



Effect of Yoga on Blood Pressure and Heart Rate in Normal Subjects of Different Age Groups

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Abstract

Background: Stress and cardiovascular disorders are a modern-day phenomenon. Yoga is an age-old technique of mediation and exercise that has now been focused increasingly due to its beneficial effects on cardiovascular and autonomic nervous systems. We in the current study tried to evaluate the blood pressure, heart rate changes in normal males and females after 6 months of yoga training. **Methods:** A total of n=50 healthy volunteers were incorporated in this study out of which n=22, were female (Group A) and n=28 were Males (group B). All the subjects were given yogic training by a qualified instructor for a period of 6 months for 1 hour daily between 6 am and 7 a.m. The following schedule was adopted 1) Warm-up exercises followed by Shavasana – 5 minutes. 2) Prayer (Suryanamaskara) – 10 minutes 3) Asanas – 20 minutes 4) Pranayama – 10 minutes, 5) Meditation – 10 minutes 6) Shavasana 5 – 10 minutes. The session was concluded by meditation and finally Shavasana. **Results:** The mean resting systolic blood pressure (mmHg) before the yogic practice was 122.5 ± 9.94 in group-A, in group-B 125 ± 7.25 . After 2 months of practice, systolic blood pressure (SBP) was reduced in Group-A to 111.7 ± 9.99 , in Group-B 124.4 ± 6.53 the p values were found to be significant. After 4 months, there was a further highly significant reduction in the resting systolic blood pressure in Group-A to 115.60 ± 10.67 , in Group-B heart rate reduced to 123.0 ± 4.84 ($P < 0.001$). The systolic blood pressure reduced further to a level of 114.2 ± 10.64 in Group-A, 120.4 ± 5.64 in Group-B after 6 months of yogic practice which is highly significant $p < 0.001$. **Conclusion:** It can be concluded that yogic practice helps to achieve a stable autonomic balance and to develop a relative hypometabolic state. Hence, yoga can be used as an intervention in aging persons to reduce the morbidity and mortality from cardiovascular diseases which are now topping the lists.

Keywords: Yoga, cardiovascular effects, normal subjects, blood pressure

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Introduction

The word yoga is derived from its Sanskrit origin “YUJ” which means “to bind” “to join” or “to apply”. The word YUJ also means “to control” or “to yoke”. This gives us another way to explain the origin of the word yoga, which is, to subdue or control the normal mental processes. It is a combination of breathing exercises, physical postures, and meditation, and

has been practiced in eastern traditional medicine. [1] In India recently Yoga and meditation have been adopted as approaches to health within the alternative medicine system. [2, 3] W. Selvamurthy et al; [4] in their study observed that regular practice of a combination of asanas for three weeks could restore the baroreceptor towards normal in patients suffering from hypertension. They also found beneficial effects of yoga and pranayama on respiratory parameters. BK Anand in their

classical study published in 1961 found yogi could spend long periods underground. An experiment with an air-tight box found they yoga gurus could lower their BMR by 50% of their normal levels. [5] A decrease in oxygen consumption was found during transcendental meditation. The psychological stress of modern-day life can cause various cardiovascular disorders due to disruption of neuroendocrine mechanisms. The psychosocial stresses activate the limbic system and hypothalamus which controls the autonomic nervous system. When this system is stimulated, an increase in output of both adrenaline and noradrenaline occur, both from sympathetic fibers as well as from the adrenal medulla causing an increase in heart rate, systolic and diastolic blood pressures. [6] Although there are various studies done on meditations and their effects in diseased states. [7] however, they are few studies conducted on healthy young individuals. And most of these studies have been on the practice of asanas and pranayamas. [8, 9] only very few studies have been done to see the effect of meditations with asanas and pranayamas. We in this study tried to study the effect of yoga on blood pressure, heart rate, and mental status in normal subjects in different age groups.

Materials and Methods

The present study was conducted in the Department of Physiology, Pratima Institute of Medical Sciences, Nagnaoor, Karimnagar. Institutional Ethical committee permission was obtained for the study. A total of n=50 healthy volunteers were incorporated in this study out of which n=28, were male and n=22 were females. Healthy normal subjects above the age of 20 years performing yoga regularly were included in the study. Subjects below 20 years of age or suffering from any chronic or systemic diseases were excluded from the study to minimize the bias. The subjects were selected after taking a detailed clinical history as in the proforma the health of the subject was assessed by noting the present, history, family history, and personal history and also by a thorough general and systemic examination. The subjects were asked not to change their life-style during the six months of the study. They were instructed not to perform any other physical exercises if they were not doing the same regularly. The

following parameters were recorded in the participants at the beginning of the study which included Weight, Height, Body Mass Index (BMI), Body Surface Area (BSA), Heart Rate (HR), Blood Pressure (BP), General Health Questionnaire (GHQ) - 28 score to assess mental status. Before recording the above parameters, the subject was asked to relax physically and mentally for 30 minutes. All the subjects were given yogic training by a qualified instructor for a period of 6 months for 1 hour daily between 6 am and 7 a.m. The following schedule was adopted 1) Warm-up exercises followed by Shavasana – 5 minutes. 2) Prayer (Suryanamaskara) – 10 minutes 3) Asanas – 20 minutes 4) Pranayama – 10 minutes, 5) Meditation – 10 minutes 6) Shavasana 5 – 10 minutes. The session was concluded by meditation and finally Shavasana. The cardiovascular status of each subject was done after 2, 4, and 6 months of yoga practice, was assessed clinically in terms of blood pressure and heart rate recordings. The mean arterial pressure was again calculated. The mental status was also assessed again with the help of the same questionnaire and the scoring was noted down. The weight was also noted down after 6 months of yoga practice. Statistical analysis was done by paired and unpaired ‘t’ test and Wilcoxon's signed-rank test. Probability values, $p < 0.05$ were considered significant.

Results

The n=50 subjects who practiced yoga for 6 months regularly were analyzed for the results. The results obtained were expressed as mean \pm standard deviation. The females were included in Group A and Males were separated as group B. The mean age of group Group A: 20-35 years, the mean age being 27.65 ± 1.22 Group B: 22 - 35 yrs mean age being 29.10 ± 1.36 . On analysis of the physical characteristics of the 50 subjects, the mean height (cm) in group-A was 156.1 ± 8.95 , group-B 160.30 ± 7.69 . The mean weight (kg) in group-A was 62.40 ± 8.81 , in group-B is 66.95 ± 8.39 . The mean BMI (kg/m^2) in group-A was 25.25 ± 2.59 , in group-B was 26.00 ± 2.49 . The mean resting heart rate (beats/min) before the yogic practice was 78.20 ± 5.06 in group A, 78.70 ± 4.66 in group B. The resting heart rate was reduced significantly to 76.80 ± 5.67 in group A, 77.60 ± 4.54 in group

B after 2 months of yoga practice. After 4 months, there was a further highly significant reduction in the resting heart rate to 75.00 ± 5.00 in group A, 76.10 ± 4.40 in group B. In one group with BMI < 25 (15 cases), the resting heart rate reduced from 76.67 ± 4.36 to 72.13 ± 3.96 , and in another group with BMI ≥ 25 (35cases), it decreased from 79.37 ± 5.23 to 75.40 ± 5.17 .

Table 1: Assessment of Physical Characteristics

Variables	Groups	Range	Mean + SD
Height (cms)	A	144 – 180	156.05 + 8.95
	B	150 – 178	160.25 + 7.69
Weight (kgs)	A	48-78	62.40 + 8.81
	B	55 – 81	66.95 + 8.32
Body mass index (BMI) kg/m ²	A	21-30	25.25 + 2.59
	B	22-32	26.00 + 2.49
Body surface area (BSA) – m ²	A	1.4 – 2	1.65 + 0.16
	B	1.5 – 2	1.71 + 0.15

The mean resting systolic blood pressure (mmHg) before the yogic practice was 122.5 ± 9.94 in group-A., in group-B 125 ± 7.25 . After 2 months of practice, systolic blood pressure (SBP) was reduced in Group-A to 117 ± 9.99 , in Group-B 124.4 ± 6.53 the p values were found to be significant. After 4 months, there was a further highly significant reduction in the resting systolic blood pressure in Group-A to 115.60 ± 10.67 , in Group-B heart rate reduced to 123.0 ± 4.84 (P < 0.001). The systolic blood pressure reduced further to a level of 114.2 ± 10.64 in Group-A, 120.4 ± 5.64 in Group-B after 6 months of yogic practice which is highly significant p < 0.001 (Table 2) statistical analysis was done by unpaired ‘t’ test. The response was also evaluated based on body

mass index (BMI). In one group with BMI < 25(15 cases), the resting systolic blood pressure reduced from 120.90 ± 6.77 to 113.6 ± 9.08 , and in another group with BMI ≥ 25 (35 cases) decreased from 128.30 ± 10 to 120.20 ± 8.08 . Although there is more responsiveness in the second group clinically, the difference in response between the two groups not statically significant. The mean resting diastolic blood pressure (mmHg) before the yogic practice was in Group-A 74.80 ± 5.81 , in Group-B 78.60 ± 5.73 . It reduced significantly to 73.50 ± 4.19 in Group A in Group B 76.80 ± 5.53 (p < 0.01) after 2 months of practice. After 4 months, there was a highly significant reduction in the resting diastolic blood pressure in Group-A to 69.60 ± 5.92 in Group-B 78.10 ± 4.17 (p < 0.9994). the diastolic blood pressure reduced further to a highly significant level of 67.80 ± 5.02 in Group-A, 78.10 ± 4.38 in Group-B after 6 months of yogic practice (P < 0.9994) (table 2). The mean weight (kg) before yogic practice in group-A 62.40 ± 8.81 was reduced to 60.95 ± 8.60 , in group-B mean weight reduced from to 66.95 ± 8.39 to 65.10 ± 7.67 after 6 months of yoga. When the weight reduction was compared between three groups, Group A, and Group B it was found that after 6 months of yogic practice, in age group A, the weight reduced from 62.40 ± 8.81 to 60.95 ± 8.60 , whereas in the age group B, the weight reduction was from 66.95 ± 8.39 to 65.10 ± 7.67 .

Table 2: Time interval related responses and their significance

Variables	Groups	Before yoga	After 2month of yoga	P value	After 4 months of yoga	P-value	After 6 months of yoga	P-value
Heart rate /min	A	78.20 ± 5.06	76.80 ± 5.67	< 0.987	75.00 ± 5.00	0.9974	73.55 ± 4.761	0.922
	B	78.70 ± 4.66	77.60 ± 4.54		76.10 ± 4.40		74.70 ± 3.91	
SBP (mmHg)	A	122.5 ± 9.94	119.7 ± 9.99	<0.001*	115.6 ± 10.67	0.9989	11.42 ± 10.64	0.99
	B	125.70 ± 7.25	124.4 ± 6.53		123 ± 4.84		120.4 ± 5.64	
DBP (mmHg)	A	74.80 ± 5.81	73.50 ± 4.19	0.9994	69.60 ± 5.92	0.9998	67.80 ± 5.02	0.99
	B	78.60 ± 5.73	76.80 ± 5.53		74.10 ± 4.71		71.80 ± 4.38	
MAP (mmHg)	A	90.70 ± 6.31	88.89 ± 5.61	0.9999	83.94 ± 5.56	0.9996	83.27 ± 6.43	0.98
	B	94.30 ± 5.36	92.67 ± 5.33		90.39 ± 4.36		88.00 ± 4.38	
Weight (kgs)	A	62.40 ± 2.81	61.90 ± 2.23	0.14589	60.96 ± 2.22	0.233	60.95 ± 2.60	0.387
	B	66.95 ± 2.39	66.23 ± 2.02		64.24 ± 1.90		64.10 ± 2.19	

Discussion

In this study, n=50 normal healthy subjects above the age of 20 years were selected

randomly and given yogic training which included asanas, pranayama, and meditation. The cardiovascular status of the subjects was assessed clinically in terms of resting heart rate

and blood pressure, and the mental status in terms of a questionnaire (GHQ-28) scoring, before the start of yogic practice and again after 6 months of yogic practice. The results were compared and analyzed to age, sex, and body mass index. The resting heart rate reduced after 6 months of yogic practice. The systolic blood pressure, Diastolic blood pressure, and Mean arterial pressure significantly decreased. On analyzing the effects of yoga in normal subjects above the age of 30 years, in the present study, it is a highly significant reduction in the resting heart rate. Systolic, diastolic, and mean arterial blood pressures after 6 months of yogic practice. Besides, there is also a highly significant improvement in the mental status of the subject. Selva Murthy et al; [4] Ray et al; [10] and Bharshankar et al; [11] similar reduction in heart rate after yoga training was recorded in hypertensive patient Murugesan et al; [12] and Vijayalakshmi et al; [13] There is a highly significant reduction in systolic and mean arterial pressure after 2, 4 and 6 months of yogic practice whereas the diastolic blood pressure shows a significant reduction after 2 months and highly significant decreases after 4 and 6 months of yoga practice. Similar findings were reported by Selva Murthy et al; [4] Ray et al; [10] and Bharshankar et al; [11] in normal healthy subjects, a significant reduction in blood pressure was also reported in hypertensive's after yoga by Andrews et al; [14] Selvamurthy et al; [4]

In the present study, a highly significant reduction in heart rate and blood pressure is seen only after 4 months of yoga indicating that a prolonged practice shows after response. A significantly higher response is seen in showing that practice of yoga at a younger age is more beneficial before the cardiovascular changes, due to the process of aging, have set in. There is also a significantly better response in subjects with a BMI of > 25. This may suggest that yoga is more effective in reducing the basal heart rate and blood pressure in morbid conditions like obesity. There is an equal response in heart rate and blood pressure reduction after yogic practice in both males and females. Stress is known to modulate the activity of the autonomic nervous system and central nervous system in a way, to cope with stress to get adapted to it. In stressful states with a preponderance of

sympathetic activity, yogic asanas and pranayama can lead to a state of reduced sympathetic activity shifting the autonomic balance towards relative parasympathetic dominance. [15] The present study showed a steady decrease in the resting heart rate and blood pressure over a period of 6 months of regular yogic practice. But long-term follow-up could not be done to detect the stage at which these cardiovascular parameters would stabilize and reduce no more. Further study in this direction is required.

Out of n=25 cases of spinal cord tumors diagnosed during the period, n=14 tumors were located in the intradural extramedullary compartment, the incidence in our series being 56%. Eight cases were extradural in location 32%, n=3 cases were intramedullary in location 12%. There were n=7 cases of nerve sheath tumors (28%) and n=5 cases of meningiomas (20%) followed by haemangioma and metastasis constituting 16% and 8% which are extradural tumors in our series. The incidence of nerve sheath tumor is reported was 50% and that of meningioma 35.5% of all intradural extramedullary tumors. The majority of the nerve sheath tumors were present in the 3rd decade and the majority of meningiomas were present in the 2nd and 3rd decades with female preponderance. Thoracic spine was a common site of occurrence, which is corresponding with the literature reported by Stein BM et al; [8] and Ramamurthi et al; [9] The benign nerve sheath tumors, neurinomas were the commonest intraspinal tumor in our series of n=25 total cases with the incidence of n=7(28%). In the literature the incidence of nerve sheath tumors reported as 25% in the series reported by Nittner et al; [10] Levy et al; [11] PC McCormick et al; [12] BM Stein et al; [8] Majority of the tumors occur in the middle age group from 35-55 years in our series. Nerve sheath tumors occur frequently in the thoracic region, the rest is almost equally distributed between the cervical and lumbosacral regions. In our study, 60% of tumors were in the thoracic region, 20% in the cervical, 20% in the lumbar region which is a 7:2:2 ratio corresponding with Nittner et al; [10] series. The majority of the tumors are located posteriorly or posterolaterally to the spinal cord, ensuring a greater percentage of surgical success without complications. In our series, 80% were

located posteriorly or posterolaterally. The majority of tumors (80%) were intradural and 10-15% extended through the dural root sleeve as dumbbell tumors occupy both intra and extradural compartments. The incidence in our series corresponds with that of 85% and 10-15% of the MacCormick et al; [13] series report. The giant neurofibromas in our series were 10-15% as type 5 which corresponds with the series reported by Ramamurthi et al; [9] 10.9%. The presenting symptoms in our series presented with a mean duration of 8 and half months. And symptoms were back pain 45%, tingling and numbness 63%, weakness of limbs 72%, bladder disturbances 27%, hyperreflexia and severe spasticity noted in 72% were documented on initial neurological examination. Radicular pain and sensory symptoms corresponding with series of Levy et al; [14] Higher incidence of weakness and bladder disturbance in our series due to randomized distribution of the population. Surgery was indicated in all patients in our series and complete excision of the lesion was achieved in 99% of cases. Which corresponds with the results of Levy et al; [14]. The rate of nerve root preservation in our series was 98%, without any persisting deficits after sacrificing the nerve root in 2 cases. We have no mortality in our series. No postoperative neurological deterioration was noted in our series.

Conclusion

The cardiovascular parameters change with age, but these alterations are slower in persons aging with regular yoga practice. Excessive eating, lack of exercise, change in lifestyle, and tension exposes us to various diseases especially high blood pressure. From the present study, it is evident that 6 months of regular yogic practice bring about a highly significant reduction in resting heart rate, systolic, diastolic, mean arterial blood pressures, weight, and also a significant, improvement in the mental status of an individual. It can be concluded that yogic practice helps to achieve a stable autonomic balance and to develop a relative hypometabolic state. Hence, yoga can be used as an intervention in aging persons to reduce the morbidity and mortality from cardiovascular diseases which are now topping the lists.

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