

## Original article

# Effect of yoga on selected cardiovascular parameters in elderly subjects

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### Abstract:

A case control study was done to find out the effects of simple yogic exercise programs (asanas and pranayamas) on selected cardiovascular function tests in thirty nine elderly individuals of both sexes, between 50 and 70 years of age, with no active medical disorders. The study was conducted at a yoga centre in Siliguri town of Darjeeling district of West Bengal. Mean Arterial Pressure (MAP), Resting Heart Rate (RHR), Heart Rate Post Exercise (HRPE) and Heart Rate Recovery Time (HRRT) were measured, once initially and again after six weeks of yoga training under supervision of a certified yoga instructor. There was definite improvement of cardiovascular functions as revealed by significant decrease in MAP, RHR, HRPE & HRRT after 6 weeks.

**Key words:** Mean Arterial Pressure (MAP), Resting Heart Rate (RHR)

### Introduction:

Yoga is an ancient Indian art which is considered a way of life and encompasses ethical conduct, social responsibility, nutrition and physical health practices<sup>(1,2)</sup>. The term “yoga” and the English word “yoke” are derived from Sanskrit Root “yuj” which means union. 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<sup>(3)</sup>. It produces consistent physiological changes and have sound scientific basis<sup>(4)</sup>.

There has been many studies to describe the effect of yogasana over cardiovascular system. Khanam

et al (1996) showed decreased heart rate and sympathetic reactivity following a brief period of yogic exercise practice in asthmatic patients<sup>(5)</sup>. Bowman et al (1997) performed a study comparing the effect of yoga and aerobic exercise on the baroreflex over healthy elderly persons. It revealed that heart rate decreased significantly following yoga but not after aerobic training. There was also an increment in VO<sub>2</sub>max by 11 percent in yoga practitioners<sup>(6)</sup>. Patel & North (1975) published a randomized control study on the effect of yoga on 34 hypertensive patients which showed a significant decrease in blood pressure in those subjects<sup>(7)</sup>. Statistically significant reduction in pulse rate were found in several other studies after regular practice of yoga

which were attributed to increased vagal tone and decreased sympathetic activity<sup>(8,9)</sup>.

Madanmohan et al (2002) showed that exercise induced rise in heart rate and mean arterial pressure following Harvard step test was less marked in yoga group among Pondicherry school children<sup>(10)</sup>. This is consistent with the findings of Muralidhara & Ranganathan (1982) who have reported an improvement in cardiac recovery index after 10 weeks yoga training program as indicated by Harvard step test<sup>(11)</sup>.

Our study was aimed to find out the effect of yogic exercises on selected cardiovascular function tests on healthy elderly people of Siliguri.

#### **Materials and methods:**

The study was conducted at a yoga centre in Siliguri town of Darjeeling district of West Bengal, India. Thirty nine subjects, including both male and female, of age group of 50 to 70 years, with no clinically detectable respiratory, cardiovascular and other medical disorders, were selected for the study.

#### **Exclusion criteria:**

- a) History of active sports training
- b) Previous experience of yoga training
- c) History of active medical illness e.g. tuberculosis, chronic lung disease, symptomatic ischemic heart disease.
- d) History of major surgery in recent past
- e) Smoker
- f) Intake of regular medicines for hypertension or diabetes mellitus
- g) Any vertebral deformities e.g. kyphosis or scoliosis

Each subject was separately explained about the study procedure and his/ her consent was obtained. They were then taught different yogic exercises by a certified yoga instructor and advised to practise specifically those exercises in 30 minutes' session regularly for 6 (six) weeks under supervision.

Approval from the institutional ethics committee was obtained.

Before the actual yogic exercise training programme commenced, measurement of the following parameters were done in each subject:

- a) **Mean Arterial Pressure (MAP)**- Defined as average arterial pressure during a single cardiac cycle. It's important since it reflects the haemodynamic perfusion pressure of organs. It's calculated as  $\frac{2}{3}$  diastolic blood pressure +  $\frac{1}{3}$  systolic blood pressure.
- b) **Resting Heart Rate (RHR)**- The resting heart rate is measured while the subject is relaxed but awake, in a neutrally temperate environment, and not having recently exerted himself or herself nor having been subject to a stress or even a surprise<sup>(12)</sup>.

A three minute step test was then carried out on each subject under supervision and the following parameters were measured:

- c) **Heart Rate Post Exercise (HRPE)**
- d) **Heart Rate Recovery Time (HRRT)** - time interval for recovery of heart rate to the pre-exercise level.

#### **Instruments used:**

- 1) **Sphygmomanometer & Stethoscope**
- 2) **Stopwatch**
- 3) **Metronome**
- 4) **Twelve inch wooden step**

#### **Three minutes step test<sup>(13)</sup> :**

The procedure begun by demonstrating the alternating stepping cadence to the subject using a metronome. In time with the beat, the subject stepped one foot up on the bench (1<sup>st</sup> step), stepped up with the second foot (2<sup>nd</sup> beat), stepped down with one foot (3<sup>rd</sup> beat) and stepped down with the other foot (4<sup>th</sup> beat). The subject tested for a total of 3 minutes or until fatigue whichever was earlier as the

metronome was set at 96 beats per minute(4 clicks = 1 step cycle) for a stepping rate of 24 cycles per minute. The subject immediately stopped on completion of test and sat down and remained still. Starting within 5 seconds, the subject's heart rate was counted for one complete minute .

**The yogic exercises that were allotted to the participants were as follows: (14)**

1. Bhastika Pranayam  
Procedure: To take in deep breaths and then completely breathe out.  
Duration: 3 minutes.
2. Kapal Bhati Pranayam  
Procedure: To push air forcefully out through the nostrils and the anterior abdominal wall will itself go in rhythmically with each expiratory movement. The subject then inhales immediately and quickly and repeats the procedure.  
Duration: to start for one minute, and gradually increase to 5 minutes.
3. Bahya Pranayam  
Procedure: To breathe air out, touch the chin to the chest, squeeze stomach completely and hold for a while; then release the chin, breathe in slowly.  
Duration: 5 times for one minute of each session.
4. Anulom Vilom Pranayama  
Procedure: To hold the right nostril with thumb, breathe in from left nostril. Now open the right nostril and close the left one with the middle and ring fingers, and breathe out from the right nostril. Now breathe in from the right nostril. Then close the right nostril and open the left one and breathe out from it, and so on.  
Duration: at least 10 minutes.

After completion of the exercise programme at the end of 6 weeks, the subjects were asked to present themselves at the yogic centre for reassessment of their cardiovascular parameters, namely MAP, RHR, HRPE & HRRT.

After the tests were done, data was compiled and put for analysis.

**Observations & results**

The statistical method applied for analysis of the data from the study was Paired Samples 't' test. This procedure compares the 'mean' of two variables for a single group.  $P < 0.05$  was considered significant.

Tables I, II, III & IV show the comparison of the results of the four parameters measured. Table V shows the comparative study of all the parameters measured before and after the exercise training. The tables are given at the end.

Results showed that there were significant decrease in MAP, RHR, HRPE & HRRT in subjects after the exercise programme.

**Discussion:**

Thirty nine subjects of both sexes of age group 50 to 70 years with no active respiratory, cardiovascular and other medical illness were selected for the study. After taking pre-exercise recordings of MAP, RHR, HRPE & HRRT, subjects were made to undergo a 6 week yogic exercise training programme and then post-exercise recordings of the same parameters were obtained. Data analysis revealed that, there were significant increase in all the parameters. The Tables I, II, III & IV show the comparison of results of MAP, RHR, HRPE & HRRT respectively, performed before and after exercise training. Table V shows the comparative study of all the parameters, performed once before and then after yogic training for 6 weeks. The changes were significant in all the cases.

Various studies on autonomic functions indicate that yoga in general bring about a tilt towards parasympathetic dominance which may explain the decrease in heart rate and blood pressure. Jyotsna R et al (2003) conducted a study in 50 subjects above 40 years of age in which they found that rise in blood pressure may be slowed down in elderly practitioners of yoga<sup>(15)</sup>. In their study conducted with nine bronchial asthma patients, Khanam et al (1996) found that yogic exercise decreased resting heart rate<sup>(5)</sup>. Wenger & Bagchi (1961), in a study on the pulse rate and BP in 5 yogic students and 6 yogic practitioners, found that there were decrease in above parameters<sup>(8)</sup>. Pratima et al (2008) observed that 6 months yoga practice on 78 subjects decreases resting pulse rate & blood pressure alongwith a increased cardiorespiratory efficiency as evaluated by bicycle ergometry<sup>(16)</sup>. Patel & North (1975) published their randomized controlled study of over 34 hypertensive subjects in Lancet in which they showed that 6 weeks of yoga relaxation method significantly decreased BP in control group compared to placebo group<sup>(8)</sup>.

Health and physical fitness depend highly on cardio-respiratory efficiency of an individual. Practice of asanas & prayanamas result in an overall improvement in cardio-respiratory function & physical fitness which improve one's tolerance to stressors<sup>(18)</sup>. After yoga training, a given level of exercise leads to a milder cardiovascular response, suggesting better exercise tolerance. A reduction in exercise-induced stress on cardio-vascular system by yoga training has physiological significance as well as clinical applications<sup>(19)</sup>. Muralidhara & Ranganathan (1982) reported an improvement in cardiac recovery index after 10 weeks of yoga training programme<sup>(11)</sup>. Bera & Rajapurkar (1993) showed that yoga training produced significant improvement in cardiovascular endurance and

anaerobic power<sup>(20)</sup>. Study by Madanmohan et al (2004) showed that Harvard step test induced changes in cardiac parameters were significantly lower following two months of yoga training<sup>(21)</sup>.

Regular practice of combination of asanas restore baroreflex sensitivity towards normal, specially in patients having essential hypertension<sup>(19)</sup>. Yogic exercises also appear to alter autonomic responses by increasing vagal tone and decreasing sympathetic discharges and peripheral resistance by affecting hypothalamic discharge<sup>(9,5,8)</sup>. Decreased sympathetic activity in turn reduces resting heart rate and catecholamine secretion and also leads to vasodilatation leading to improvement in peripheral circulation and hence a decrease in diastolic blood pressure<sup>(16)</sup>. It is also observed that regular yogic practices reduce basal metabolic rate and resting oxygen consumption<sup>(22)</sup>. All these may be responsible for reduction in resting pulse rate. These factors also decreases work load on heart leading to decrease in cardiac output and hence systolic blood pressure<sup>(16)</sup>.

In light of these facts, yogic exercise can become an important way of lifestyle modification and physical activity for prevention of many diseases as prescribed by World Health Organization, especially in elderly, where rigorous physical exercises is not always advisable.

#### **Conclusion:**

It was observed that six weeks of regular yoga training in elderly individuals aged between 50 to 70 years showed definite improvement in their cardiovascular functions, as observed from improvement in their MAP, RHR, HRPE and HRRT. This may be due to an overall parasympathetic dominance over sympathetic system with an improvement in cardiovascular endurance. Further study is needed to find out other causes.

**Table I: COMPARISON OF MAP (mm hg) READINGS BEFORE & AFTER YOGIC EXERCISE**

	Smallest Observation	1 <sup>st</sup> quartile (Q1)	Median (Q2)	3 <sup>rd</sup> quartile (Q3)	IQR	Largest Observation
Before Yoga	79.33	84.335	89.33	93.665	9.33	99.33
After Yoga	78	83.335	88	90.67	7.335	97.33

**Table II: COMPARISON OF RHR (beats/minute) READINGS BEFORE & AFTER YOGIC EXERCISE:**

	Smallest Observation	1 <sup>st</sup> quartile (Q1)	Median (Q2)	3 <sup>rd</sup> quartile (Q3)	IQR	Largest Observation
Before Yoga	62	69.5	74	78.5	9	91
After Yoga	62	68	71	78	10	94

**Table III: COMPARISON OF HRPE (beats/minute) READINGS BEFORE & AFTER YOGIC EXERCISE:**

	Smallest Observation	1 <sup>st</sup> quartile (Q1)	Median (Q2)	3 <sup>rd</sup> quartile (Q3)	IQR	Largest Observation
Before Yoga	117	121	128	130	9	138
After Yoga	113	120	124	128.5	8.5	138

**Table IV: COMPARISON OF HRRT (minute) READINGS BEFORE & AFTER YOGIC EXERCISE**

	Smallest Observation	1 <sup>st</sup> quartile (Q1)	Median (Q2)	3 <sup>rd</sup> quartile (Q3)	IQR	Largest Observation
Before Yoga	5	6	6	7	1	8
After Yoga	5	5.5	6	6.5	1	8

**Table V: COMPARASION OF READINGS OF THE PARAMETERS BEFORE AND AFTER YOGIC EXERCISE. ( All values are mean +/- SD, n=39 in each group.)**

	MAP(mm hg)	RHR (beats/minute)	HRPE (beats/minute)	HRRT(minute)
Before yoga	89.1576 ± 5.9494	74.3157 ± 6.4976	127.1315 ± 5.8821	6.5 ± 0.8230
After yoga	87.4828 ± 5.1254	72.5526 ± 6.8858	124.6315 ± 6.3736	6.0526 ± 0.8255
Significance	S	S	S	S

S: P < 0.05.

This study shows that there was significant reduction of MAP, RHR, HRPE and HRRT in all subjects after 6 weeks of regular yoga training.

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