National Journal of Physiology, Pharmacy and Pharmacology

RESEARCH ARTICLE

Effect of yoga on exercise-induced cardiovascular responses in normotensive individuals

Narayan Khurde[1], Pawan Goyal[2], Chintan Parmar[2], Vishnu D Udhan[2]

[1]Department of Physiology, Sree Narayana Institute of Medical Sciences, Ernakulum, Kerala, India, [2]Department of Physiology, NAMO Medical Education Research Institute Erstwhile Govt. Medical College, Silvassa, Dadra and Nagar Haveli and Daman and Diu (UT), India

Correspondence to: Vishnu D Udhan, E-mail: vishnu.udhan@gmail.com

Received: September 28, 2020; **Accepted:** October 16, 2020

ABSTRACT

Background: Yoga is acclaimed for its diverse health benefits. Various studies confirm its positive impact on cardiovascular (CV) health and fitness. However, there is an extreme paucity in data pertaining to CV responses to exercise following long-term yogic practice with larger sample size. **Aim and Objective:** The present study was undertaken to evaluate the CV responses to exercise after long-term yogic practice in normotensive individuals. **Materials and Methods:** This pre- and post-yoga interventional single cohort study was conducted on normotensive healthy individuals (n = 200). Exercise-induced change in heart rate (HR), systolic (SBP) and diastolic blood pressure (DBP) was evaluated before and after 6 months yoga practice. Modified Harvard step test (HST) was used as an exercise tool. The data were analyzed and compared by SPSS and paired t-test, respectively. For statistical significance, P-value was established at 5%. **Results:** Post-yogic HR was significantly higher ($P < 0.0001$), while post-yogic SBP and DBP after HST were significantly ($P < 0.0001$) declined compared to their respective baseline value. **Conclusion:** Results show the effectiveness of yogic training in modulating CV responses to exercise. Reduction of blood pressures is suggestive of increased CV tolerance to exercise. Yoga may be considered as a potent preventive measure for future CV diseases).

KEY WORDS: Yoga; Harvard Step Test; Heart Rate; Blood Pressure; Cardiovascular Tolerance

INTRODUCTION

Concept of yoga and practices has its lengthy existence in ancient Indian philosophy. Hatha yoga, one of the most common types of yogic practice among followers. Since the last 3 decades, yoga has gained remarkable popularity among western countries. Scientific communities too have started validating the health benefits of yoga claimed in mythological literature. Consequently, this is exponentially reflected as increased scientific publications on its widespread health benefits. Yoga, although a holistic approach toward life but modern-day yoga practices, commonly includes certain physical postures, breathing exercises, and mediation. Various components of health such as physical, mental, emotional as well as spiritual health are well promoted by yoga practice.[1] Hence, yoga as a way of mind-body exercise, various studies have reported its cardiopulmonary fitness, functioning, and mental health-promoting effects.[2,3]

Access this article online	
Website: www.njppp.com	Quick Response code
DOI: 10.5455/njppp.2021.11.10270202016102020	

Physical inactivity is one of the most leading behavioral risk factors of cardiovascular diseases (CVDs) such as coronary artery disease, heart attack, stroke, heart failure, and other complications.[4] High blood pressure is among the few modifiable risk factors which can be prevented and controlled with altered behavior. Regular physical exercise is a well-identified intervention for its widespread health-promoting effects at all ages in both genders and to significantly reduce

the risk of CVDs.[5-7] Scientific review reveals the positive correlation between regular aerobic exercise and blood pressure in healthy individuals.[8]

Outcomes of various studies indicate yoga as not only a tool to improve cardiac health but also a preventive and adjunct therapeutic measure for CVDs.[9-13]

There are plenty of studies available which reports the positive effects of yoga on CV parameters in health and disease. However, most of the studies are not adequately complemented with a larger sample size and duration of yogic training. Further, literature review reveals extremely limited data are available on exercise-induced CV changes after yogic training. Therefore, to know whether yoga can modulate the CV response to exercise stress, the present study was intended with the objective to assess the exercise-induced CV response after long-term yoga training with relatively larger sample size.

MATERIALS AND METHODS

Design of the Study and Sample Size

Normotensive[14] healthy individuals (n = 200) of both the gender (male 120 and female 80) within 30 – 50 years of the age range (mean age 39±0.95 years) were recruited in this pre- and post-yoga interventional single cohort study. The sample size was calculated using the formula.[15]

Inclusion and Exclusion Criteria

Self-motivated healthy and normotensive individuals who voluntarily willing to undergo 6 months yoga training (1 h/day) were included in the study. Whereas, individuals with any systemic, mental disorders; physical inabilities, pregnant women; on anti-hypertensive drugs; and receiving any physical exercise and/or yoga training were excluded from the study.

Ethical Clearance

Written consent was obtained from all study participants. The ethical clearance was received from the institutional ethical committee (Reg. No. ECR/581/INST/MH/2014) before starting the study.

Intervention

Yoga (Asanas, Pranayama, and Meditation) intervention was given for 6 months (1 h/day, 6 days/week) continuously by a trained yoga instructor.

Study Variables and Measurement

One day before the intervention begins, baseline or pre-yogic heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) were measured immediately after cessation of modified Harvard step test (HST). Similarly, a day after the completion of intervention for 6 months, post-yogic HR, SBP, and DBP after HST were measured.

Modified HST[16-18]

In this test setup, 18 inches step was used. The test was performed in up-up and down-down fashion with 30 steps per minute speed. Time was kept on metronome for the 5 min unless subject stops from exhaustion. HR, SBP, and DBP were measured immediately after cessation of HST.

Statistical Analysis

Collected data were analyzed using SPSS (24th Version). Quantitative data were presented as mean±standard deviation (SD). Mean±SD was calculated as the mean difference. For comparative data analysis, paired t-test was used. P-value at 5% was established to check the statistical significance.

RESULTS

Table 1 shows a comparison between baseline and post-yogic mean HR, SBP, and SBP after exercise by HST.

The study participants showed a highly significant ($P < 0.0001$) increase in post-yogic HR after HST compared to the baseline value. On the contrary to HR, participants showed a highly significant ($P < 0.0001$) reduction in post-yogic SBP and DBP after HST compared to their baseline values.

DISCUSSION

Essentially, HR and blood pressure are the vital attributes among many which symbolize the CV health status. Exercise-induced changes in these parameters are critically important to assess the clinical status of CV fitness. The present pre- and post-yoga interventional study was aimed to assess the change in exercise-induced CV responses in healthy individuals.

The results show, increase in post-yogic HR after HST, decrease in post-yogic SBP and DBP after HST than their respective baseline values.

In spite of the difference in study design and sample population compared to the present study, the findings of Madanmohan *et al*.[19] are similar to our findings, specifically in relation to HR. In a review study, Trakroo *et al*.[20] had reported a similar kind of finding pertaining to rise in post yogic HR after HST. According to them, increased CV reactivity to stressor is known to be a CV risk factor; however, reduced reactivity is an indicator of fitness. Increased physical fitness

Table 1: Mean HR, SBP, and DBP after HST before and after yogic training

Variables	Measurements	Mean±SD (*n*=200)	Mean difference	*P*-value
HR after HST* (bpm)	Pre-yogic	135.14±7.74	6.54	<0.0001†
	Post-yogic	141.69±8.03		
SBP (mmHg) after HST*	Pre-yogic	167.65±14.00	7.45	<0.0001†
	Post-yogic	160.20±9.89		
DBP (mmHg) after HST*	Pre-yogic	83.26±5.75	1.47	<0.0001†
	Post-yogic	81.79±2.90		

HR: Heart rate, SBP: Systolic blood pressure, DBP: Diastolic blood pressure. *Harvard step tests; †Highly significant

index (PFI) is a clear suggestion of faster HR recovery; therefore, improvement in CV response to an exercise. Hence, a significant increase in HR after HST after yoga training in the current study may be attributed to increased HST performance. This assumption is well supported by Muralidhara and Ranganathan.[21]

The interesting finding of this study was to observe a significant reduction in post-yogic SBP and DBP after HST compared to their baseline values. Our finding with respect to reduction in post-yogic SBP and DBP after HST matches with the finding of Madanmohan *et al*.[19] and Parkhad *et al*.,[22] in their similar kind of interventional study involving adolescent girls, has reported a significant increase in SBP, while a decrease in DBP after step test. Amid these varied outcomes, a study with analogous study design and exercise tool had reported the increased PFI level after the long-term yogic intervention.[2] Hence, our finding might draw consequential inference because, despite improvement in HST performance, there is a significant reduction in post-yogic SBP and DBP. Therefore, our result indicates the efficacy of yogic training in modulating the CV responses to decrease the CV reactivity and increase tolerance to exercise-induced stress.

We presume that, increase in post-yogic HR after HST might be due to increased HST performance. While increased parasympathetic dominance, blood flow to heart muscle, endothelial functions, and respiratory efficiency, reduction in vascular tone, arterial stiffness due to yoga training might have collectively raised CV tolerance to exercise after long-term yogic training which ultimately resulted in a reduction in SBP and DBP after HST.

Strength and Limitations of the Study

The present study was conducted on healthy individuals with a larger sample size. This study was considered a single cohort study; hence, only yoga group was considered and not the control group. Further, there was no gender-based comparative data analysis performed. In addition, being a combined yoga model (Asanas, Pranayama, and Meditation) was used as an intervention; therefore, it was difficult to assign the underlying cause of effects to any specific limb of yoga. In the future, the study can be repeated with a control group and gender-based analysis for a better understanding of exercise-induced CV responses.

CONCLUSION

The data obtained in this study indicate the positive effect of yoga practice on CV fitness, especially when subjected to exercise. Data show increased CV fitness by reducing CV arousal response and reactivity in normotensive individual. Therefore, yoga may be recommended as a prophylactic intervention to prevent future CVDs.

ACKNOWLEDGMENT

The authors would like to thank Dr. Pravin Kalyankar, Dr. Sharadchandra Wankhede, Dr. Pramod Shinde, and Dr. Jayant Baride, Yoga teacher Shri. Balasaheb Joshi.

REFERENCES

1. Herrick CM, Ainsworth AD. Invest in yourself. Yoga as a self-care strategy. Nurs Forum 2000;35:32-6.
2. Udhan VD, Wankhede SG, Phatale SR. Effect of yoga on cardio-respiratory health markers: Physical fitness index and maximum oxygen consumption (VO_2 Max). J Clin Diagn Res 2018;12:CC21-3.
3. Udhan VD, Wankhede SG, Shinde P. Effectiveness of yoga as mind-body exercise over memory, perceived stress and mental health. Int J Adv Res 2018;6:147-51.
4. Sovová E, Čajka V, Pastucha D, Malinčíková J, Radová L, Sovová M. Positive effect of yoga on cardiorespiratory fitness: A pilot study. Int J Yoga 2015;8:134-8.
5. Cardiovascular Diseases. World Health Organization. Available from: http://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds). [Last accessed on 2020 Feb 20].
6. Risk Factors. World Health Organization. Available from: https://www.who.int/cardiovascular_diseases/en/cvd_atlas_03_risk_factors.pdf. [Last accessed on 2020 Feb 20].
7. Bijnen FC, Caspersen CJ, Mosterd WL. Physical inactivity as a risk factor for coronary heart disease: A WHO and International Society and Federation of Cardiology position statement. Bull World Health Organ 1994;72:1-4.
8. Cornelissen VA, Smart NA. Exercise training for blood pressure: A systematic review and meta-analysis. J Am Heart

Assoc 2013;2:e004473.
9. Manchanda SC, Narang R, Reddy KS, Sachdeva U, Prabhakaran D, Dharmanand S, *et al*. Retardation of coronary atherosclerosis with yoga lifestyle intervention. J Assoc Physicians India 2000;48:687-94.
10. Field T. Yoga clinical research review. Compliment Ther Clin Pract 2011;17:1-8.
11. Choudhary DS, Choudhary DR, Chawla DV, Soni DN, Kumar DJ, Choudhary K. Effects of yoga and physical exercise on cardio-respiratory parameters: Effect of yoga and physical exercise. Natl J Integr Res Med 2013;4:49-54.
12. Manchanda SC. Yoga--a promising technique to control cardiovascular disease. Indian Heart J 2014;66:487-9.
13. Mehrotra R. Yoga and the heart. J Clin Prev Cardiol 2016;5:138-42.
14. Association of Physicians of India. Indian guidelines on hypertension (I.G.H.)-III. 2013. J Assoc Physicians India 2013;61:2-36.
15. Bhalwar R. Textbook of Public Health and Community Medicine. 1st ed. New Delhi: Published in Collaboration with World Health Organization; 2009.
16. Brouha L. The step test: A simple method of measuring physical fitness for muscular work in young men. Res Q 1943;14:31-7.
17. Ryhming I. A modified Harvard step test for the evaluation of physical fitness. Arbeitsphysiologie 1953;15:235-50.
18. Gallagher JR, Brouha L. V. A Simple method of evaluating fitness in boys: The step test. Yale J Biol Med 1943;15:769-79.
19. Madanmohan, Udupa K, Bhavanani AB, CC Shatapathy, Sahay A. Modulation of cardiovascular response to exercise by yoga training. Indian J Physiol Pharmacol 2004;48:461-5.
20. Trakroo M, Bhavnani AB. Physiological benefits of yogic practices: A brief review. Int J Tradit Complement Med 2016;1:31-43.
21. Muralidhara DV, Ranganathan KV. Effect of yoga practice on cardiac recovery index. Indian J Physiol Pharmacol 1982;26:279-83.
22. Parkhad SB, Palve SB, Chandrashekar M. Effect of yoga on indices of cardiovascular system in Maharashtrian adolescent girls. Natl J Physiol Pharm Pharmacol 2015;5:129-33.

How to cite this article: Khurde N, Goyal P, Parmar C, Udhan VD. Effect of yoga on exercise-induced cardiovascular responses in normotensive individuals. Natl J Physiol Pharm Pharmacol 2020;10(12):1095-1098.

Support: Nil, **Conflicts of Interest:** None declared.