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Original Research Article

Effect of Yoga on Autonomic Function Test

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Abstract:

Introduction: When young people experience stress from their work, career tension, social life, and surroundings, one of the main issues they face is sympathetic over activity, also known as autonomic disturbance. Studies have shown that yoga practice enhances cardiac autonomic function and generates a number of alterations in normal physiology. So, this study was conducted to determine how yoga affected the cardiac autonomic functions in yoga practitioners.

Objective: To assess the cardiac autonomic function in yoga practitioner and also compare the cardiac autonomic function among the yoga & non yoga practitioner.

Methodology: This cross-sectional comparative study was started among 60 healthy volunteers in males, after recruiting them based on inclusion and exclusion criteria in the age group of 20–40 years. The autonomic reactivity tests like Resting Heart Rate, Heart Rate response to Valsalva maneuver, DBP rise to Sustained Hand-Grip test and DBP response to Cold Pressor Test were done.

Results: Participants in the yoga group experienced a significant ($P < 0.05$) decrease in their resting heart rate (82.38 ±16.48 vs. 76.96 ± 6.39), as well as a sustained handgrip test (16.10 ± 3.04 vs. 13.93 ± 1.96) parameter. There was no significant difference between the groups in the DBP response to the Cold Pressor Test or the HR response to Valsalvamanoeuvre ($P > 0.05$).

Conclusion: Among those who regularly practiced yoga, the current study found reduced sympathetic activity and increased parasympathetic activity. Thus, yoga can be used on a daily basis to lower stress and prevent lifestyle-related illnesses in the future.

Keywords: Yoga, Autonomic function test, Body Mass Index, Cold Pressor Test, Diastolic Blood Pressure, Hand Grip Test, Valsava Ratio.

Introduction

In India, yoga has been a scientific way of living since ancient times. Yoga practice improves normal physiology in a number of ways. Both immediate and long-term benefits of meditation include a balanced parasympathetic and sympathetic nervous system and a wakeful hypo metabolic physiological state. [1] Yoga's beneficial effects and other advantages were mostly seen in cardio-respiratory and autonomic processes. [2]

Breathing is a person's representation of life power. [2] The body and mind are dynamically connected through breath. Pranayama is a natural breath-cleansing technique that has been proposed as a path to mental and physical well-being. [3] Regularly practicing breathing techniques or pranayama, are believed to promote cardiovascular health, lower sympathetic activity, and raise parasympathetic tone by either increasing parasympathetic activity or decreasing sympathetic activity. [4] In Sanskrit, the yogic postures are called Asana. All the yogic postures are categorized according to their usefulness such as 1) Cultural posture 2) Relaxative posture 3) Meditative posture. [5] Meditation is the specific consciousness state in which deep relaxation and enhanced internalized attention coexist. Meditation is a great way to reduce stress via hypothalamic-pituitary axis. Meditation is thought to be beneficial for both stress reduction and cardiovascular health. [6]

Every human being is continuously under stress in our fast-paced, highly technologically advanced, and demanding workplace. [7] Life requires stress

because, a brief period of acute stressmight enhancethe performance by causing an increase in sympathetic discharge. [8] The autonomic nervous system is crucial for the body's preparation to adjust sensory, visceral, motor, and neuro-endocrine systems in order to cope with stress and the other different environmental changes. [9] Therefore, unbalanced autonomic nervous system response with sympathetic over activity can cause development of hypertension, arrhythmias, and metabolic dysfunction. [10,11] In both industrialized and developing nations, cardiovascular illnesses are recognized as the leading cause of morbidity and mortality. [12]

Exercise is a well-established strategy for effectively managing the hormonal, local, and neuronal mechanism of cardiovascular function. [13] Yoga is a superior form of exercise because it incorporates breathing techniques (pranayama), meditation, and postures (asana). It is also safe for persons with chronic, incapacitating diseases like arthritis, heart failure, or chronic back pain. [14]

This study was undertaken to evaluate the autonomic functions among individuals practicing yoga regularly as their curriculum and compare it with individuals who do not practice yoga.

Case Definition: Young male adults between the ages of 20 and 40 who have practiced yoga regularly for at least three months, one hour per day, are eligible [15,16]

Materials and Methods

Duration of the Study: One Year (October 2023 to September 2024)

Type of the Study: Comparative Cross-sectional study

Study Population: Male yoga practitioners & male volunteers who do not practice yoga.

: Cases were collected from Yoga Centers of Dibrugarh Town& controls were collected from every municipality ward of Dibrugarh town.

Inclusion Criteria: Males aged 20-40 years. [15]. Age matched yoga practitioner and non-yoga practitioner. Those who give informed consent.

Exclusion Criteria: Athletes, Manual labours, Individuals involved in any other form of physical exercise. Individuals suffering from any illness. Those who did not give informed consent.

Sample Size: Considering the Resting HR (bpm) to be 80.92±11.76 and 69.24 ±10.64 among the Non yoga & Yoga Practitioner respectively14& taking non response rate of 10%, sample size for the present study is calculated & rounded off to be 30 in each group with 95% confidence and 90% power.

Case Definition: Young male adults between the ages of 20 and 40 who have practiced yoga regularly for at least three months, one hour per day, are eligible [15,16]

Ethical Clearance: This study was commenced after obtaining ethical clearance from the host institution, Assam Medical College, Dibrugarh. (AMC/EC/2025/2172) Informed consent was taken from the patient before interviewing.

Methodology: Young adults fulfilling the inclusion criteria were being selected. Written consent was taken from the subject after proper explanation. A detailed history was taken regarding the bellow mentioned and recorded in the pre-structured proforma.

- Duration of Yoga practice
- How much time spend daily in the yoga center
- Any history of injury during yoga practice.
- In which time morning or evening they do yoga.
- Food habit- vegetarian/ non-vegeterian
- Time since last meal & yoga.

Autonomic Tests

- Resting Heart Rate was checked.
- Heart Rate response to Valsalva Manoeuver was checked.
- Diastolic Blood Pressure rise to Sustained Hand Grip test was checked.
- Diastolic Blood Pressure response to cold in Cold Pressor Test was checked.

Materials

ECG machine (Maestros Electronics MR 300), analog watch, Digital BP machine (standardized), nose clip, sphygmomanometer, stadiometer, weighing machine (standardized), and Hand dynamometer.

Methods

Autonomic Tests

1. Resting Heart Rate: Participants had been given an initial 10 minutes of Rest in the supine posture, after which ECG was recorded continuously for 5 Minutes to assess the heart rate

2. Heart Rate response to valsalva manoeuver: First the Participants were being requested to sit on a chair. After that the nostrils were closed with nose clips, then the subject were being instructed to blow into a sphygmomanometer tube for 15 seconds in order to maintain a mercury level of 40 mm Hg. Both during and 45 seconds after the manoeuvre, the ECG will be recorded. The ratio of the longest R-R interval following the release of the strain and the smallest R-R interval during the strain was measured.

Valsalva Ratio = Maximum RR distance after Valsalva Manoeuvre / Minimum RR distance during Valsalva Manoeuvre

3. Diastolic Blood Pressure response to Cold Pressor Test: The participant's baseline blood pressure was taken &the basal blood pressure was calculated by taking the mean of two readings that were taken five minutes apart. After that, they were being instructed to immerse one of their upper limbs in cold water (2-4 degrees Celsius) for one minute. Then their blood pressure was being taken at the 60-second interval from the other limb. The Diastolic Blood Pressure response to cold was considered as CPT parameter.

4. Diastolic blood pressure rise to sustained handgrip test: The participants had been given 10 minutes to relax before the exercise, and a digital BP machine was used to test their resting blood pressure. After that, the subjects had been given instructions on how to perform a sustained hand grip exercise with a dynamometer for three minutes while maintaining a pressure of 30% of their maximum activity with their (dominant hand). The non-exercising arm's blood pressure will be taken both during the operation and after the exercise is finished. The rise in diastolic blood pressure (DBP) response to handgrip exercise was considered as HGT parameter

Statistical Analysis: The statistical analysis of data was being performed using the computer program, Statistical Package for Social Sciences (SPSS for Windows, version 20.0. Chicago, SPSS Inc.) And Microsoft Excel 2010. Results on continuous variables were being presented as mean ± standard deviation and were analyzed using student t-test. Discrete data were being expressed as numbers (%) and were being analyzed using Chi-square test and Fisher's exact test. A p-value of less than 0.05 was considered statistically significant.

Results and Analysis

Table 1: Age Distribution of Yoga and Non Yoga

Age Group (years)	Yoga		Non Yoga		p value*
	n	%	N	%	
20–30	28	93.33	28	93.33	1.000
>30–40	2	6.67	2	6.67	
TOTAL	30	100.00	30	100.00	

n : Number of Cases; % : Percentage
*Fisher Exact Test; The p-value is not significant at 5% level of significance

The table above shows the percentage of people in different age groups. Majority (93.33%) was between 20 and 30 years old, and 6.67% of the study population was more than 30 years old.

Table 2: Daily practice hour in the Yoga centre

How much time spend daily in the Yoga center(minutes)	Number (n)	Percentage (%)
<60	0	0.00
60–90	27	90.00
>90–120	2	6.67
>120	1	3.33
TOTAL	30	100.00
Mean ±S.D.	73 ±23.22 minutes	
Range	60–150 minutes	

The table above shows the results of duration of daily yoga practice. Majority (90%) of yoga practitioner do daily yoga more than 90 minutes.

Table 3: In which time they do Yoga

In which time they do Yoga	Number (n)	Percentage (%)
Morning	25	83.33
Evening	5	16.67
TOTAL	30	100.00

The results of the sample of 30 people showed 83.33% were doing yoga in the morning and 16.67% were doing yoga in the evening.

Table 4: Duration of Yoga Practice (in months)

Duration of Yoga Practice (in months)	Number (n)	Percentage (%)
3–6	10	33.33
>6–12	8	26.67
>12	12	40.00
TOTAL	30	100.00
Mean ±S.D.	11.27 ±5.81 months	
Range	3–24 months	

The table above shows the results of duration of yoga practice. Majority (40%) of yoga practitioner were doing yoga more than 12months.

Table 5: Comparison of Mean Sympathetic Function Test based on duration of Yoga Practice

Sympathetic Function Test	≤12 months (n = 18)				>12 months (n = 12)				p value*
	Mean	±S.D.	Min	Max	Mean	±S.D.			
DBP response to CPT	84.56	6.85	70	98	89.33	7.83	75	100	0.099
DBP rise to sustained handgrip test	14.06	1.66	12	18	13.75	2.42	10	19	0.707
n : Number of Cases; % : Percentage *Student t Test; The p-value is not significant at 5% level of significance									

The table above shows the results of Comparison of Mean Sympathetic Function Test based on duration of Yoga Practice.

Table 6: Comparison of Mean Sympathetic Function Test between participants of Yoga and Non Yoga group

Sympathetic Function Test	Yoga				Non Yoga				p value*
	Mean	±S.D.	Min	Max	Mean	±S.D.			
DBP response to CPT	86.47	7.51	70	100	89.43	7.36	76	102	0.128
DBP rise to sustained handgrip test	13.93	1.96	10	19	16.10	3.04	10	20	0.002*
n : Number of Cases; % : Percentage *Student t Test; The p-value is significant at 5% level of significance									

The table above shows the results of comparison of Mean Sympathetic Function Test between participants of yoga & non-yoga group. DBP rise to sustained handgrip test was significant in our study.

Table 7: Comparison of Mean Parasympathetic Function Test based on duration of Yoga Practice

Parasympathetic Function Test	≤12 months (n = 18)				>12 months (n = 12)				p value*
	Mean	±S.D.	Min	Max	Mean	±S.D.			
Resting HR	78.06	6.50	68	90	75.25	6.11	68	86	0.241
HR response to Valsalva Manoeuver	1.64	0.11	1.5	1.83	1.59	0.11	1.48	1.84	0.229
n : Number of Cases; % : Percentage *Student t Test; The p-value is not significant at 5% level of significance									

The table above shows the results of Comparison of Mean Parasympathetic Function Test based on duration of Yoga Practice

Table 8: Comparison of Mean Parasympathetic Function Test between participants of Yoga and Non Yoga group

Parasympathetic Function Test	Yoga				Non Yoga				p value*
	Mean	±S.D.	Min	Max	Mean	±S.D.			
Resting HR	76.93	6.39	68	90	82.38	16.48	66	99	0.003*
HR response to Valsalva Manoeuver	1.62	0.11	1.48	1.84	1.61	0.13	1.48	1.88	0.613
n : Number of Cases; % : Percentage *Student t Test; The p-value is significant at 5% level of significance									

The table above shows the results of comparison of Mean Parasympathetic Function Test between participants of yoga & non-yoga group. Resting HR is significant in our study

Discussion

In the present study majority of participants who have practiced yoga are between 20 and 30 years. The mean age was 22.83±3.02 years. The minimum age was 20 years. Mubarak G et al. [17] in their study on 50 yoga practicing healthy volunteers found out that most subjects were in the age group of 17 to 22 years. Thus these findings were consistent with our study. In the study done by R Shobana et al. [14] the mean age of the participants was 20.28±2.84. Our study showed similar finding. In the present study, it was found that 33.33% participants were doing yoga since more than 3 months but less than 6 months, 26.67% participants were doing yoga since more than six months but less than 12 months and 40% were doing yoga since more than 12 months. The mean duration of yoga practice was 11.27±5.81.The mean Resting Heart Rate was 78.06 ± 6.50 among participants who had been practicing yoga for less than a year & the mean Resting Heart Rate was 75.25 ±6.11among participants who had been practicing yoga for more than a year; P value was 0.241 which was significant. The mean HGT parameter was 14.06 ±1.66 among participants who had been practicing yoga for less than a year & the mean HGT parameter was 13.75 ±2.42among participants who had been practicing yoga for more than a year, P value was 0.707 which was insignificant.

In the study done by R Shobana et al. [14], significant differences in HGT and resting heart rate were

found among participants who had been practicing yoga for more than a year. The mean Resting Heart Rate was 71±9.46 among participants who had been practicing yoga for less than a year & the mean Resting Heart Rate was 64.18±10.30 among participants who had been practicing yoga for more than a year, P value was 0.05 which was significant. The mean HGT parameter was 12.48±4.29 among participants who had been practicing yoga for less than a year & the mean HGT parameter was 9.87±3.18 among participants who had been practicing yoga for more than a year, P value was 0.03 which was significant. This might be because the participants were able to attain a deep psychosomatic state of relaxation. [18]

In the study done by N Shantakumari et al. [19] those who practiced yoga for more than three months it was found that there is decrease in total cholesterol, triglycerides, LDL, with an improvement in HDL in Diabetes patients with dyslipidemia.

In the present study, those who practiced yoga had considerably lower Resting Heart Rate parameter than those in the control group and the outcomes were aligned with earlier research. In the yoga group, the minimum Resting Heart Rate was 68bpm& maximum Resting Heart Rate was 90bpm, the mean resting heart rate was 76.93±6.39 and on the other hand in the non-yoga group the minimum Resting Heart Rate was 66 bpm & maximum Resting Heart rate was 99 bpm, the mean Resting Heart Rate was 82.38±16.48. P Value is (0.003) which is significant. The changes in Yoga practitioners maybe because of the the dominance of the parasympathetic nervous system over the sympathetic nervous system.

In the study done by R Shobana et al. [14] those who practiced yoga the mean resting heart rate was 69.24±10.64. Thus these findings were consistent with our study. In the study done by Mubarak G et al. [17] those who practiced yoga for more than six months the mean Resting Heart Rate of the participants was 68.6±5. [11]. Our study showed similar finding.

In the study done by Amadawalaet al. [16], those who practiced yoga the mean Resting Heart Rate of the participants was 83.83±8.53. Thus these findings were consistent with our study.

In the study done by Mohan et al. [20] those who practiced savitri pranayama & shavasan the mean Resting Heart Rate of the participants was 63±1.4.Thus these findings were consistent with our study.

In the study done by Telles S et al [18]. Those who practiced yoga the mean Resting Heart Rate of the participants was 68.00 ±1.27. Thus,our study showed similar finding.

Diastolic Blood Pressure rise to sustained Handgrip Test

In the present study, those who practiced yoga had considerably lower handgrip testparameter than those in the control group and the outcomes were aligned with earlier research.Hand grip test exercises have been shown to increase diastolic blood pressure as well as heart rate.In the yoga group, the minimum DBP rise with HGT was 10 mmhg& maximum DBP rise with HGT was 19 mmhg, the mean DBP was13.93 ±1.96. On the other hand, in the non-yoga group the minimum DBP rise with HGT was 10 mmhg & maximumDBPrise with HGT was 20 mmhg, the mean DBP was16.10±3.04. Comparing the HGT parameter between yoga & non yoga group, the P value was 0.002 which is significant.

Yoga increases the parasympathetic nervous system and decreases the sympathetic nervous system, which may be the causes of the lower blood pressure rise in yoga practitioners who have taken the Handgrip test. [20]

In the study done by R Shobana et al. [14] those who practiced yoga the mean DBP rise with HGT were 10.20±3.67. On the other hand in the non-yoga group the mean DBP rise to HGT was 16.30±4.5310. The P value was 0.02 which is significant. Thus these findings were consistent with our study.

In the study done by Bharsankaret al [21]. Those who practiced yoga the mean DBP response to HGT of the participants were 83.88±4.97 and in the control group the mean DBP response to HGT were 89.00±5.4.The P value was less than 0.001 which is significant during comparison of HGT parameter between study & control group. Thus these findings were consistent with our study. In the study done by Mubarak G et al. [17] it was found that after six months of yoga practice the mean DBP rise with HGT was 19.80±2.07 and before six months the mean DBP rise with HGT was 19.80±2.07. The P value was 0.65 which isnon-significant. Thus these findings were not consistent with our study.

In the study done by Khadka et al. [22] it was found that the SBP rise to HGT was 188 mmhg in essential hypertensive patients and after 6 weeks of yoga practice the SBP rise to HGT was decreased to 164 mmhg in those essential hypertensive patients.

Diastolic Blood Pressure response to Cold in Cold Pressor Test

In the present study, the parameters of Diastolic Blood Pressure response to cold in Cold Pressor Test had no significant difference between the yoga and control groups. In the yoga group, the minimum DBP was 70 mmhg and maximum DBP was 100 mmhg, the mean MAP was 86.47 ±7.51.On the

other hand, in non-yoga group the minimum DBP was 76 mmhg& maximum DBP was 102 mmhg, the mean DBP was 89.43±7.36. P Value is (0.128) which is insignificant.

In the study done by Rajak et al. [23] it was found that before doing yoga practice the mean DBP of the study population was 95.0± 6.23 and after six months of yoga practice the mean DBP of the study population was85.0±4.74. P value was 0.0004 which was significant& indicates that hyper reactive subjects become hypo reactive after regular practice of yoga. Thus these findings were not consistent with our study. In the study done by Bajpai et al. [24] it was found that the mean DBP response to CPT reduced from 87.69± 3.909 to 81.75± 3.562 after three months of yoga practice.

In the study done by Deepa et al, [25]. It was found that following Yoga Nidra practice, the supine diastolic pressure decreased from 90.67 ± 9.0 mm Hg to 76.93 ± 9.6 mm Hg.

Comparison of autonomic function tests based on the duration of yoga practice

In the present study, those who practice yoga for less than one year the mean parameters were Resting HR (78.06±6.50), VR (1.64±0.11), and CPT (81.11±19.15), HGT (14.06±1.66). Those who practice yoga for more than one year the mean parameters were Resting HR (75.25±6.11), VR (1.59±0.11), and CPT (89.33±7.83), HGT (13.75±2.42). P value is not significant for each parameter.

In the study done by R Shobana et al. [14] it was found that those who practice yoga for less than one year the mean parameters were Resting HR (71.72±9.46), VR (1.33±0.73), and HGT (12.48±4.29). Those who practice yoga for more than one year the mean parameters were Resting HR (64.18±10.30), VR (1.33±0.73), and HGT (12.48±4.29). P value is 0.05 for resting HR and P value is 0.03 for HGT parameter. Thus, in this study significant results were observed in resting HR, HGT among those doing yoga practice for more than 1 year.

Heart Rate response to Valsalva Manoeuver

In the present study, the parameters of heart rate response to Valsalva manoeuver had no significant difference between the yoga andcontrol groups. In the yoga group, the minimum Valsalva ratio was 1.48 & maximum Valsalva Ratio was 1.84, the mean valsalva ratio was 1.62±0.11 and on the other hand in non-yoga group the minimum valsalva ratio was1.48 &maximum Valsalva ratio was 1.88, the mean Valsalva ratio was 1.61±0.13. P Valueis (0.613) which is insignificant. In the study done by R Shobana et al. [14] those who practiced yoga the mean valsalva ratio was 1.81±0.12 and in the control group the mean valsalva ratio was 1.56±0.33. In the study done by G Mubarak et al. [17] those who practiced yoga the mean valsalva ratio of the participants was 1.58±0.12 and in the control group the mean valsalva ratio was 1.57±0.13.

In the study done by Sahoo et al. [26] it was found that those who practice yoga since 4 months Valsalva ratio was increased from 1.09 to 1.17 in males and 1.09 to 1.21 in females. In the study done by Khadka et al. [22] it was found that the initial average VR was 1.17 in essential hypertensive patients and after 6 weeks of yoga practice the VR was increased to 1.46 in those essential hypertensive patients. In the study done by Bharsankaret al. [21] those who practiced yoga the mean valsalva ratio of the participants was 1.440±0.217 and in the control group the mean valsalva ratio was 1.240±0.147. Comparing the Valsalva Ratio between study & control group, the P value was less 0.001 which was significant.

The findings were not similar to that of our study and also P value for VR was not significant in our study. This could be due to inadequate performance of the study subjects.

Limitation

1. Even though every attempt was made to ensure that autonomic tests are performed correctly systematic error might occur due to poor performance by the participants as well as instrumental error.
2. The study was completed in a short amount of time- just one year.

Conclusion

The observations of our study strongly indicate that there is decrease in sympathetic activity and improvement in parasympathetic activity in regular yoga practicing individual. According to our study's findings, those who practiced yoga had considerably lower resting heart rates and Handgrip test parameters than those in the control group and the outcomes were aligned with earlier research. [14,15,19,26.27,28]. Since young people are constantly subjected to stress from their jobs, social lives, and surroundings, practicing yoga would help them cope up with stress by controlling and enhancing their sympathetic nervous system, which would instantly restore equilibrium and prevent the inhibitory parasympathetic system from being activated. Long-term, consistent yoga practice has been shown to have important benefits, including enhancing autonomic processes and reducing the risk of lifestyle illnesses and their complications. Therefore, the education and health department can use it as an evidence-based practice to promote yoga as a component of their daily routines as well as part of the curriculum.

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