A Study of Assessment of Cardiac Autonomic Functions after Yogasana and Pranayama

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ABSTRACT

Introduction: Modern lifestyle, busy work schedule, lack of exercise, more expectancy generates stress in human life. Stress is a crucial factor in origin of diseases. Stress leads to autonomic imbalance. Yoga has very positive effects on stress. Yoga is now widely used for prevention and treatment of various disorders and to achieve the physical, Physiological, Psychological, spiritual and social well being of the person. So this study is planned to see the effects of yoga on healthy subjects as an important preventive measure to remain away from diseases. The present study was undertaken to show the various effects of selective yogasana and pranayama on cardiac autonomic functions in healthy subjects between age group 31 to 60 years.

Material and Methods: The subjects fulfilling the inclusion criteria underwent the yogasana and pranayama sessions. Anthropometric data was collected. The cardiovascular status of 45 healthy subjects was assessed by cardiac autonomic function tests before the start of and after 3 months of yogasanaand pranayama practice daily for one hour. The instruments Diabetic Risk Profiler by Genesis Healthcare System Hydrabad, Handgrip dynamometer, digital blood pressure apparatus, cold water tub were used. The tests conducted were resting heart rate, resting blood pressure, deep breathing test(E/I ratio), orthostatic heart rate response (30/15 ratio), valsalva ratio, sustained handgrip test, cold pressor test and blood pressure response to standing.

Results: After yogasana and pranayama for three months significant reduction in resting HR, SBP and DBP were found. Mean resting heart rate (HR) was decreased from 77.04/min to 71.38/min, mean SBP from 121mmHg to 117.51 mmHg and mean DBP from 83.42mmHg to 79.91mmHg. There was significant increase in parasympathetic reactivity parameters like orthostatic HRR from 1.12 to 1.50, Deep breathing from 1.20 to 1.52 and valsalva ratio from 1.24 to 1.67. There was significant decrease in sympathetic reactivity variables like sustained HGT Difference of diastolic BP (ΔDBP) from 11.40 to 7.73 mmHg, cold pressor test ΔDBP 11.67 to 7.71mmHg and BP response to standing Difference of systolic BP (ΔSBP) from 10.71 to7.64 mmHg. There were no statistical significant change observed in anthropometric parameters like body mass index (BMI) from 24.12 to 23.28 and waist hip ratio(WHR) from 0.87 to 0.85.

Conclusion: It can be concluded that yogasana and pranayama has beneficial effects on cardiac autonomic activities and reactivity. This lifestyle should be followed regularly as a preventive measure by the persons with cardiac diseases to get relief and also healthy persons to remain away from cardiovascular problems.

Keywords: BP, HR, Parasympathetic, Sympathetic, Yoga, Pranayama

INTRODUCTION

Yoga is always described as union. It is union of mind, body and soul. It is an ancient spiritual discipline and Indian philosophy that have been transmitted orally through generations.[1] Yoga has been shown to be one of the most popular complimentary alternative therapies with growing use in many chronic diseases.[2] Its prime focus is relaxation of mind and body.Yogic state is defined as fully rested and relaxed body and fully awake, relaxed mind.Yoga is practice to attain permanent peace of mind. Patanjali, the father of Ayurvedic medicine, wrote a treatise called the 'Yoga Sutras' in which he formulated this discipline.[3] There are various yoga traditions, among them Astang yoga is one of the most popular which incorporates the 8 limbs framed by Sage Patanjali. These limbs are Yam and Niyam (moral and ethical restraints), Asana (postures), Pranayam (regulation of breathing), Pratyahara (internalization of the senses), Dharana (concentration), Dhyana (meditation), and Samadhi (self-realization).[4] Among the eight limbs, Yogasana and Pranayama are the third and fourth limbs of yoga, mostly practiced and have very important role in alternative healthcare for prevention and cure of diseases.[5] Yogasana commonly mean a seat or a sitting position by which the body could be maintained straight and still for long period of time for doing Meditation (Dhyana).[6] Pranayama consists of various ways of inhaling, exhaling for retention of more oxygen. It was devised by ancient Yogic masters to create synergy between theself-energizing life force and individuals mind body and spirit by regulation of prana(oxygen).[7] Regular practice of Pranayama is known to improve cardio-respiratory autonomic status.[8]

The base cause of noncontagious diseases is a stress. This stress leads to many chronic diseases like diabetes, asthma, obesity, depression, gastrointestinal problems, Alzheimer's disease, coronary heart diseases (CHD), hypertension. From many decades researchers have reviewed the importance of

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relation of stress and autonomic nervous system(ANS) with cardiovascular complications.[9,10] ANS regulates the functions of visceral organs in the body, by the way ofinvoluntary control. Two components of ANS viz sympathetic and parasympathetic nervous system act in a reciprocate manner to maintain the balance of visceral functions. Yoga can be modulate functions ofthese two limbs of ANS to maintain the balance and harmony by that way homeostasis of the physiological systems is maintained.[11] The parasympathetic stimulation calming the cardiovascular activity while sympathetic stimulation increases cardiovascularactivities.[12] Specific yogasana are playing very important role in autonomic balance and by that way gives relief from hypertension and achieves other benefits in visceral function. These asanas are vajrasan, vajrasana yogmudra, Paschimottanasan, Bhujagasan, Makarasan, Pawanmuktasan, Shavasan, setubandhasan, and Virasan. While Pranayama which plays important role in Modulation and balance of ANS are AnulomVilom(Nadishuddhi Pranayama), Bhramari and sheetali pranayama.[13] Many studies are increasing which are showing the quantitative markers of ANS functions. These markers are Cardiac activities and cardiac reactivates. Researchers showed the relation between an increased probability of severe arrhythmias and signs of either increased sympathetic or reduced vagal activity.[14,15] Yoga is becoming very important alternative medicine for curing of diseases, as well as more beneficial for healthy persons for preventive measure and better health.[16] Comparatively less attention is given on this aspect of yoga by clinically healthy population in India. So this study is undertaken to show the importance of yogasana and pranayama in healthy subjects.

Objective of the present study was to see the effects of yogasana and pranayama by the way of pre yoga and post yoga intervention in healthy persons in age group of 31 to 60 years of age.

MATERIAL AND METHODS

45 healthy subjects between 31 – 60 years of age group were selected on the basis of inclusion and exclusion criteria. The participants were from the same socio - economic and nutritional status. Study was conducted in Yoga lab of Department of Physiology, from 2018-19. The study protocol was explained to the all the participants. Written informed consent was taken from all the participants. Institutional ethical committee approval was taken. All the volunteers were clinically examined to rule out any systemic disease.Anthropometric data was collected. BMI and waist hip ratio was calculated. The cardiovascular status of 45 healthy subjects was assessed by cardiac autonomic function tests before the start of session and after 3 months of yogasana and pranayama practice. The instruments Diabetic Risk Profiler by Genesis Healthcare System Hyderabad, Handgrip dynamometer, digital blood pressure apparatus, cold water tub were used. After recording all pretest parameters, Yoga sessions were started. All subjects were trained under the guidance of certified yoga teacher. All subjects were performed yogasan and pranayama sessions for one hour daily in morning, for six days in a week for three months. Initially with less time, individual asana and pranayam time was extended to maximum possible time after training.

Inclusion Criteria: Subjects who were non-smokers and non-alcoholics, ready to perform yogic exercises and pranayama, not doing any physical exercise are included in the study.

Exclusion Criteria: Subjects who were having any acute illness, diabetes mellitus, antihypertensive drugs or any medication interfering with ANS, history of breathlessness, chest pain, asthma, any physical disability excluded from the study.

Tests for pre-test and post-test were, as given below.All tests were explained to every participant carefully to minimise errors. Three attempts were given. The best value was taken.

Parasympathetic System Parameters

Subjects were given five minutes rest in supine position. All parasympathetic tests were conducted on automated Diabetic Risk Profiler machine of Genesis healthcare systems, by its Autonomic segments.

1) Resting Heart rate – By applying four ECG electrodes (Two below clavicular region of chest and two at lower abdominal region) of automated machine resting heart rate was recorded.

2) Deep breathing test (E/I ratio) – By applying four ECG electrodes, after rest, subject was asked to take deep respiration with inspiration for 5 seconds and expiration for 5 seconds (only 5 cycles per minute).

3) Orthostatic heart rate response (30/15 ratio) – At supine position ECG is recorded for one minute. Subjects were asked to stand immediate and fast and ECG is recording continuously for one more minute.

4) Valsalva ratio - Valsalva ratio is a measure of change of heart rate that takes place during a
period of forced expiration against a closed glottis or mouth piece. By applying four ECG
electrodes and recording,subjects were asked to blowout forced expiration in mouth piece
to glow complete line of bulbs on indicator of automated machine for 15 seconds.
After stopping it, ECG recording was kept continue till completion of one minute.

Sympathetic System parameters –

Subjects were given five minutes rest in supine position.

1) Resting blood pressure was recorded by using digital sphygmomanometer of Omeron make.

2) Isometric handgrip test: Subjects were asked to press the bar of handgrip dynamometer by dominant hand with maximum possible force for 2-3 seconds. Value was noted. The subjects were asked to apply the pressure to maintain the 1/3rd of the maximum value obtained, for one minute.

Simultaneously blood pressure change was noted by applying the BP cuff to opposite hand. Diastolic BP difference was noted.

3) Cold pressor test: Subjectswere asked to immerse right hand in ice cold water of 4°C for one minute. Simultaneous blood pressure was recorded before and immediately after completion of test by applying BP cuff of automated digital BP apparatus to opposite hand. Diastolic BP difference was noted.

4) Orthostatic variation in blood pressure: Subjects were asked to rest in supine for 2 min. After recording BP, subjects were asked to stand immediately. Again blood pressure was measured. Difference in systolic blood pressure was noted.

After three months yoga and pranayama session immediately from next day sympathetic and parasympathetic system parameters(post test data), were collected.

Prayer and warmup	**Time**
Prayer and Omkar chanting	3 min
Warm-up movements	3 min
Yogasana performed	
Bhujangasan	2 min
Setubandhasan	2 min
Pawanmuktasan	2 min
Makarasan	3 min
Vajrasan	3 min
VajrasanaYogmudra	2 min
Pachimottanasan	3 min
Virasan	2 min
Shavasan	5 min
Pranayam with Pose – Padmasan or Sukhasan	
Anulomvilom (alternate nostril breathing)	5 min
Bhramari (honeybee sound during expiration)	3 min
Sheetali (Inspiration through mouth with extruded rolled tongue)	3 min
Prayer	3 min
Omkar chanting	3 min

Table-1: Daily schedule of asana and pranayama.

STATISTICAL ANALYSIS

The data were tested for normal distribution. The data of general characteristics was analysed using
Paired student *'t'* test. Statistical software SPSS was used for analysis of data.

RESULTS

Anthropometric parameters of pre and post yoga were not statistically significant.The variables of cardiac autonomic activity and reactivity shown significant difference between pre yoga and post yoga parameters.There were significant difference in all the parameters of parasympathetic system

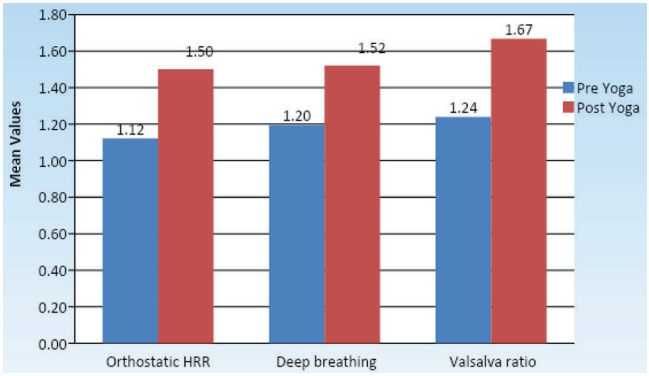

Figure-1: Graph of parasympathetic parameters.

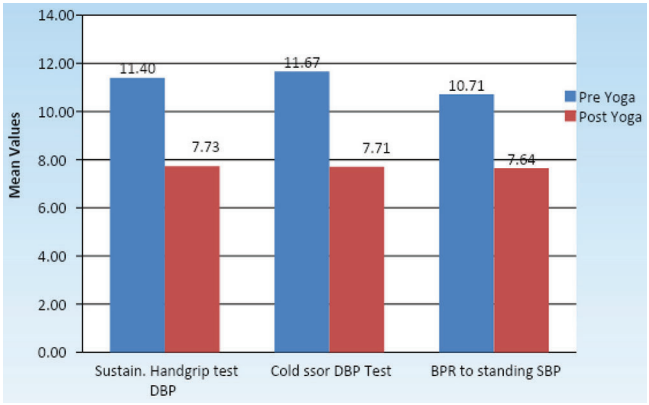

Figure-2: Graph of sympathetic parameters.

Variable		**Pre Yoga**	**Post Yoga**
Anthropometric	Height. Cm	165.78	165.78
	Weight kg	66.07	63.82
	BMI Kg/M^2	24.12	23.28
	Waist circumference (cm)	31.69	31.38
	Hip circumference (cm)	36.62	36.62
	WHR	0.87	0.85
Parasympathetic	Resting HR	77.02	71.38
	Orthostatic HRR	1.12	1.50
	Deep breathing	1.20	1.52
	Valsalva ratio	1.24	1.67
Sympathetic	Resting SBP mmHg	121.00	117.51
	Resting DBP mmHg	83.42	79.91
	SustainedHandgrip test ΔDBP	11.40	7.73
	Cold pressorTest ΔDBP	11.67	7.71
	BPR to standing ΔSBP	10.71	7.64

Table-2: Comparison of Mean values Pre and Post Yoga

Paired data	Variable	Mean	N	Std. Deviation	Std. Error Mean	P value	Significance
Pair 1	Pre Yoga RHR	77.02	45	3.31	0.49	< 0.05	Significant
	Post Yoga RHR	71.38	45	2.79	0.42		
Pair 2	Pre Yoga Orthostatic HRR	1.12	45	0.06	0.01	< 0.05	Significant
	Post Yoga Orthostatic HRR	1.50	45	0.41	0.06		
Pair 3	Pre Yoga Deep breathing	1.20	45	0.06	0.01	< 0.05	Significant
	Post Yoga Deep breathing	1.52	45	0.37	0.06		
Pair 4	Pre YogaValsalva ratio	1.24	45	0.05	0.01	< 0.05	Significant
	Post YogaValsalva ratio	1.67	45	0.38	0.06		
Pair 5	Pre Yoga R SBP mmHg	121.00	45	3.28	0.49	< 0.05	Significant
	Post YogaR SBP mmHg	117.51	45	2.59	0.39		
Pair 6	Pre Yoga R DBP mmHg	83.42	45	3.51	0.52	< 0.05	Significant
	Post Yoga R DBP mmHg	79.91	45	2.86	0.43		
Pair 7	Pre Yoga Sustain. Handgrip test ΔDBP	11.40	45	1.51	0.23	< 0.05	Significant
	Post Yoga Sustain. Handgrip test ΔDBP	7.73	45	1.70	0.25		
Pair 8	Pre Yoga Cold pressor ΔDBP Test	11.67	45	1.57	0.23	< 0.05	Significant
	Post YogaCold pressor ΔDBP Test	7.71	45	1.58	0.23		
Pair 9	Pre Yoga BPR to standing ΔSBP	10.71	45	1.65	0.25	< 0.05	Significant
	Post Yoga BPR to standing ΔSBP	7.64	45	1.57	0.23		

Table-3: Paired T test application for testing effect of Yoga on Parasympathetic and Sympathetic variables

like RHR, orthostatic HRR, deep breathing and valsalva ratio.

(Table - 2). In all the sympathetic parameters, statistically significant difference was present in the tests such as resting SBP, DBP, sustained HGT, cold pressor test and BP response to standing. In all the variables *P* value was less than 0.05 so results were significant (Table- 3)

Level of significance was 5% and p value < 0.05 was taken as significant.

Resting heart rate was changed from mean 77.02 in pre yoga to 71.38 in post yoga. Mean of orthostatic HRR in pre yoga was 1.12 and 1.50 in the post yoga group. Pre yoga deep breathing mean was 1.20 and in post yoga it was 1.52. Mean of valsalva ratio in pre yoga was 1.24 and that of post yoga was 1.67. (Fig. 1)

Resting blood pressure decreases from mean 121.00 to 117.51mmHg.Sustained HGT parameters decreases from mean 11.40 to 7.73 mmHg. Cold pressor test parameters decreases from 11.67 to 7.71 mmHg. BPR to standing from supine decreases from 10.71 to 7.64mmHg.

DISCUSSION

This present study revealed that improvement occurs in cardiac autonomic activity and reactivity. This improves parasympathetic system variables and decreases sympathetic system variables by the training of three months of yogasana and pranayama sessions.Our results are similar with the findings of Pal G. K. et al who have reported the yoga is beneficial for cardiac autonomic system.[17]

Yogasana and pranayama sessions showed significant decrease in heart rate by the way of increased vagal tone and decreased sympathetic tone. Parasympathetic segment of nervous system via vagus sends cardio-inhibitory impulses which releases acetylcholine on heart that decreases heart rate by increasing vagal tone.[18] Catecholamines are the general vasoconstrictor hormones released from adrenal medulla in response to sympathetic stimulation. The decrease in sympathetic tone becomes responsible for decrease in catecholamine secretion. It prevents vasoconstriction and allows vasodilatation in the peripheral circulation which is beneficial for decrease resistance and blood pressure and load on cardiovascular system.[19] It was observed in the study of Karambelkar P.V. et al that regular practice of yoga decreases oxygen consumption and decreases blood flow, which tend to decrease heart rate and blood pressure.[20]

In deep breathing test(E:I ratio) statistically significant increase was observed. The results were similar like previous study of Sonika Chaudhariet. et al.[21] This increase is due to increased vagal activities, because change in heart rate during respiration is due to vagal stimulation.[22] Valsalva ratio is significantly increased after yogasana and pranayama sessions. This increment is due to change in sensitivity of the baroreceptors located on major blood vessels in thoracic region. Our study shown same findings of Mourya M. et.al.study.[23] Orthostatic change in heart rate is change in HR due to immediate standing from supine position significantly increased after yoga practice, which is similar to previously quoted by Sunita Bisht Nene et al.[24]

In the sympathetic system variables, stress induced by sustained handgrip test and cold pressor test increases the blood pressure.In sustained HGT and CPT stimulation of cold receptor[25], triggers sympathetic activation leading to marked vasoconstriction. This also leads to marked increase inheart rate, blood pressure due to catecholamine release. In our study this increase of BP is significantly reduced by yogasana and pranayama sessions. This is also probably due to increased vagal tone and decreased sympathetic activities. The previous study by Sharma G et al observed same finding[26] Change in BP response to standing is due to peripheral vascular factors

CONCLUSION

It can be concluded that yogasana and pranayama has beneficial effects on cardiac autonomic activities and reactivity. It improves autonomic balance by increasing vagal tone and decreasing sympathetic tone. Stress do not produce much problem in body by regular practice of yoga. This lifestyle should be followed regularly as a preventive measure by healthy persons also to remain away from cardiovascular problems.

REFERANCES

1. B.K.S. Iyengar. Light On Yoga. 2nd ed. New York: Schocken Books; 1976.
2. Elizabed De Michelis. History of Modern yoga.
3. SunitaBisht Nene1, Aduri Raja Sumandatta.Study of Autonomic Nervous Functions in People Practicing Yoga. IJSR 2015;4:2.
4. Meenakshi Devi Bhavanani.History of yoga
5. McCaffrey R, Ruknui P, Hatthakit U, Kasetsomboon P. The effects of yoga on hypertensive persons in Thailand. Holist Nurs Pract.2005;19:173–80.
6. Stuck M, Meyer K, Rigotti T,BauerK, Sack U. Evaluation of a yoga based stress management training for teachers: Effects on immunoglobulin-A secretion and subjective relaxation. J Med Res.2003;3:59 -68.
7. G. Sharma, L.K. Sharma, S. Sood, Synergistic approach of applied physiology & yoga to combat lifestylediseases, The Internet Journal of Alternative Medicine, 2009, volume 7, number 1.
8. Brown R. P., Gerbarg P. L.,Sudershan Kriya yogic breathing in the treatment of stress, anxiety & depression: part 1 neurophysiological model, The Journal of Alternative and Complementary Medicine February 2005;11:189-201.
9. Sahoo JK, Vatve M, Sahoo KD, Patil VV. Effect of specific yogasanas on cardiovascular autonomic function test.Pravara Med Rev. 2010; 5: 10-15.
10. Oparil S. The sympathetic nervous system in clinical and experimental hypertension. Kidney Int. 1986;30:437–452.
11. Selvamurthy W, Nayar H S, Joseph N T, Joseph S. Physiological effects of yogic practice. Nimhans Journal 1983;1:71-80
12. Mirabai A, Sutnga T, Sarada N. A Study on the Effect of Yoga on Sympathetic Nervous System Journal of Dental and Medical Sciences 2017;16:13-16.
13. Paula Pyne. Hata Yoga (e. book)
14. Minakshi Devi Bhavanani. History of yoga. ICYER, Ananda Ashram, Pondicherry
15. Elizabed D. Michelis. The History of modern yoga.
16. IyengarBKS. 'Yoga' The Path of Holistic Health. First American Edition, DK Publishing, 375 Hudson Street, New York, 10014, 2001
17. Pal GK, Velkumary S, Madanmohan. Effect of short-term practice of breathing exercises on autonomic function in normal human volunteers. Indian J Med Res. 2004; 120: 115-121
18. Wenger M. A. and Bagchi B.K. Studies of autonomic functions in practitioners of yoga in India. Behavioral science. 1961; 312-323
19. Textbook of Medical Physiology Guyton, Hall. 11th edition, Elsevier, Philadelphia, pg 201
20. Karambelkar P.V. and Bhole M. V. Heart control and yoga practices. 1971 Yoga Mimansa, 53-65.
21. Sonika Chaudhari, Mansingh Chaudhari, Pukhraj Chaudhari, Study on the Effect of yoga on resting cardiovascular Parameters and Cardiovascular Autonomic Functions, IJTSRD, 2018;3:817-821.
22. Angelone, A., & Coulter, N. A. Respiratory sinus arrhythmia: A frequency dependent phenomenon. Journal of Applied Physiology 1964;19:479-484.
23. Mourya M, Mahajan AS, Singh NP, Jain AK.Effect of slow- and fast-breathing exercises on autonomic functions in patients with essential hypertension. J Altern Complement Med. 2009;15;7: 711-717.
24. SunitaBisht Nene, Aduri Raja Sumandatta Study of Autonomic Nervous Functions in People Practicing Yoga 2015;4:2064-2067
25. Adams R. D., Victor M., Principles of neurology, MacGraw Hill Book, 4th edition, part II, Section VI, Page. No. 431.
26. Sharma G, Sharma LK, Sood S. Synergistic approach of applied physiology and yoga to combat lifestyle diseases. The Internet Journal of Alternative Medicine. 2009;:1-6.

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