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

Sangita R. Phatale¹, B. V. Shinde², Sunil Patil³, P. U. Shinde⁴

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 yogasana and 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 respiratory 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 respiratory variables like sustained HGT Difference of diastolic BP (ΔDBP) from 11.40 to 7.73 mmHg, cold pressor test ΔDBP 11.67 to 7.71 mmHg and BP response to standing Difference of systolic BP (ΔSBP) from 10.71 to 7.64 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. Yoga 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 Yama and Niyama (moral and ethical restraints), Asana (postures), Pranayam (regulation of breathing), Pratyahara (internalization of the senses), Dharana (concentration), Dhyanam (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 themself-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

¹Professor, MGM Medical College, Aurangabad, ²Assistant Professor, MVP’S Dr. VPMC, Nashik, ³Assistant Professor, MVP’S Dr. VPMC, Nashik, ⁴Professor and Head, MGM Medical College, Aurangabad, India

Corresponding author: B. V. Shinde, Assistant Professor, MVP’S Dr. VPMC, Nashik, Maharashtra, India


DOI: http://dx.doi.org/10.21276/ijcmr.2019.6.11.6
relation of stress and autonomic nervous system (ANS) with cardiovascular complications.\textsuperscript{9,10} ANS regulates the functions of visceral organs in the body, by the way of involuntary control. Two components of ANS viz sympathetic and parasympathetic nervous system act in a reciprocal manner to maintain the balance of visceral functions. Yoga can be modulate functions off these two limbs of ANS to maintain the balance and harmony by that way homeostasis of the physiological systems is maintained.\textsuperscript{11} The parasympathetic stimulation calming the cardiovascular activity while sympathetic stimulation increases cardiovascular activities.\textsuperscript{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, Bhujagasana, Makarasana, Pawanmuktasana, Shavasan, setubandhasan, and Virasan. While Pranayama which plays important role in Modulation and balance of ANS are AnulomVilom(Nadishuddhi Pranayama), Bhramari and sheetali pranayama.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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 yogasana 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 yoga exercises and pranayama, not doing any physical exercise were 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: Subjects were 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**
- Prayer and Omkar chanting: 3 min
- Warm-up movements: 3 min
- Yogasana performed
  - Bhujangasan: 2 min
  - Setubandhasan: 2 min
  - Pawanmuktasana: 2 min
  - Makarasana: 3 min
  - Vajrasana: 3 min
- Vajrasana Yogmudra: 2 min
- Pachimottanasana: 3 min
- Virasana: 2 min
- Shavasana: 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

**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 parameters.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre Yoga</th>
<th>Post Yoga</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthropometric</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height, Cm</td>
<td>165.78</td>
<td>165.78</td>
</tr>
<tr>
<td>Weight kg</td>
<td>66.07</td>
<td>63.82</td>
</tr>
<tr>
<td>BMI Kg/M²</td>
<td>24.12</td>
<td>23.28</td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>31.69</td>
<td>31.38</td>
</tr>
<tr>
<td>Hip circumference (cm)</td>
<td>36.62</td>
<td>36.62</td>
</tr>
<tr>
<td>WHR</td>
<td>0.87</td>
<td>0.85</td>
</tr>
<tr>
<td>Parasympathetic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resting HR</td>
<td>77.02</td>
<td>71.38</td>
</tr>
<tr>
<td>Orthostatic HRR</td>
<td>1.12</td>
<td>1.50</td>
</tr>
<tr>
<td>Deep breathing</td>
<td>1.20</td>
<td>1.52</td>
</tr>
<tr>
<td>Valsalva ratio</td>
<td>1.24</td>
<td>1.67</td>
</tr>
<tr>
<td>Sympathetic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resting SBP mmHg</td>
<td>121.00</td>
<td>117.51</td>
</tr>
<tr>
<td>SustainedHandgrip test ∆DBP</td>
<td>11.40</td>
<td>7.73</td>
</tr>
<tr>
<td>Cold pressor test ∆DBP</td>
<td>11.67</td>
<td>7.71</td>
</tr>
<tr>
<td>BPR to standing ∆SBP</td>
<td>10.71</td>
<td>7.64</td>
</tr>
</tbody>
</table>

**Table-1: Daily schedule of asana and pranayama.**

**Figure-1:** Graph of parasympathetic parameters.

**Figure-2:** Graph of sympathetic parameters.
### Table-3: Paired T test application for testing effect of Yoga on Parasympathetic and Sympathetic variables

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

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 117.51 mmHg. 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 7.64 mmHg.

**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. In our study this increase of BP is significantly reduced by yoga and pranayama sessions. This increment is due to change in heart rate during respiration is due to vagal stimulation. Valsalva ratio is significantly increased after yogasana and pranayama sessions. This increment is due to change in heart rate during respiration and decreases blood flow, which tend to decrease heart rate and blood pressure. 

In deep breathing test (E:I ratio) statistically significant increase was observed. The results were similar like previous study by Sonika Chaudhari et al. This increase is due to increased vagal activities, because change in heart rate during respiration is due to vagal stimulation. In the sympathetic system variables, stress induced by sustained handgrip test and cold pressor test increases the blood pressure.

In the sympathetic system variables, stress induced by sustained handgrip test and cold pressor test increases the blood pressure.

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. It was observed in the study of Kambelkar 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. 

In the sympathetic system variables, stress induced by sustained handgrip test and cold pressor test increases the blood pressure.
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.

REFERENCES

2. Elizabed De Michelas. History of Modern yoga.
4. Meenakshi Devi Bhavanani. History of yoga
13. Paula Pyne. Hata Yoga (e. book)