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Original Research Article

Effect of yoga on sympathetic nervous system of human body

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ABSTRACT

Introduction: Yoga is a mind and body practice with a 5,000-year history in ancient Indian philosophy. Various styles of yoga combine physical postures, breathing techniques, and meditation or relaxation. Yoga is a psycho-somatic-spiritual discipline for achieving union and harmony between our mind, body and soul and the ultimate union of our individual consciousness with the universal consciousness.
Aims and Objectives: 1: To evaluate the effects of yoga on sympathetic nervous system in yoga practitioners above the age group of 35 years; 2: To compare the results of sympathetic function tests in yoga practitioners with that of non yoga practitioners in the same age group.
Materials and Methods: An observational cross sectional study was carried out in 50 normal yoga practitioners and 50 normal non yoga practitioners above the age group of 35 years. Yoga practitioners were selected randomly from different yoga centers in Shimoga. Non yoga practitioners were selected randomly among non teaching staff of Shimoga institute of medical sciences, Shimoga. The ethical clearance for the study was obtained from the ethical committee.
Results: In our study, there is significant decrease in the BMI (p=0.013), physiological parameters such as heart rate (p=0.002), respiratory rate (p=0.001) and blood pressure and in sympathetic tests there is significant decrease in DBP in yoga practitioners compared to non yoga practitioners.
Conclusion: It can be concluded that the regular practice of a set of yoga training blunted the sympathetic drive and lateralised the autonomic function towards parasympathetic control.

1. Introduction

The main aim of autonomic system of is to maintain the optimal internal environment (Homeostasis) of the body. It governs various body functions which are normally carried out without conscious control.[1]

Numerous studies indicate a strong association between compromised ANS (e.g. decreased vagal activity or increased sympathetic activity) and sudden cardiac and non sudden cardiac death. Lifestyle modifications are also increasingly recognized as important factors in the treatment, prevention and rehabilitation of cardiovascular disorders. One highly popular and currently researched lifestyle modification is yoga. Regular Yoga practice has been postulated to help in prevention of disease, in particular, to streamline autonomic functions, specifically by modulating vagal efferents.[2]

Hence the present study was designed to know the effects of yoga on sympathetic nervous system.

2. Aims and Objectives

To evaluate the effects of yoga on sympathetic nervous system in yoga practitioners above the age group of 35 years.

To compare the results of sympathetic function tests in yoga practitioners with that of non yoga practitioners in the same age group.

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3. Materials and Methods

An observational cross sectional study was carried out in 50 normal yoga practitioners and 50 normal non yoga practitioners above the age group of 35 years. Yoga practitioners were selected randomly from different yoga centers in Shimoga. Non yoga practitioners were selected randomly among non teaching staff of Shimoga institute of medical sciences, Shimoga. The ethical clearance for the study was obtained from the ethical committee.

3.1. Inclusion criteria

1. Study Group: Yoga practitioners attending yoga centers of both sex above the age group of 35 years in Shimoga.
2. Control Group: Non yoga practitioners of either sex above the age group of 35 years having similar exclusion criterias of study group will be selected from non teaching staff of SIMS Shimoga.

3.2. Exclusion criteria

1. Evidence of hypertension (BP $>$ 140/90mmHg), known case of diabetes mellitus.
2. Subjects receiving drugs that are known to interfere with cardiac function such as beta blockers, sympathomimetic drugs, vasodilators and diuretics.
3. Associated disease or conditions known to affect autonomic function like Guillean Barre syndrome, Poliomyelitis, Diphtheria, Tuberculosis, Syphilis, Amyloidosis, Chronic renal failure and others.
4. Subjects with chronic history of alcohol intake and tobacco consumption in any form.
5. Subjects having cardiac and respiratory disorders.

3.3. Procedure

In each subject following physiological parameters were recorded.

1. Respiratory rate (cycles/minute)
2. Heart rate (Beats/minute)
3. Systolic and Diastolic blood pressure (mm of Hg) by using mercury sphygmomanometer.

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2. Heart rate (Beats/minute)
3. Systolic and Diastolic blood pressure (mm of Hg) by using mercury sphygmomanometer.

The sympathetic activity is assessed by

1. Blood pressure response to cold pressor test
2. Blood pressure response to sustained handgrip exercise

Blood pressure response to cold pressor test

Each subject was explained about the procedure and asked to sit comfortably in a chair and baseline BP was recorded. Then the subject was asked to immerse his hand in cold water maintained at 4-6^0 C, the BP was recorded at 30 sec intervals in the other arm for a period of 2 minutes.

Blood pressure response to sustained Hand grip exercise

Each subject was asked to sit comfortably in a chair. Initially the subject was asked to exert maximal hand grip strength on hand grip dynamometer with dominant hand. Then the subject was asked to exert 30% of maximal hand grip strength for 5 minutes (at least for 3 min) with dominant hand. Diastolic blood pressure was measured in the non-dominant hand at rest and at one minute intervals during hand grip. The maximum rise in diastolic BP (mm of Hg) during hand grip was noted.

3.4. Statistical analysis

Statistical analysis is done in consultation with statistician. All the data are entered in EPI INFO version 3.5.3 and analysis is done using SPSS software version 20.

All values are presented as Mean + Standard Deviation (Mean + SD). Comparison of mean values of parameters between Control and Study group is done by unpaired t test. Correlation between various autonomic function parameters

1. p Value $>$0.05 is taken as not significant.
2. p Value $<$0.05 is taken as significant.
3. p Value $<$0.01 is taken as highly significant.
4. p Value $<$0.001 is taken as very highly significant.[3]

4. Results

Table 1 Age (Years) of control and study Group :

Mean Age + SD of control Group- 41.38$\pm$4.208

Mean Age $\pm$ SD of study Group - 41.20$\pm$4.165

There is no significant variation in age of both Groups.

Table 2 Anthropometric measurements of subjects both in study group and control group.

Height (cms) of control and study Group :

Mean + SD of control Group- 164.34$\pm$ 7.320 cms

Mean $\pm$ SD of study Group - 164.60$\pm$ 7.972 cms

There is no significant (p=0.865) difference in the height of the subjects between the study Group and control Group.

Weight (Kg) of control and study Group:

Mean + SD of control Group- 64.88$\pm$8.86

Mean $\pm$ SD of study Group - 62.92$\pm$6.379

There is no significant (p=0.208) difference in the weight of the subjects between the study Group and control Group.

BMI (*kg*/m2) of control and study Group:

Mean + SD of control Group - 23.90 + 1.66

Mean $\pm$ SD of study Group - 23.18 + 1.13

There is significant (p=0.013) difference in the BMI of subjects between the study Group and control Group.

Table 3 Physiological parameters of subjects both in study group and control group.

Resting Pulse Rate (beats/min) of control and study Group:

Mean + SD of control Group- 72.82±3.486

Mean ± SD of study group- 70.64±3.286

There is highly significant (p=0.002) decrease in the Resting Pulse Rate of subjects in study Group compared to control Group.

Resting Respiratory Rate (cycles/min) of control and study Group:

Mean + SD of control Group- 14.04±1.603

Mean ± SD of study group - 13.02±1.491

There is a highly significant (p=0.001) **decrease in the Resting Respiratory Rate of subjects in study Group compared to control Group.

Resting Systolic Blood Pressure (mm of Hg) of control and study Group:

Mean + SD of control Group- 123.48±5.108

Mean ± SD of study group - 122.00±4.081

There is insignificant (p=0.113) decrease in the Resting SBP of subjects in study Group compared to non yogic Group.

Resting Diastolic Blood Pressure (mm of Hg) of control and study Group:

Mean + SD of control Group- 82.44±4.006

Mean ± SD of study group- 80.28±3.104

There is highly significant (p=0.003) decrease in the Resting Diastolic Blood Pressure of subjects in study Group compared to control Group.

Tables 4 and 5 Tests to assess sympathetic system functions in subjects both in study group and control group.

Blood pressure response to cold pressor test (increase in SBP in mm Hg) in control and study Group:

Mean SBP + SD of control Group- 15.44 ± 3.63

Mean SBP + SD of study Group- 12.9 ± 2.97

There is significant (p=0.000) increase in the blood pressure (SBP) response to cold pressor test in control Group compared to study group.

Blood pressure response to cold pressor test (increase in DBP in mm Hg) in control and study Group:

Mean DBP + SD of control Group- 13.04 ± 3.136

Mean DBP + SD of study Group- 11.20 ± 3.05

There is significant (p=0.004) increase in the blood pressure (DBP) response to cold pressor test in control Group compared to study Group.

Blood pressure response to sustained hand grip (increase in SBP in mm Hg) in control and study Group:

Mean SBP + SD of control Group - 13.4 ± 3.31

Mean SBP + SD of study Group- 10.8 ± 3.61

There is significant (p=0.000) increase in the blood pressure (SBP) to sustained hand grip exercise in control Group compared to study Group.

Blood pressure response to sustained hand grip (increase in DBP in mm Hg) in control and study Group:

Mean DBP + SD of control Group - 10.4 ± 3.32

Mean DBP + SD of study Group- 8.7 ± 3.40

There is significant (p=0.012) increase in the blood pressure response to sustained hand grip in control Group compared to study Group.

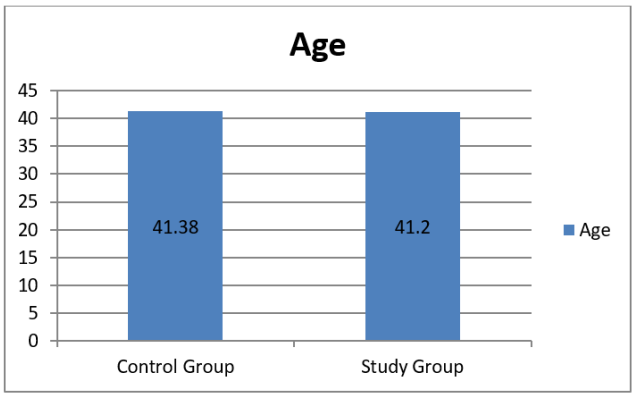

Fig. 1: Mean age of control and study group

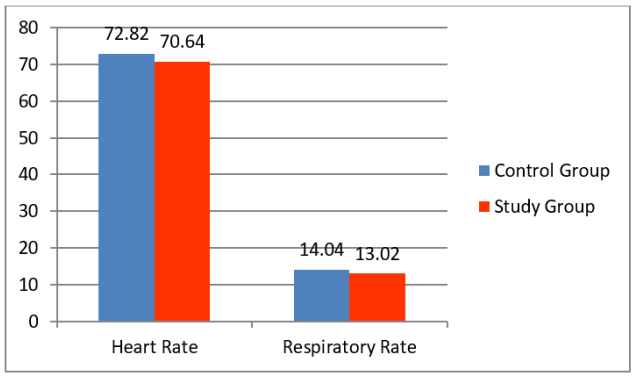

Fig. 2: Resting respiratory rate and pulse rate of study and control group

5. Discussion

5.1. Blood pressure response to cold pressor test

Under conditions of stress of physical or psychological origin, there is activation of sympathetic nervous system. The cold pressor response which consist of placing the hand into cold water acts as a painful stimulus and has been used to study the autonomic response of different individuals. The afferent fibers for this response are the pain fibers which are stimulated by placing the hand in cold water and the efferent fibers are sympathetic fibers. The response of 15-20 mm Hg increase in systolic BP and diastolic BP by 10 mmHg is considered as normal response to cold pressor test.

Table 1: Age (Mean + SD) of control and study Group

Parameter	Control Group	Study Group	Level of significance
Age (Years)	41.38±4.208	41.20±4.165	p= 0.830

*p <0.05: Significant, ** p <0.01: Highly significant, *** p <0.001: Very highly significant

Table 2: Anthropometric measurements Mean ± SD of control and study group

Parameters	Control Group	Study Group	Level of significance
Height (cms)	164.34±7.320	164.60±7.972	0.865
Weight (Kg)	64.88±8.86	62.92±6.379	0.208
BMI (*kg*/m 2)	23.90 + 1.66	23.18 + 1.13	0.013

*p <0.05: Significant, **p <0.01: Highly significant, ***p <0.001: Very highly significant

Table 3: Physiological Parameters (Mean ± SD) of subjects in control and study group.

Parameters	Control Group	Study Group	Level of significance
Resting PR (bpm)	72.82±3.486	70.64±3.286	0.002
Resting RR (cycles/min)	14.04±1.603	13.02±1.491	0.001
Resting SBP (mm of Hg)	123.48±5.108	122.00±4.081	0.113
Resting DBP (mm of Hg)	82.44±4.006	80.28±3.104	0.003

*p <0.05: Significant, ** p <0.01: Highly significant, *** p <0.001: Very highly significant

Table 4: Blood pressure response to cold pressor test (increase in SBP and DBP)

Blood pressure response to cold pressor test	Control Group	Study Group	Level of significance
SBP	15.44 ± 3.63	12.9 ± 2.97	0.000
DBP	13.04 ± 3.136	11.20 ± 3.05	0.004

*p <0.05: Significant, ** p <0.01: Highly significant, *** p <0.001: Very highly significant

Table 5: Blood pressure response to sustained hand grip (increase in SBP and DBP)

Blood pressure response to hand grip exercise	Control Group	Study Group	Level of significance
SBP	13.4 ± 3.31	10.8 ± 3.61	0.000
DBP	10.4 ± 3.32	8.7 ± 3.40	0.012

*p <0.05: Significant, **p <0.01: Highly significant, ***p <0.001: Very highly significant

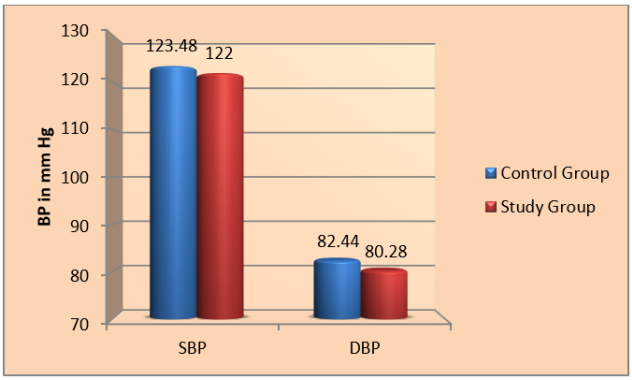

Fig. 3: Resting SBP and DBP of study and control group

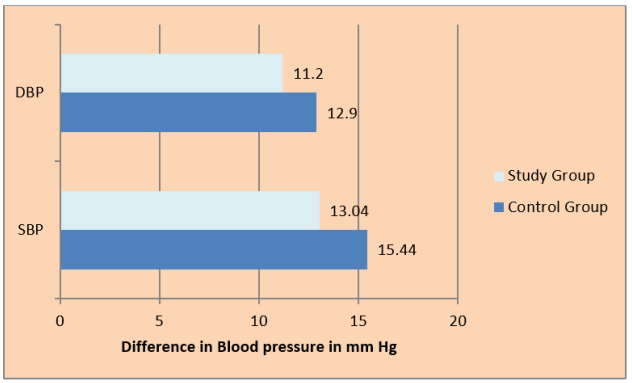

Fig. 4: Blood pressure response to cold pressor test in both study and control group

In our study there is significant decrease in SBP (p=0.000) and DBP (0.004) in study group compared to control group.

Similar to our study, Kiran et al performed a study on the influence of raja yoga meditation on cold pressor

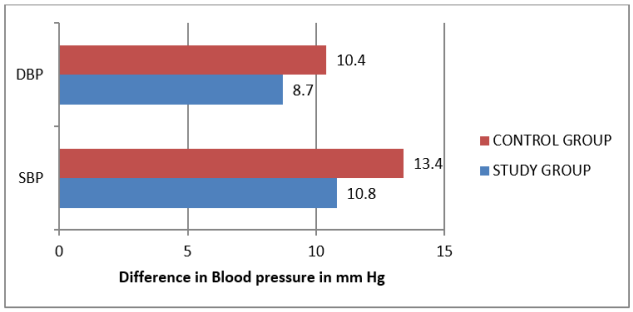

Fig. 5: Difference in blood pressure during hand grip exercise

response. The purpose of the study was to compare the rise in the mean value of SBP and DBP in acute stressful conditions in Rajayoga meditators and non meditators by performing CPT. They found rise in mean value of SBP and DBP to be 6.32 ± 2.41 and 6.0 ± 2.65 respectively in meditators whereas non meditators showed increase in the mean value of SBP and DBP to be 13.88 ± 3.95 and 13.66 ± 3.35. There was significant(p=0.001) difference between the two groups. Meditation is believed to gradually diminish sympathetic dominance, resulting in better balance between the sympathetic & the parasympathetic, resulting in greater autonomic stability.

Regular practice of Rajyoga meditation does have a relaxing effect on the mind and body and decreases the blood pressure response to acute stress and pain. By modifying the state of anxiety, meditation reduces stress induced sympathetic over activity.[4]

5.2. Blood pressure response to sustained hand grip

In our study there is significant difference in the blood pressure response SBP (p=0.000) and DBP (p=0.012) to sustained hand grip exercise between the yogic Group and non yogic Group.

Blood pressure response to Sustained Hand Grip appear to be more sensitive parameters to detect autonomic function amongst the two Sympathetic function tests.

Similar to our study Khadka R et al studied the effect of yoga on cardiovascular autonomic reactivity in essential hypertensive patients. In their study 14 essential hypertensive patients, who were on salt.reduction and similar antihypertensive were randomized into two groups; control (n=7; age 42.2±11.9 years) and yoga (n=7; age 44.9±10.8 years). The yoga group practiced yoga for $\frac{1}{2}$ h/d, 6 d/week for 6 weeks. The control group did not practice any type of yogic exercises or relaxation techniques. They concluded significant reduction in SBP was found after yogic practices in response to hand grip exercise.[5]

Similar to our study Kiran et al concluded that during hand grip test the mean value of changes in systolic and diastolic blood pressures in meditators are 13.12 ± 3.57mmHg and 11.96 ± 2.98 resp while in non meditators20.24 ± 4.83 and 17.20 ± 3.90 resp. The values are highly significant (P<0.001).[6]

Reduction in the blood pressure indicates a shift in the balancing components of autonomic nervous system towards the parasympathetic activity. This modulation of autonomic nervous system activity might have been brought about through the conditioning effect of yoga on autonomic functions.

6. Conclusion

With increased awareness and interest in health, one should adopt the non-pharmacological methods like Yoga exercise, meditation and lifestyle modification to control the modifiable risk factors responsible for cardiovascular morbidity and mortality. It can be concluded that Yogic techniques may affect the autonomic activity significantly blunting the sympathetic discharge and might help in reducing psychosomatic disorders.

7. Source of funding

None.

8. Conflict of interest

None.

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