva ratio.

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INTRODUCTION

Meditation is the science of peace in one's personal and social life, and it has been extensively explored by scientists. It helps in achieving harmony between mental, physical, and spiritual being. Meditation has been termed a "wakeful, hypometabolic state of parasympathetic dominance."¹

Meditation is an intricate approach that causes autonomic system modifications, involving several correlated cognitive approaches. Meditation balances parasympathetic and sympathetic functions and causes a wakeful hypometabolic physiological condition; these are both long-term and short-term benefits.² Meditation decreases stress and increases autonomic stability caused by inhibiting limbic arousal in the brain by producing precise neural activation patterns.³ Yoga including relaxation therapy is known to improve cardiovascular autonomic functions. Meditation is associated with reduced sympathetic adrenergic receptor sensitivity, which might affect cardiovascular response during stress.⁴ There is appearance of frontal midline theta rhythm in electroencephalogram during meditation, which reflects concentration of mind as well as meditative state of relief from anxiety and decreased sympathetic activity. This suggests that there is a close relationship between activity of medial frontal neural circuitry and autonomic functions. As a result, central nervous system functions are possibly controlled by yoga and meditation.⁵

Practice of transcendental meditation has been found to cause a decrease in autonomic parameters, such as heart rate (HR), respiratory rate (RR), blood pressure (BP), skin conductance, adrenergic activity, and increased alpha activity in electroencephalogram.⁶⁻⁸

Meditation enhances parasympathetic activity and improves cardiovascular parameters. A simple way to prove this is to find out the baroreceptor activity by performing Valsalva maneuver. There is a need to prove and consolidate this hypothesis. The present study was

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therefore undertaken to study the effect of Rajyoga meditation on HR, BP, and baroreceptor reflex activity in meditators and compare it with values obtained from nonmeditators. Baroreceptor reflex activity was measured by using noninvasive technique, i.e., Valsalva maneuver. The meditation technique, which was practiced by the subjects enrolled in the study, was Rajyoga meditation. This meditation technique helps in the relaxation of body, mind, and behavioral changes causing positive attitude.⁹

MATERIALS AND METHODS

The present study was a case-control study. Before the start of the study, institutional ethics committee approval was obtained. Hundred healthy adult subjects in the age group 25 to 50 years were selected for the study. Out of these, 50 were meditators and 50 nonmeditators. The 50 meditators selected for the study were from Brahma Kumari Ashram in the city, practicing Rajyoga meditation for more than 2 years. The nonmeditators were selected from the general population. Both the groups were comparable for values of age, height, weight, and body surface area (BSA). Written informed consent was taken from the participating subjects.

The recording of HR and BP and Valsalva response was determined in all the subjects in the morning hours between 8 and 10 am during the months of August to November. Subjects selected were nonalcoholic, nonsmokers, not taking any drugs, and those having similar dietary habits and physical and mental activities in the work and home atmosphere. All subjects were clinically examined. Data on physical characteristics, such as age, height, weight, and body mass index, were obtained. History of fainting attacks was asked. The HR was measured with the stethoscope being kept over the apex for one full minute. The BP was recorded with a standard mercury sphygmomanometer and three consecutive readings were taken. We calculated the mean of the three readings taken at an interval of 8 minutes.

The procedure was explained to the subjects prior to the investigation of Valsalva maneuver.

The Valsalva maneuver leads to sudden voluntary increase in intrathoracic and intraabdominal pressures provoked by straining.¹⁰ The subject was seated, connected to electrocardiogram leads, and BP cuff was tied on him/her. The nostrils were clipped. In this, the subject was asked to blow out into the rubber tube of the mercury manometer (40 mm test or Flack's Air-force test instrument) to create a pressure of 40 mm Hg and maintain it for 10 seconds. Electrocardiogram was recorded (lead II) for 1 minute before straining, 15 seconds during straining, and 30 seconds after the release of strain. Three such readings were taken at an interval of 15 minutes, and average was taken as the final reading. The "Valsalva ratio" was calculated as follows:¹¹

$$\text{Valsalva ratio} = \frac{\text{Longest RR interval after strain}}{\text{Shortest RR interval during the strain}}$$

Difference in the mean values for age, height, weight, BSA, and Valsalva ratio was subjected to unpaired t test. The test of significance for the difference in the two groups was analyzed by unpaired t test using Statistical Package for the Social Sciences (SPSS) 20 version.

RESULTS

Table 1 shows the anthropometric profile of 50 meditators and 50 nonmeditators. Both the groups were comparable for values of age, height, weight, and BSA.

In meditators, the mean age, height, weight, and BSA were 35.80 ± 7.69 years, 163.28 ± 5.70 cm, 56.24 ± 6.92 kg, and 1.59 ± 0.10 m² respectively. In nonmeditators, the mean age, height, weight, and BSA were 36.76 ± 6.38 years, 162.80 ± 6.95 cm, 58.30 ± 8.39 kg, and 1.61 ± 0.12 m² respectively.

Table 2 compares mean values of cardiovascular parameters in meditators and nonmeditators. The mean value of pulse rate was lower in meditators (77.08 ± 5.39) than the control group (80.68 ± 5.71), and the difference

Table 1: Anthropometric data of meditators and nonmeditators

Group	Age (years)	Height (cm)	Weight (kg)	BSA (m ²)
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD
Meditators	35.80 ± 7.69	163.28 ± 5.70	56.24 ± 6.92	1.59 ± 0.10
Nonmeditators	36.76 ± 6.38	162.80 ± 6.95	58.30 ± 8.39	1.61 ± 0.12

Table 2: Comparison between mean values of cardiovascular parameters in study and control groups

Parameters	Meditators (mean \pm SD)	Nonmeditators (mean \pm SD)	p-value	Significance
Pulse rate (beats/min)	77.08 ± 5.39	80.68 ± 5.71	<0.002	HS
SBP (mm Hg)	124.60 ± 5.394	129.56 ± 4.30	<0.000	HS
DBP (mm Hg)	77.84 ± 4.65	80.80 ± 4.78	<0.002	HS
Valsalva ratio	1.60 ± 1.20	1.33 ± 0.33	<0.001	HS

HS: Highly significant

was statistically significant ($p < 0.001$), The mean value of SBP in meditators was 124.60 ± 5.39 and in the nonmeditators was 129.56 ± 4.30 . This difference was also statistically highly significant. The mean value of DBP in the meditators was 77.84 ± 4.65 and it was lower than the values in the nonmeditators, i.e., 80.80 ± 4.78 . We also compared the Valsalva ratio between the two groups. In meditators, Valsalva ratio was higher (1.60 ± 0.20) than in nonmeditators (1.33 ± 0.13), and the difference was highly significant. A Valsalva ratio greater than 1.5 indicates the presence of the Valsalva response.¹²

The present study has reflected some of the effects of meditation, especially on the autonomic status, in individuals practicing Rajyoga meditation. Overall decrease in the mean values of HR, SBP, and DBP, as well as increased Valsalva response was observed in meditators in comparison with the values so obtained from nonmeditators.

There can be variation in body responses, depending upon the stage of meditation, i.e., at start of meditation, during meditation, and its aftereffects. Variation in parameters also depends on age, sex, and the duration of meditation performed per day along with the total duration in years of meditation done.¹³ Therefore, both meditators and controls were age, sex, height, and weight matched. A regular practice of meditation is believed to establish a hypometabolic state of parasympathetic dominance, which causes resetting of the level of metabolic functioning to a lower rate. The people who have been meditating for years show marked differences in their physiological response as well as their ability to control their own physiology compared with meditators who have only been practicing meditation for a short time. So, it has been stated that meditation modulates its physiological effects through autonomic nervous system.^{14,15}

The reduction in HR after regular meditation is associated with a blunted sympathetic activity. Similar trends in HR were noted in other studies.^{16,17} In the present study, there was a highly significant reduction in HR, SBP, and DBP, which can be attributed to modulation of autonomic activity with parasympathetic predominance and relatively reduced sympathetic tone.¹⁸ Meditation decreases the state of anxiety, lowering the sympathetic overactivity due to stress. This decreases the arterial tone and therefore the peripheral resistance causing reduction in DBP as well.¹⁹ While one of the studies on Rajyoga meditation showed a improvement in basic cardiorespiratory parameters in long-term meditators,²⁰ another study on Rajyoga meditation stated significant improvement in physiological cardiorespiratory functions in both short-term and long-term meditators. A significant decrease was seen in HR, RR, SBP, and DBP for 15 minutes as well as 30 minutes after meditation.²¹ The results of these studies are consistent with the present study.

The Valsalva ratio was higher, and the BP overshoot was lower in meditators compared with nonmeditators. These observations support that the regular practice of meditation, depending upon the years of meditation, increases parasympathetic activity and lowers the sympathetic activity. Valsalva maneuver is one of the tests to determine the parasympathetic activity and autonomic control of heart. It is a forced expiration against a closed glottis. The raised pressures have important effects on venous return, BP, and HR. Variations of the maneuver can be used either in medical examination as a test of cardiac function or autonomic nervous control of the heart.²²

Our study is consistent with a number of previous studies on cardiac and autonomic functions in meditators.²³⁻²⁵ There have been studies on practice of yoga, which is also a type of meditation. One of the studies by Bharshankar et al²⁶ and another by Khadka et al²⁷ also showed a significant decrease in HR, SBP, and DBP, as well as increase in Valsalva ratio in yoga practitioners. The Valsalva ratio, which is a marker of parasympathetic reactivity and baroreflex function, was found to be increased after yogic practices, indicating increase in parasympathetic reactivity and baroreflex sensitivity. Increase in parasympathetic activity/reactivity has obvious relation, possibly reciprocally decreasing sympathetic activity.

Our findings do not match those of Telles and Desiraju²⁸ on autonomic changes during "Om" meditation. The study revealed an increase in peripheral vascular resistance in subjects both during meditation and control periods, which is a sign of increased sympathetic tone, but a single model of sympathetic activation or overall relaxation may be inadequate to describe the physiological effects of a meditation technique.

The parasympathetic nervous system, when activated by rest, relaxation, and happy thoughts, is essential for balanced living and for all healing. Moving yourself into a healthy parasympathetic state and staying there as much of the time as possible helps heal all health conditions, both physical and emotional ones.

CONCLUSION

The present study signifies the role of Rajyoga meditation in the modification of responses of cardiac and autonomic parameters, tilting the scales and a shift from sympathetic to parasympathetic. The Valsalva ratio value was increased probably because parasympathetic tone had gradually built up in meditators. This study undoubtedly seems to link meditation to the world of science and demonstrates its power to modulate the autonomic nervous system. The study recommends meditation as a way to attain calmness and serene lifestyle having positive effects on physical and mental health.

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