

Cardiovascular and Metabolic Responses to Vinyasa Yoga and Paced Surya Namaskar B

Stefanie Joshua* and Christopher C Dunbar

Department of Kinesiology, Brooklyn College- CUNY, USA

Abstract

Objectives: The purpose of this study is to assess cardiovascular response to a thirty-minute continuous and uniformly paced session of Surya Namaskar B. The metabolic response to the yoga protocol is compared to the maximum cardiovascular response assessed utilizing a Bruce Protocol treadmill test to determine whether or not the a vinyasa flow yoga practice, including frequent paced Surya Namaskar B, meets the guidelines for moderate intensity activity as outlined by the American College of Sports Medicine (ACSM).

Methods: Four healthy men and women (37 - 62 years) who have practiced vinyasa yoga for at least six months participated in the study. Participants completed a Bruce Protocol treadmill test to assess maximum cardiovascular and metabolic response. In a subsequent session, participants completed thirty minutes of a paced Surya Namaskar B yoga protocol.

Results: Participants exhibited an average 50% or more of their VO₂ max and between 5-8 METS during the course of the thirty-minute yoga protocol.

Conclusion: The practice of Surya Namaskar B, paced at approximately one sequence completed over 45 seconds, can elicit a moderate intensity cardiovascular response and meets the guidelines of moderate intensity activity.

Keywords: Cardiovascular; Surya namaskar; Vinyasa yoga

Introduction

Yoga is both an ancient and broad discipline that can incorporate numerous and varied facets (pranayama, meditation, postures) into its practice. Pranayama, the name for various breath control techniques, may be practiced with meditation techniques to calm and focus the mind. In many yoga lineages, these techniques are practiced, in conjunction with yoga postures that help to keep the body fit, for the creation of a mind-body wellness approach. Many of these facets of yoga have been studied and have been shown to cultivate improvements to health [1]. As a form of stress management, research has shown that the practice of yoga and meditation can help reduce anxiety, stress and oxygen consumption [2,3]. As yoga becomes more popular as a form of stress reduction and exercise in the United States, there are conflicting reports and research about the energy expenditure and cardiovascular (CV) benefits of yoga with assertions that yoga may help elicit benefits for stress management, but does not meet the requirements for moderate intensity activity [4]. Some studies of practitioners, who engaged in yoga practices when compared to other forms of exercise, have found that the yoga practice elicits low metabolic expenditures [5-7]. Other research has concluded that the practice of yoga may lead to weight gain in some individuals, because of possible reductions in resting energy expenditure as a result of long-term practice of yoga [8]. However, in the studies of the metabolic responses to yoga, where low metabolic response was elicited, the yoga treatments studied were of static yoga sequences, without aerobic movement, where aerobic activity is defined as continuous rhythmic movement involving the large muscle groups [9]. Vinyasa flow yoga is a type of yoga that involves flowing transitions into the yoga sequences and the continuous nature of the movement in the sequences generally qualifies as aerobic movement. Vinyasa flow yoga may incorporate yoga sun salutations (series of linked postures) into the posture sequences. Surya Namaskar (a preset series of linked yoga poses) has been studied and has been shown to elicit a moderate intensity cardiovascular response [10,11]. Surya Namaskar B, an alternate version of the Surya Namaskar yoga series, integrates additional yoga postures as well as incorporates two jump transitions

within the sequence. To this date, Surya Namaskar B has not been studied exclusively over a thirty-minute session to examine the heart rate response and its efficacy as a moderate intensity exercise option. Mody examined continuous bouts of Surya Namaskar, which included twelve repetitions of each round, averaging three minutes per round [10]. The Surya Namaskar B yoga sequence in this study follows a faster pace (practiced at one round per 45 seconds over a thirty-minute bout) in order to examine metabolic and heart rate (HR) response and the sequence's overall propensity as a tool for weight control. Metabolic response to the yoga treatment is compared to the maximum volume of oxygen consumption (VO₂max) achieved during an exercise treadmill test administered in the study using a Bruce Protocol treatment. Exercise treadmill tests, for assessment of VO₂max, are largely considered to be the most accurate method for assessing an individual's maximum oxygen consumption and cardiovascular fitness [12].

Method Subjects

Four experienced vinyasa yoga practitioners (2 men, 2 women) volunteered to participate in the study. All practitioners had practiced vinyasa yoga for at least six-months prior to the study and were recruited from a local yoga studio. The subjects ranged in age from 37 to 62 years. The participants provided written, informed consent prior to participating in the study. Participants also completed a demographic questionnaire, which included questions about their physical activity

*Corresponding author: Stefanie Joshua, Department of Kinesiology, Brooklyn College- CUNY, USA, Tel: (212) 529-0973; E-mail: stefanie.joshua@gmail.com

Received December 28, 2015; Accepted March 10, 2016; Published March 17, 2016

Citation: Joshua S, Dunbar CC (2016) Cardiovascular and Metabolic Responses to Vinyasa Yoga and Paced Surya Namaskar B. J Yoga Phys Ther 6: 230. doi:10.4172/2157-7595.1000230

Copyright: © 2016 Joshua S, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

participation. The participants were assessed to be low risk according to American College of Sports Medicine (ACSM) risk stratification. The study was submitted to and approved by the CUNY.

Brooklyn College Institutional Review Board. All testing sessions were completed in an exercise physiology laboratory at Brooklyn College in New York City. Practitioners were asked to not engage in high exertion activities on the day of their participation in each session. The lab testing components of the study occurred in two separate sessions for each participant in individual testing sessions. The four participants were coded using the following method: P1F1 (participant 1, female 1), P2M2 (participant 2, male 1), P3F2, P4M2. P1F1 is a 62 year-old female (height=63.5 inches, weight=117lbs); P2M1 is a 37 year-old male (height=69 inches, weight=175lbs); P3F2 is 45 year-old female (height =61 inches, weight=115lbs); P4M2 is a 40 year-old male (height=67 inches, weight=158lbs).



Figure 1: Yoga Protocol Facemask.

Equipment

A Parvo Medics TrueOne 2400 Metabolic Measurement System, Hans Rudolph one-way breathing tube and valve, and facemask were utilized for the measurement of expired air for volume of oxygen consumption (VO₂) analysis during the tests. A Quinton Q-Tel RMS Cardiac Telemetry system, with 4-lead electrocardiogram (ECG) placement, was utilized to monitor and record heart rate response. Additional equipment used included an ipad and speaker for the broadcast of the pre-recorded paced yoga protocol (Figure 1).

Procedures

Bruce protocol treadmill testing

Resting measurements and demographic data was collected prior to testing, which included resting heart rate, height and weight.

During the first in-lab session, each participant completed a Bruce Protocol treadmill test; a ramped protocol was utilized for this study [13]. Metabolic data was measured continuously via the breathing tube and facemask throughout the testing and ECG recordings were printed at one- minute intervals at the 50-second mark. Measurements were recorded at test termination.

Yoga protocol testing

A thirty-minute audio recording of a continuous Surya Namaskar B sequence, recorded for the study, was utilized to guide the yoga protocol test. The sequence pace was devised and recorded by the study's Primary Investigator, who is a Registered Yoga Teacher of ten years. Each posture of the sequence was recited on the recording and the participant followed the audio prompts (Figures 1 and 2). Each round of Surya








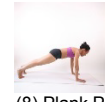












 (1) Chair Pose	 (2) Forward Bend	 (3) Prepare Pose	 (4) (jump to) Four- Limb
 (5) Upward Facing Dog	 (6) Downward Facing	 (7) Warrior I Pose (rt. leg)	 (8) Plank Pose
 (9) Four-Limb Staff Pose	 (10) Upward Facing Dog	 (11) Downward Facing	 (12) Warrior I Pose (left leg)
 (13) Plank Pose	 (14) Four-Limb Staff Pose	 (15) Upward Facing Dog	 (16) Downward Facing
 (17) Jump feet forward	 (18) Prepare Pose	 (19) Forward Bend	 (20) Chair Pose

Figure 2: Surya Namaskar B Yoga Sequence.

Namaskar B averaged a pace of one round every forty-five seconds. Metabolic data was measured continuously via the breathing tube and facemask throughout the testing. After the completion of six rounds (five minutes), participants held one of the postures (Utkatasana- Chair pose) for approximately 15 seconds to serve as a marker between each five- minute benchmark reached.

Following the completion of both protocols, the participants engaged in a monitored cool down.

Results

All participants timed out of their Bruce Protocol treadmill test due to fatigue and no adverse conditions were noted. During the Bruce protocol, P1F1 reached stage 4 and peaked at 11:30 min/sec; P2M1 reached stage 5 and peaked at 13:00 min/sec; P3F2 reached stage 4 and peaked at 12:00 min/sec; P4M2 reached stage 5 and peaked at 13:31 min/sec. During the yoga protocol testing, all participants completed the thirty-minute protocol without incident. (Figure 3).

Figure 3 is a comparison of maximum volume of oxygen consumption (VO₂max) achieved via Bruce protocol versus average volume of oxygen consumption (VO₂) during the SuryaNamaskar B yoga protocol (VO₂ average for yoga calculated starting at minute six for establishment of steady state.) The data demonstrates that participants reached ranges of 49 – 56% of their VO₂max during the yoga protocol. Comparison of the percentage of the yoga protocol to the VO₂max from the treadmill test is an indication of the intensity of the aerobic activity compared with the subject's maximum (Figure 4).

Figure 4 is a comparison of peak heart rate (HRmax) achieved during the treadmill test versus HRmax during the yoga protocol. Participant P1F1 reached 82% of HRmax during the yoga protocol; P2M1 regarding 89% of HRmax, P3F2 reached 94% of HRmax and P4M2 reached achieved 87% of HRmax, during the yoga protocol. These percentages fall within the ACSM guidelines of moderate intensity activity (40%-60%) of VO₂R [14]. Percentage of one's maximum heart rate during exercise is also a measurement of cardiovascular intensity. (Figure 5).

Figure 5 shows the work output in Metabolic Equivalent of Task (METs) for the yoga protocol for each participant over the thirty-minute session. As would be expected, male participants exhibited a higher METs workload output compared to female participants, attributed to reduced overall cardiac output and other differing physiological characteristics between men and women [15]. Female participants achieved MET ranges between 5-7 and male participants between 7-8.6 METs, both ranges meeting the guidelines for moderate to vigorous activity [16]. Metabolic equivalents ranges can provide a comparison to equivalent activities of the same range.

Discussion

The findings of this study are in line with other studies of the yoga sun salutations (linked set of continuous flowing poses) that show that these posture sequences can elicit a moderate intensity metabolic response. In a study of a hatha yoga protocol, consisting of mainly statically held postures with some sun salutations incorporated in the sequence, the static postures portion of the sequence exhibited a low metabolic

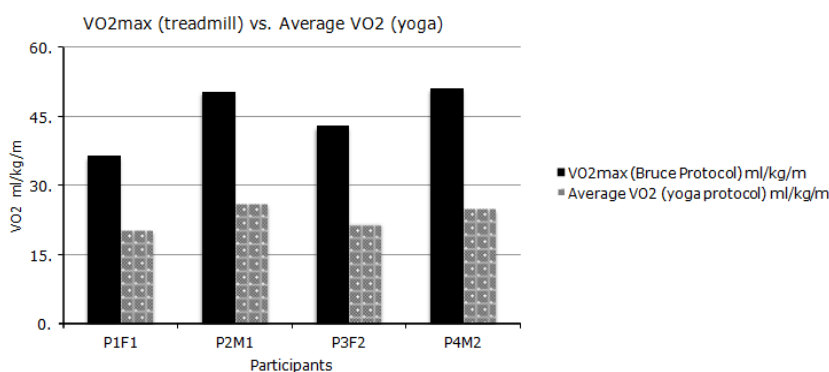


Figure 3: VO2max (treadmill) vs. Average VO2 (yoga).

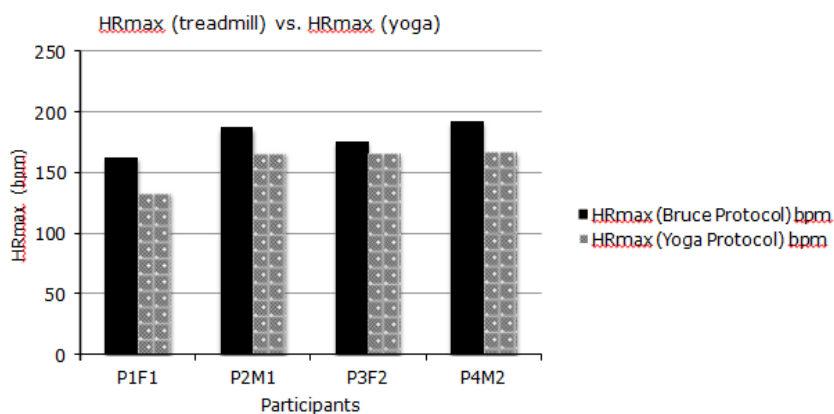


Figure 4: HRmax (treadmill) vs. HRmax (yoga).

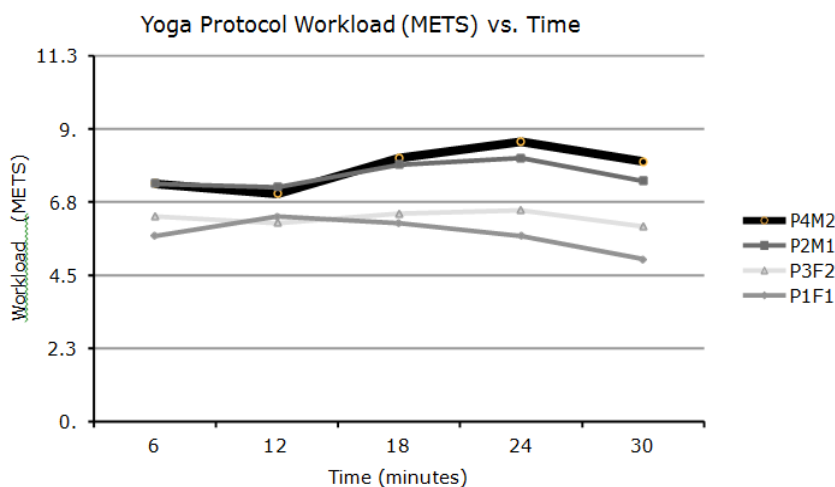


Figure 5: Yoga Protocol Workload (METS) vs. Time.

response, but the authors found that, in contrast, the sun salutations portions (flowing continuous movements) elicited a moderate response [5]. In another yoga study, consisting of thirty minutes of continuous yoga sun salutations, a moderate intensity metabolic and cardiovascular response was recorded [10]. This study utilizes a specific and consistent pace as a benchmark for the completion of the sun salutation, Surya Namaskar B, and demonstrates that the practice can meet moderate intensity physical activity guidelines, when measured against the individual's assessed maximum capacity.

A limitation of this study is the small sample size. Direct measurement of VO_2 is a costly, labor intensive and time-consuming process [17]. This factor limited the ability of the researchers to increase the sample size of this study. However other studies of the cardiovascular response to yoga sun salutations (flowing, continuous yoga sequences) with a small sample size or moderately sized samples support the findings in this study [5,6,9].

Finding innovative and accessible ways for populations to access physical activity is a topic that will remain on the forefront of exercise research and public health policy, as individuals live longer lives and as rates of cardiovascular disease and other comorbidities associated with sedentary lifestyle remain prominent. The data from this study demonstrates that the practice of Surya Namaskar B, when paced accordingly, can elicit a moderate intensity cardiovascular response from the body. There are numerous types and lineages of yoga practices. Some yoga practices are performed and sequenced with poses that are held longer with less of a focus on cardiovascular response. Vinyasa flow yoga, at the pace of this study, may not be an optimal practice for all populations, however it may serve as an accessible form of exercise that meets the intensity requirement to reduce risk of cardiovascular disease and improve exercise tolerance. This practice can also be adapted to fit wider demographics, through modification of pace and postures. Research has demonstrated that as further research is conducted on vinyasa flow yoga and the "Sun Salutations," the discipline may develop into a viable and popular exercise option and perhaps become a mainstay in the arena of physical activity and fitness.

Acknowledgement

This study could not have been completed without the generous support of the Department of Kinesiology, Brooklyn College and the tireless guidance and support of Dr. Christopher C. Dunbar.

References

- Sengupta P (2012) Health impacts of yoga and pranayama: A state-of-the-art review. *Int J Prev Med* 3: 444-458.
- Streeter CC, Whitfield TH, Owen L, Rein T, Karri S K, et al. (2010) Effects of yoga versus walking on mood, anxiety, and brain GABA levels: a randomized controlled MRS study. *J Altern Complement Med* 16: 1145-1152.
- Telles S, Reddy SK, Nagendra HR (2000) Oxygen consumption and respiration following two yoga relaxation techniques. *Appl Psychophysiol Biofeedback* 25: 221-227.
- American Heart Association (2014) Yoga and Heart Health.
- Clay CC, Lloyd LK, Walker JL, Sharp KR, Pankey RB (2005) The metabolic cost of hatha yoga. *J Strength Cond Res* 19: 604-610.
- Hagins M, Moore W, Rundle A (2007) Does practicing hatha yoga satisfy recommendations for intensity of physical activity which improves and maintains health and cardiovascular fitness? *BMC complementary and alternative medicine* 7: 40.
- Broad W J (2012) The science of yoga: The risks and the rewards. Simon and Schuster.
- Chaya MS, Kurpad AV, Nagendra HR, Nagarathna R (2006) The effect of long term combined yoga practice on the basal metabolic rate of healthy adults. *BMC complementary and alternative medicine* 6: 28.
- Brown SP, Miller WC, Eason JM (2006) Exercise physiology: basis of human movement in health and disease. Lippincott Williams & Wilkins.
- Mody BS (2011) Acute effects of Surya Namaskar on the cardiovascular & metabolic system. *J Bodyw Mov Ther* 15: 343-347.
- Sinha B, Ray US, Pathak A, Selvamurthy W (2004) Energy cost and cardiorespiratory changes during the practice of Surya Namaskar. *Indian J Physiol Pharmacol* 48: 184-190.
- Glassford RG, Baycroft GHY, Sedgwick AW, Macnab RBJ (1965) Comparison of maximal oxygen uptake values determined by predicted and actual methods. *J Applied Physiol* 20: 509-513.
- Bruce RA, Kusumi F, Hosmer D (1973) Maximal oxygen intake and nomographic assessment of functional aerobic impairment in cardiovascular disease. *Am Heart J* 85: 546-562.
- American College of Sports Medicine (2011) ACSM's Complete Guide to Fitness & Health. Human Kinetics.
- Charkoudian N, Joyner M J (2004) Physiologic considerations for exercise performance in women. *Clin Chest Med* 25: 247-255.
- American College of Sports Medicine (2010) ACSM's Guidelines for Exercise Testing and Prescription.
- Grant S, Corbett K, Amjad AM, Wilson J, Aitchison T (1995) A comparison of methods of Predicting maximum oxygen uptake. *Br J Sports Med* 29: 147-152.