

ORIGINAL ARTICLE

Effect Of Yoga On Cardiovascular And Mental Status In Normal Subjects Above 30 years Of Age

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Abstract: The cardiovascular diseases are much on a rise ever since the past few decades in developing countries. This study was done to analyze the effect of yoga on cardiovascular and mental status in normal subjects above the age of 30 years. The cardiovascular status was assessed by recording the blood pressure and heart rate; and mental status in terms of a questionnaire, before and after 6 months of regular yogic practice. The mean resting heart rate (beats/min) before yoga was 77.8 ± 4.8 , which reduced significantly to 71.3 ± 5.2 after 6 months of yogic practice ($p < 0.001$). The mean resting systolic blood pressure (mm Hg) before yogic practice was 131.4 ± 10.2 and after 6 months, it was lowered to a highly significant ($p < 0.001$) level of 123.5 ± 9.9 . The mean resting diastolic blood pressure (mm Hg) before yoga was 85.6 ± 6.8 and reduced significantly ($p < 0.001$) to 79.6 ± 7.3 . The mean General Health Questionnaire-28 (GHQ-28) score before yogic practice was 8.4 ± 5.7 which reduced to 5.0 ± 4.1 after 6 months ($p < 0.001$), showing a positive attitude of the subjects. Hence, yogic practice can be used as an intervention in ageing persons to reduce the morbidity and mortality from cardiovascular diseases.

Key words: Yoga, Cardiovascular diseases, Mental status, Normal subjects

Introduction

The cardiovascular changes due to the process of ageing are being preponed ever since the past few decades [1]. The principal cause being the increased stress and strain that we encounter in our day-to-day living [2-3]. One simpler, inexpensive method of overcoming this stress and the consequent cardiovascular complications is the practice of YOGA [2-4]. Although much research work has been done on yoga and the cardiovascular status, most of them are in diseased conditions [2-4], where yoga is practised as a form of therapy with no special emphasis on the age-group. There are only a few papers in which the preventive effects of yoga on the cardiovascular and mental status are studied in normal subjects above the age of 30 years in whom the cardiovascular diseases and mental instability due to stress become more common. The blood pressure and heart rate was recorded and the mental status assessed in terms of a questionnaire, before the start of yogic practice and once again after 6 months of regular yogic practice and the results compared to know the effect of yoga on cardiovascular and mental status in normal subjects above the age of 30 years, with a strong hope to reduce the incidence, early morbidity and mortality from the age-related cardiovascular changes.

Materials and Methods

50 healthy subjects above the age of 30 years, 28 males and 22 females, performing yoga regularly were included in the study. The health of the subject was assessed by history and clinical examination. The same subjects were chosen as both study and control group in order to minimize the confounding factors. A written consent was obtained. The following parameters were measured before the start of yogic training: Weight, Height, Body Mass Index (BMI) - calculated as $\text{Weight (Kg)} / \text{Height}^2 \text{ (m)}$, Heart Rate (HR), Blood Pressure (BP) and 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. The blood pressure was then recorded with a mercury sphygmomanometer (Diamond), in supine position in the right upper limb by auscultatory method. Similarly, three readings were taken at an interval of 15 minutes each and an average of the three values calculated. The mean arterial pressure ($\text{MAP} = \text{DBP} + 1/3 \text{ PP}$) was also calculated. In the same resting condition, an electrocardiogram was recorded in Lead II (using CARDIART 108T, J8A,14901) and the average R-R interval of ten complexes was taken and the heart rate ($\text{HR} = 1500 / \text{R-R interval}$) was calculated. The mental status of each subject was assessed in a resting condition with the help of General Health Questionnaire (GHQ)-28 [5] in which the subject selects one answer from a set of four for each of the 28 questions. Depending on the answers, a score for each answer is given and the total score is calculated. A lesser score indicates subjective well being and positive attitude; and a greater score indicates negative attitude of the individual. All the subjects were given yogic training by a qualified instructor for a period of 6 months for 1 hour daily between 6 a.m and 7 a.m. The schedule consisted of:

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 to 10 minutes.

The asanas practised were: Vrikshasana, Trikonasana, Hastha padasana, Suryanamaskara, Vajrasana, Veerasana, Padmasana, Baddhakonasana, Shashankasana, Parvatasana, Makarasana, Bhujangasana, Dhanurasana, Pavana Mukthasana, Matsyasana, Sarvangasana, Halasana, Chakrasana, Shavasana.

The different types of pranayamas performed were: Surya Anuloma Viloma Pranayama, Chandra Anuloma Viloma Pranayama, Nadisuddhi Pranayama, Bhastrika Pranayama. The session was concluded by Rajayoga meditation and finally shavasana.

The cardiovascular status of each subject, 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 noted down. Statistical analysis was done by paired and unpaired 't' test and Wilcoxon's signed rank test. Probability values, $p < 0.05$ were considered as significant.

Results

Fifty subjects who practised yoga for 6 months regularly were analyzed for the results. The results obtained are expressed as mean \pm standard deviation. The age of subjects ranged from 31-78 years, the mean age being 48.0 ± 11.1 years. There were 30 cases in the age group of ≤ 50 years and 20 cases in the age group of >50 years. Out of the 50 cases, 28 cases were males and 22 cases were females. On analysis of the physical characteristics of the 50 subjects, the mean height (cm) was 160.3 ± 9.3 ; the mean weight (kg) was 64.1 ± 10.7 ; the mean BMI (kg/m^2) was 24.8 ± 3.3 ; and the mean BSA (m^2) was 1.67 ± 0.17 .

Resting Heart Rate: The mean resting heart rate (beats/min) before yogic practice was 77.8 ± 4.8 . It reduced significantly to 77.1 ± 5.0 ($p < 0.01$) after 2 months of practice. After 4 months and 6 months, there was further highly significant reduction in the resting heart rate to 73.5 ± 5.0 ($p < 0.001$) and 71.3 ± 5.2 ($p < 0.001$) respectively. (Table-1, Figure-1). Statistical analysis was done by paired 't' test.

Table-1: Time interval-related cardiovascular and mental responses to yoga with their significance

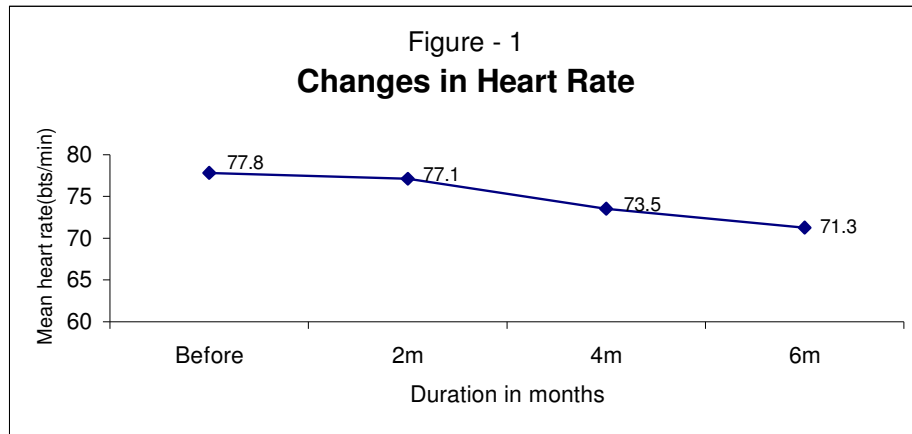
	Before Yoga	After 2 months of Yoga	p value	After 4 months of Yoga	p value	After 6 months of Yoga	p value
Heart rate (beats/min)	77.8 ± 4.8	77.1 ± 5.0	<0.01 * (t = 3.14)	73.5 ± 5.0	<0.001 *** (t=15.5)	71.3 ± 5.2	<0.001 *** (t = 15.8)
S.B.P. (mm of Hg)	131.4 ± 10.2	130.3 ± 9.9	<0.001 *** (t = 5.4)	126.4 ± 9.8	<0.001 *** (t=12.9)	123.5 ± 9.9	<0.001 *** (t = 13.7)
D.B.P. (mm of Hg)	85.6 ± 6.8	85.02 ± 6.7	<0.01 * (t = 3.90)	81.8 ± 6.8	<0.001 *** (t=13.5)	79.6 ± 7.3	<0.001 *** (t = 14.4)
M.A.P. (mm of Hg)	100.9 ± 7.3	100.1 ± 7.2	<0.001 *** (t = 5.78)	96.7 ± 7.3	<0.001 *** (t=15.6)	94.3 ± 7.6	<0.001 *** (t = 15.8)
GHQ-28 (Score for 28)	8.4 ± 5.7	-	-	-	-	5.0 ± 4.1	< 0.001 *** (z= 5.86)

All values expressed as mean \pm S.D.

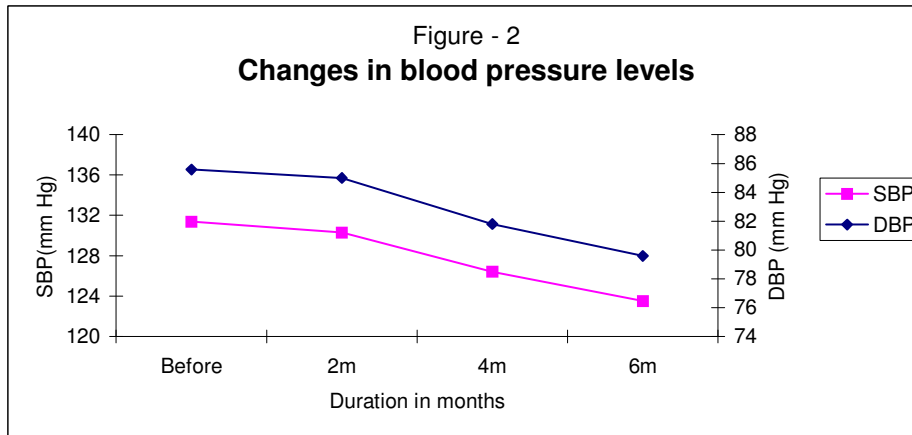
Analysis for all parameters done by paired 't' test except GHQ score which was done by Wilcoxon's signed rank test.

*** \rightarrow Highly significant, * \rightarrow Significant

After 6 months of yogic practice, in the age group of ≤ 50 years (30 cases), the resting heart rate reduced from 77.8 ± 5.2 to 70.5 ± 5.5 ; whereas in the age group of > 50 years (20 cases), the heart rate decreased from 77.7 ± 4.1 to 72.5 ± 4.5 . The difference in response between these two groups was significant [$p < 0.05$] (Table-2, Figure-3). Statistical analysis was done by unpaired 't' test.



Systolic Blood Pressure: The mean resting systolic blood pressure (mm Hg) before yogic practice was 131.4 ± 10.2 . After 2, 4 and 6 months of practice, systolic blood pressure (SBP) reduced to a highly significant level of 130.3 ± 9.9 ($p < 0.001$), 126.4 ± 9.8 ($p < 0.001$) and 123.5 ± 9.9 ($p < 0.001$), respectively. (Table-1, Figure-2). Statistical analysis was done by paired 't' test.



After 6 months of yogic practice, in the age group of ≤ 50 years, the resting systolic blood pressure reduced from 129.1 ± 10.7 to 120.6 ± 10.3 ; whereas, in the age group of > 50 years, the systolic blood pressure decreased from 134.9 ± 8.4 to 127.9 ± 7.5 . Although, more response is seen in ≤ 50 years age group clinically, the difference in response between these two groups was not statistically significant (Table-2, Figure-3). Statistical analysis was done by unpaired 't' test.

Diastolic Blood Pressure: The mean resting diastolic blood pressure (mm Hg) before yogic practice was 85.6 ± 6.8 . It reduced significantly to 85.02 ± 6.7 ($p < 0.01$) after 2 months of practice. After 4 months and 6 months, there was a highly significant reduction in the resting diastolic blood pressure to 81.8 ± 6.8 ($p < 0.001$) and 79.6 ± 7.3 ($p < 0.001$) respectively. (Table-1, Figure-2). Statistical analysis was done by paired 't' test.

After 6 months of yogic practice, in the age group of ≤ 50 years, the resting diastolic blood pressure reduced from 84.5 ± 7.3 to 77.4 ± 7.6 ; whereas, in the age group of > 50 years, the diastolic blood pressure decreased from 87.2 ± 5.8 to 83.0 ± 5.5 . The difference in response between these two groups was highly significant ($p < 0.001$), the response being better in the age group of ≤ 50 years (Table-2, Figure-3). Statistical analysis was done using unpaired 't' test.

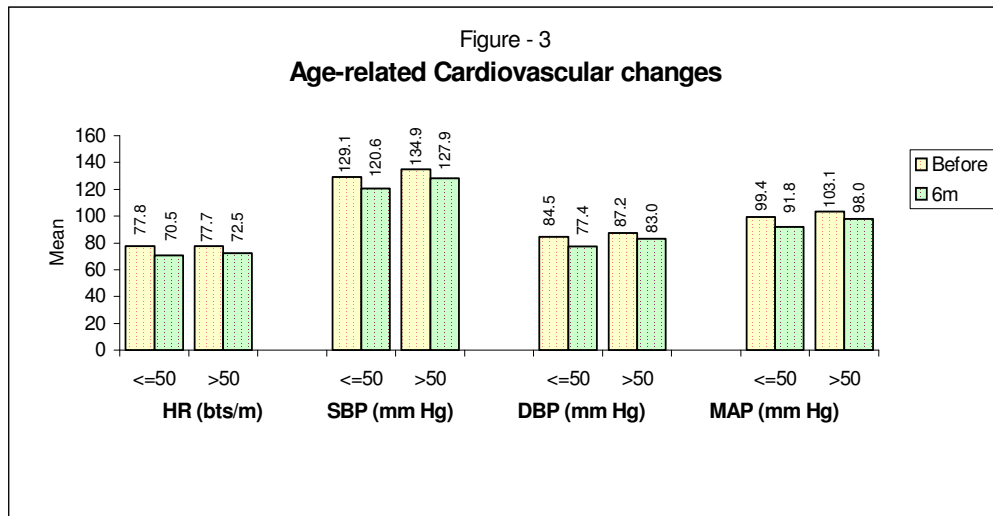
Table-2: Age-related cardiovascular and mental responses to yoga with their significance

	Age group (yrs)	No. of cases	Before yoga (B)	After 6 months (A)	Difference (B-A)	p value
Heart Rate (beats/min)	≤ 50	30	77.8 ± 5.2	70.5 ± 5.5	7.3 ± 2.6	< 0.05 * ($t=2.71$)
	> 50	20	77.7 ± 4.1	72.5 ± 4.5	5.2 ± 2.9	
S.B.P. (mm of Hg)	≤ 50	30	129.1 ± 10.7	120.6 ± 10.3	8.5 ± 3.7	< 0.20 ($t=1.31$)
	> 50	20	134.9 ± 8.4	127.9 ± 7.5	7.0 ± 4.5	
D.B.P. (mm of Hg)	≤ 50	30	84.5 ± 7.3	77.4 ± 7.6	7.1 ± 2.5	< 0.001 *** ($t=3.86$)
	> 50	20	87.2 ± 5.8	83.0 ± 5.5	4.2 ± 2.7	
M.A.P. (mm of Hg)	≤ 50	30	99.4 ± 7.8	91.8 ± 7.8	7.6 ± 2.5	< 0.01 * ($t=3.09$)
	> 50	20	103.1 ± 6.1	98.0 ± 5.8	5.1 ± 3.0	
GHQ-28 (score for 28)	≤ 50	30	7.5 ± 6.2	3.9 ± 4.5	3.6 ± 3.2	< 0.63 ($t=0.49$)
	> 50	20	9.8 ± 4.5	6.6 ± 3.0	3.2 ± 2.3	

All values expressed in mean \pm S.D.

Analysis for all parameters done by unpaired 't' test.

*** \rightarrow Highly significant, * \rightarrow Significant



Mean Arterial Pressure: The resting mean arterial pressure (mm Hg) before yogic practice was 100.9 ± 7.3 . After 2, 4, and 6 months of regular yogic practice, there was a highly significant reduction in the resting mean arterial pressure to 100.1 ± 7.2 ($p < 0.001$), 96.7 ± 7.3 ($p < 0.001$) and 94.3 ± 7.6 ($p < 0.001$) respectively. (Table-1). Statistical analysis was done using paired 't' test.

After 6 months of yogic practice, in the age group of ≤ 50 years, the resting mean arterial pressure reduced from 99.4 ± 7.8 to 91.8 ± 7.8 ; whereas in the age group of > 50 years, the mean arterial pressure decreased from 103.1 ± 6.1 to 98.0 ± 5.8 . The difference in response between these two groups was significant ($p < 0.01$), the response being better in the age group of ≤ 50 years (Table-2, Figure-3). Statistical analysis was done by unpaired 't' test.

Mental Status: The mental status was analyzed with the help of a questionnaire (GHQ-28) and the total score noted down. Lesser score indicates positive attitude and greater score indicates negative attitude of the individual towards life and more susceptibility of the individual to psychiatric/psychosomatic disorders. The mean GHQ-28 score before yogic practice was 8.4 ± 5.7 which reduced to 5.0 ± 4.1 after 6 months of yoga indicating highly significant improvement in the mental status of the subjects [$p < 0.001$] (Table-1). Statistical analysis was done using Wilcoxon's signed rank test. It was found that after 6 months of yogic practice, in the age group of ≤ 50 years (30 cases), the GHQ score reduced from 7.5 ± 6.2 to 3.9 ± 4.5 ; whereas, in the age group of > 50 years (20 cases), the GHQ score decreased from 9.8 ± 4.5 to 6.6 ± 3.0 . Although, more improvement is seen in the mental status of ≤ 50 years age group clinically, the difference in response between the two groups was not statistically significant (Table-2). Statistical analysis was done by unpaired 't' test.

Discussion

On analyzing the effects of yoga in normal subjects above the age of 30 years, in the present study, it is found that there is a highly significant reduction in the resting heart rate, systolic, diastolic, and mean arterial blood pressures after 6 months of yogic practice. In addition, there is also a highly significant improvement in the mental status of the subject. On studying the results with respect to the duration of yogic practice, there is a significant reduction in resting heart rate after 2 months of yogic practice and a highly significant reduction after 4 months and 6 months of yoga. There is a highly significant reduction in systolic and mean arterial pressures after 2, 4 and 6 months of yogic practice whereas the diastolic blood pressure shows a significant reduction after 2 months and a highly significant decrease after 4 and 6 months of yoga practice. As explained earlier, reduction in heart rate and blood pressure suggests an altered autonomic balance in the subjects practising yoga with predominance of the parasympathetic system and relatively reduced sympathetic tone [6-7]. This modulation of autonomic nervous system activity might have been brought about through the conditioning effects of yoga on autonomic functions and mediated through the limbic system and higher areas of central nervous system [8]. Pranayam training brings about a decrease in basal sympathetic tone and an increase

in basal parasympathetic activity [9]. Meditation by modifying the state of anxiety reduces stress-induced sympathetic overactivity thereby decreasing arterial tone and peripheral resistance; and resulting in decreased diastolic blood pressure and heart rate [7, 10]. This ensures better peripheral circulation [11] and blood flow to tissues [12]. Shavasana brings about an altered proprioceptive and exteroceptive influences to the hypothalamus thereby decreasing sympathetic activity and hence a decrease in basal heart rate and blood pressure [13-14]. 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 a better response. A significantly higher response is seen in the age group of < 50 years showing that practice of yoga at younger age is more beneficial before the cardiovascular changes, due to the process of ageing, have set in. The present study also shows that after 6 months of yogic practice, there is a highly significant improvement in the mental status as seen by a reduction in GHQ-28 scoring. Yogic exercise brings about behavioural changes [15]. Static postures of yogasanas and controlled rhythmic breathing of pranayamas involve minimal bodily movements and result in maximal physical and mental relaxation [15] to achieve the improvement of psychological and psychomotor components. A better response in mental status is seen in subjects < 50 years of age (insignificant). Most of the studies conducted so far have generalized their results irrespective of age and duration of yogic practice. Very few studies have been conducted on subjects above 30 years of age [14-15] in which age group, cardiovascular diseases are more prevalent. In the present study, an attempt was made to fill up these lacunae. The responses to 6 months of yoga practice were assessed with respect to age, and duration of yogic practice. Better response was seen in the age group of < 50 years and in subjects who practised yoga for at least 3 months. The better response, seen in the age group of less than 50 years, can be attributed to more elastic blood vessels and also better reflex activity, before the atherosclerotic and the other changes of ageing have started. It can thus be concluded that these results and their explanations would justify the incorporation of yoga as part of our lifestyle in prevention of age-related cardiovascular complications and also in making an individual mentally more competent.

References

1. Shah S N. API Textbook of Medicine. 7th ed. Mumbai: The Association of Physicians of India; 2003: 432-433.
2. Nagarathna R, Nagendra H R. Yoga for hypertension and heart diseases. 1st ed. Bangalore: Swami Vivekananda Yoga Prakashana; 2003.
3. Swami Satyananda Saraswati. Yoga and cardiovascular management. 2nd ed. Munger: Yoga Publications Trust; 2001.
4. Swami Shankardevananda. The effects of yoga on hypertension. 2nd ed. Munger: Bihar School of Yoga; 1998.
5. Goldberg D. Manual of the General Health Questionnaire. Windsor: NFER Publishing Company; 1978.
6. Santha Joseph, Sridharan K, Patel SKB, Kumaria M L, Selvamurthy W, Joseph N T et al. Study of some physiological and biochemical parameters in subjects undergoing yogic training. *Indian J Med Res* 1981; 74: 120-124.
7. Anand B K. Yoga and medical sciences. *Indian J Physiol Pharmacol* 1991;35 (2): 84-87.

8. Selvamurthy W, Nayar H S, Joseph N T, Joseph S. Physiological effects of yogic practice. *Nimhans Journal* 1983; 1 (1): 71-80.
9. Udupa K, Madanmohan, Bhavanani AB, Vijayalakshmi P, Krishnamurthy N. Effect of pranayam training on cardiac function in normal young volunteers. *Indian J Physiol Pharmacol* 2003; 47 (1): 27-33.
10. Vyas R, Dikshit N. Effect of meditation on respiratory system, cardiovascular system and lipid profile. *Indian J Physiol Pharmacol* 2002; 46 (4): 487-491.
11. Bhargava R, Gogate M G and Mascarenhas J F. Autonomic responses to breath holding and its variations following pranayama. *Ind J Physiol Pharmacol* 1988; 32 (4): 257-264.
12. Gopal K S, Bhatnagar O P, Subramanian N, Nishith S D. Effect of yogasanas and pranayamas on blood pressure, pulse rate and some respiratory functions. *Ind J Physiol Pharmacol* 1973; 17 (3): 273-276.
13. Bera T K, Gore M M, Oak J P. Recovery from stress in two different postures and in shavasana-A yogic relaxation posture. *Indian J Physiol Pharmacol* 1998; 42 (4): 473-478.
14. Madanmohan, Udupa K, Bhavanani A B, Krishnamurthy N, Pal G K. Modulation of cold pressor induced stress by shavasan in normal adult volunteers. *Indian J Physiol Pharmacol* 2002; 46 (3): 307-312.
15. Bharshankar J R, Bharshankar R N, Deshpande V N, Kaore S B, Gosavi G B. Effect of yoga on cardiovascular system in subjects above 40 years. *Indian J Physiol Pharmacol* 2003; 47 (2): 202-206.

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