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Original Research Article

Effect of yoga on parasympathetic nervous system of human body

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ABSTRACT

Introduction: Psychosocial stress of our modern life precipitates various cardiovascular and other disorders by distorting basic neuroendocrine mechanism and thus autonomic nervous system. The harmful effects of these stress on bodily systems can be reduced effectively by enhancing the adaptive mechanisms of our body that can restore the equilibrium. By giving rest to the mind and body, yoga can shake off many disorders of psychosocial origin.
Aims and Objectives: 1: To evaluate the effects of yoga on parasympathetic nervous system in yoga practitioners above the age group of 35 years; 2: To compare the results of parasympathetic 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 parasympathetic tests there is significant decrease in valsalva ratio (p=0.005) in yoga practitioners compared to non yoga practitioners.
Conclusion: Observations from our study suggest that regular practice of yoga can bring significant improvement in the autonomic balance, respiratory performance and wellbeing. It can thus be concluded that these results would justify the incorporation of yoga as part of lifestyle in prevention of hyper-reactivity to stress related disorders and age related cardiovascular complications.

1. Introduction

The autonomic nervous system is the portion of nervous system that regulates most of the visceral functions of the body. This system helps to control arterial pressure, gastrointestinal motility, gastrointestinal secretion, urinary bladder emptying and many other activities.[1]

Cardiovascular functions are controlled by neural factors primarily concern with the Autonomic Nervous System (ANS), which plays a major role in maintaining and regulating cardiac functions, e.g. systolic and diastolic blood pressure (SBP and DBP) and heart rate (HR). Imbalances in these lead to cardiovascular disorders such as hypertension, ischaemia, infarction, etc. Yoga is considered a holistic practice generating a sense of well-being through its various actions on physiological systems in a seemingly complex, yet integrated manner.[2]

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

2. Aims and Objectives

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

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

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.

3.4. The Parasympathetic activity is assessed by:

1. Heart Rate response to Valsalva Maneuver
2. Heart Rate response from standing to lying

3.5. Heart rate response to Valsalva maneuver

Each subject was asked to sit comfortably. A nose clip was applied and subject was asked to blow through the mouth piece attached to the mercury manometer for 15 seconds maintaining a pressure of 40mm Hg. Throughout the manoeuvre ECG is recorded continuously and for 30 seconds after release of strain. A marker button was used to indicate the point at which the subject started to do the Valsalva maneuver and also marked the point where he stops.

Heart rate response to Valsalva maneuver is expressed as:

$$Valsalva\ ratio = \frac{Longest\ R-R\ interval\ after\ the\ maneuver}{Shortest\ R-R\ interval\ during\ the\ maneuver}$$

3.6. Heart rate response from standing to lying:

Each subject was asked to stand quietly and then lie down without help while a continuous electrocardiogram was made from 20 beats before to 60 beats after lying down. A marker button was used to indicate the point at which the subject started to lie down. The individual R-R intervals were measured with a ruler from the ECG and the results expressed as a ratio of the longest R-R interval during the five beats before lying down to the shortest R-R interval during the 10 beats after lying down (standing to lying ratio; S:L ratio).

Heart rate response from standing to lying was expressed as

$$S/L\ ratio = \frac{Longest\ R-R\ interval\ during\ 5\ beats\ before\ lying\ down}{Shortest\ R-R\ interval\ during\ 10\ beats\ after\ lying\ down}$$

3.7. 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 Mean age distribution of subjects both in study group and control group.

Table 2 Sex distribution of subjects both in study group and control group.

Table 3 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± 7.320 cms

Mean ± SD of study Group - 164.60± 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±8.86

Mean ± SD of study Group - 62.92±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 ± 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 4 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.

Table 5 Tests to assess parasympathetic system functions in subjects both in study group and control group.

Heart Rate response to Valsalva maneuver in control and study Group:

Mean VR + SD of control Group- 1.51 ± 0.166

Mean VR+ SD of Study Group - 1.43 ± 0.972

There is significant (p=0.005) decrease in the Valsalva ratio (VR) of subjects in study Group compared to control Group.

Immediate heart rate response from standing to lying (30:15 ratio) in control and study Group:

Mean Ratio + SD of Control Group- 1.34 ± 0.122

Mean Ratio + SD of Study Group- 1.31 +0.162

There is insignificant (p=0.260) difference in the immediate heart rate response to lying between the study Group and control Group.

Table 1: Age distribution of subjects in study and control group

Age in years	Control group	Study group
35-40	26	23
41-45	11	17
46-50	13	10

Table 2: Sex distribution of subjects

Gender	Control group	Study group
Male	30	30
Female	20	20

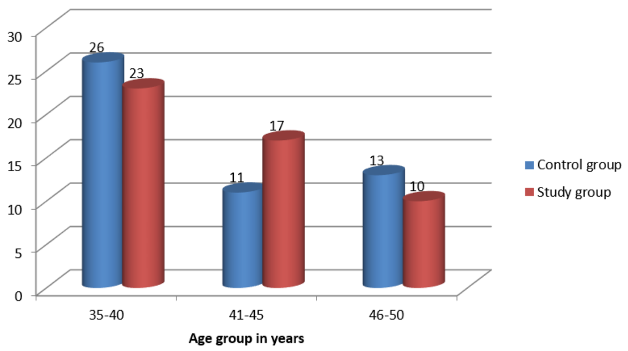

Fig. 1: Age distribution of control and study group

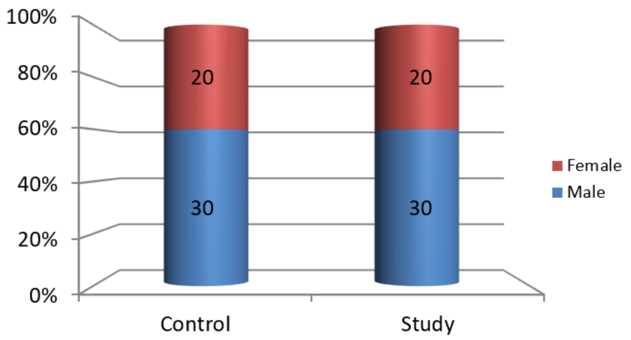

Fig. 2: Sex distribution of subjects in study group and control group

5. Discussion

5.1. Heart rate response to Valsalva maneuver

A normal response to Valsalva maneuver is characterized by a decrease in the pulse pressure & tachycardia during

Table 3: 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*/m2)	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 4: 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 5: Tests to assess the function of parasympathetic system

Parameters	Control Group	Study Group	Level of significance
Valsalva Ratio	1.51± 0.166	1.43 ± 0.97	0.005
Immediate HR response from standing to lying (30:15)	1.34 ± 0.122	1.31 +0.162	0.260

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

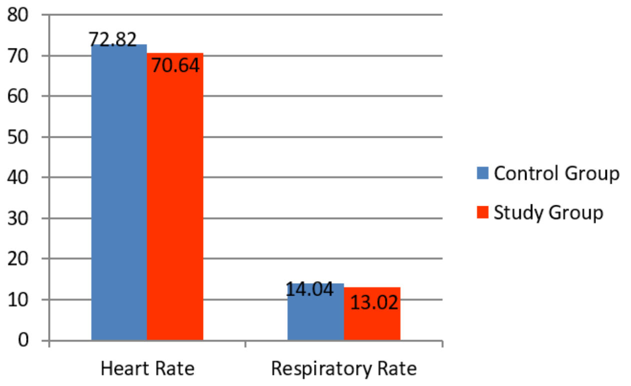

Fig. 3: Resting respiratory rate and pulse rate of study and control group

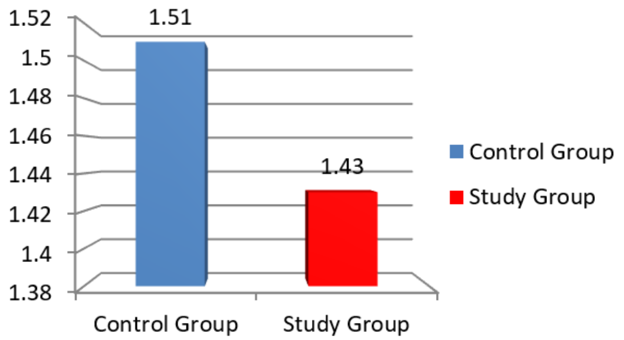

Fig. 5: Valsalva ratio in study and control group

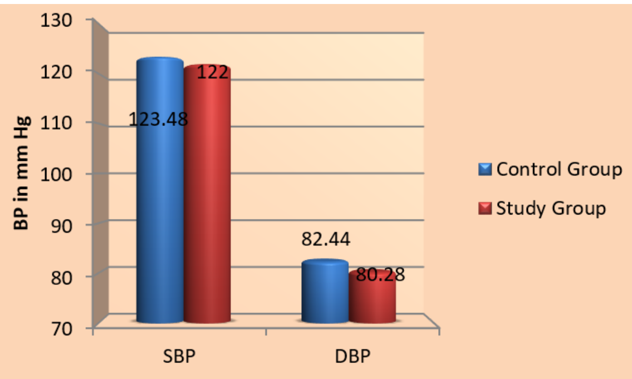

Fig. 4: Resting SBP and DBP of study and control group

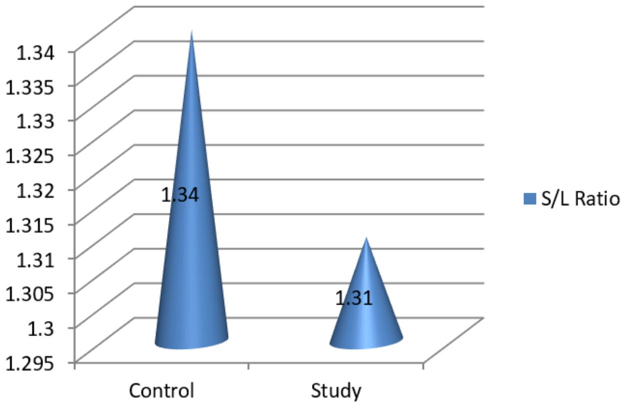

Fig. 6: S/L ratio in study and control group

strain & blood pressure overshoot & bradycardia following the strain.[4] The Valsalva maneuver tests the integrity of both parasympathetic & sympathetic divisions of autonomic nervous system. The hemodynamic changes during the maneuver are mediated via baroreceptors. With parasympathetic affection, the baroreceptor mediated reflex bradycardia response to elevated blood pressure will be reduced.

In the present study the mean value of Valsalva ratio in Study Group is 1.43 $\pm$ 0.972 and that of control group is 1.51 $\pm$ 0.166 thus showed a significant ($p<0.005$) decrease in study group compared to control group.

Khadka R et al conducted a study on effect of yoga on cardiovascular autonomic reactivity in essential hypertensive patients. They divided the hypertensive group into two, one group practiced yoga and the other one is taken as control. They measured The Valsalva ratio, which is a marker of parasympathetic reactivity and baroreflex function, which was low before yoga was found to be increased after yogic practices, indicating increase in parasympathetic reactivity and baroreflex sensitivity.[5] This study was conducted on hypertensive patients which might be the reason for change in the finding compared to our study.

5.2. Heart rate response to lying

Normally, when a subject lies down from a standing position, there is brief initial rise followed by a fall in heart rate. The initial rise is due to rapid decrease of vagal tone and latter fall is because of increase of vagal tone. This is seen in normal subjects and is more marked in young individuals. It is maximal at the 3^{rd} or 4^{th} beat after lying down and is followed by a decrease in heart rate beyond the resting level to reach a plateau around beats 25-30.

The mean Ratio + SD of Study Group is 1.31 +0.162 and mean Ratio + SD of Control Group is 1.34 $\pm$ 0.122 In the present study there is insignificant difference ($p>0.05$) in standing to lying ratio between the study group and control group.

Our study is not in accordance with the study conducted previously by Naveen K Z et al.[6]

6. Conclusion

We conducted an observational cross-sectional study to evaluate the effect of yoga on autonomic nervous system in 100 normal healthy subjects (50 yoga practitioners and 50 non yoga practitioners in the age group of above 35 years). Observations from our study suggest that regular practice of yoga can bring significant improvement in the autonomic balance, respiratory performance and wellbeing. It can thus be concluded that these results would justify the incorporation of yoga as part of lifestyle in prevention of hyperreactivity to stress related disorders and age related cardiovascular complications.

7. Source of funding

None.

8. Conflict of interest

None

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