Complementary Therapies in Clinical Practice 32 (2018) 195–199

Contents lists available at ScienceDirect

Complementary Therapies in Clinical Practice

journal homepage: www.elsevier.com/locate/ctcp

# Heart rate and thermal responses to power yoga

Matthew M. Schubert*, Amy S. Clark, Annie B. De La Rosa, Sean C. Newcomer

*CSU San Marcos, Department of Kinesiology, San Marcos, CA, USA*

ARTICLE INFO

*Keywords:*
Yoga
Heart rate
Intensity
Exercise prescription

ABSTRACT

*Background:* and Purpose: Yoga has grown in popularity and may offer a viable alternative form of physical activity. The purpose of this study was to examine heart rate, hydration, and thermal responses to a power yoga sequence.

*Materials and Methods:* Twenty-seven men and women (n = 4/23; Mean ± SD age = 23.3 ± 3.3 years; BMI = 23 ± 3 kg $m^{-2}$) underwent ~45 min of power yoga. Heart rate and skin temperature were recorded. Mass was measured before and after exercise to estimate fluid loss. Time spent in light, moderate, and vigorous heart rate zones was calculated.

*Results:* Heart rate and skin temperature increased ($p < 0.0001$). Participants spent more time in moderate and vigorous heart rate zones than in light intensity ($p < 0.0001$). There was a reduction in body mass (−0.28 ± 0.13 kg, $p < 0.0001$).

*Conclusion:* Power yoga may be considered moderate-vigorous intensity exercise, based on heart-rate.

## 1. Introduction

Yoga is a physical practice that was developed in India several thousand years ago and is now being used as an alternative form of exercise in the United States. Yoga has become increasingly popular in the West with surveys suggesting 31 million American adults have practiced yoga at least once in their lifetime [1]. Yoga was ranked seventh in a survey of fitness trends for 2018 b y the American College of Sports Medicine (ACSM) [2]. While yoga and exercise have been argued to be distinct constructs, yoga can confer many of the same benefits as exercise, but with a focus on the mind and spirituality instead of fitness or competition [3]. Yoga can be divided into many different branches and styles, depending on the perceived purpose, instructor, etc. This can present challenges to researchers due to inconsistencies in terms and definitions [4]. In modern literature, Hatha yoga encompasses "postural" yoga, which appears to be the form that is of interest to researchers examining complementary or alternative therapies [4]. Postural yoga differs from other forms of yoga, such as meditational, by focusing on the "orthopraxy of postures (asanas)" compared to a "specific set of meditations" [4,5]. Within postural yoga, power yoga (sometimes referred to as vinyasa; for clarity we use the term "power yoga" throughout the manuscript) is focused more on strength building as opposed to meditation or stretching, by incorporating a quick pace using a "breath to movement" technique or involving long isometric holds [6,7].

Current health guidelines recommend that individuals accumulate 30 min of moderate-intensity aerobic exercise at least 5 days a week, or the equivalent amount of vigorous-intensity exercise (20 min·$d^{-1}$, 3 d·$wk^{-1}$) [8]. These guidelines state that these intensities are equivalent to ~64–76% heart rate max ($HR_{MAX}$) and 3–5.9 metabolic equivalents (METs) for moderate-intensity and > 77% $HR_{MAX}$ and > 6 METs for vigorous-intensity. Guidelines also encourage exercises to increase strength, balance, and flexibility. In this regard, yoga may be well-suited for meeting existing exercise guidelines in a multitude of populations [8]. However, it is also important to note that yoga is also performed for many other benefits including stress reduction, self-reflection, and meditation [3].

The existing data on the intensity of yoga is unclear; the data are likely confounded by type of yoga and the populations studied. Larson-Meyer recently performed a systematic review and reported that the majority of studies assessing energy expenditure during yoga fall within the light (< 3 METs) to moderate intensity (3–6 METs) [9]. Heart rate responses have reported values ranging between 50 and 86% predicted $HR_{MAX}$ [10–12]. Differences in participant populations, type of yoga, environmental conditions, and other study characteristics likely explain the wide range of results that have been observed in the literature. An abstract reported that 15 min of power yoga stimulated a heart rate equal to ~77% $HR_{MAX}$ and energy cost of 6.7 METs, which would classify power yoga as a moderate intensity activity; however, the duration of this session was very short [13]. More recent work has

* Corresponding author. Dept. of Kinesiology, California State University, San Marcos, UNIV 325, USA.
*E-mail address:* mschubert@csusm.edu (M.M. Schubert).

https://doi.org/10.1016/j.ctcp.2018.07.003
Received 17 May 2018; Received in revised form 12 July 2018; Accepted 16 July 2018
1744-3881/ 

reported that power yoga elicited a lower energy expenditure and MET values (4.3 vs. 4 METs) than self-selected walking, but a higher heart rate (101 vs. 114 BPM), and higher age-predicted percent $HR_{MAX}$ (53% v. 60%) during 45 min of activity [14].

During prolonged exercise, or exercise in hot/humid conditions, increased heart rate and body temperature are common [15]. Even with a constant core temperature, however, increases in skin temperature drive increases in heart rate [16]. Fluid loss through increased sweat rate is also prevalent. This leads to cardiovascular strain as the blood shifts towards the cutaneous vasculature, leading to reduced stroke volume and increased heart rate to maintain cardiac output. The thermal responses to yoga have focused on Bikram yoga, which is a 90 min sequence performed in hot (~40 °C) conditions [10]. Given that isometric contractions, such as those common during power yoga, can increase heart rate as well [17], it is possible that even yoga conducted in thermoneutral environments may lead to elevated skin and core temperature, causing levels of fluid loss that approach hypohydration (≥2% body mass loss) [18].

While studies have measured the metabolic costs of yoga, Hatha and Bikram yoga have been the main styles examined [10–12,19,20]. As Bikram yoga typically elicits environmental stress and restorative yoga focuses on relaxation poses and mind-body interaction and reflection, power yoga may be more appealing for fitness and body toning [5,7,14]. Therefore, the purpose of this study was to determine physiological (heart rate, skin temperature, and changes in body mass) responses to power yoga in college students. We hypothesized that participants would spend a majority (> 60%) of the class in moderate-vigorous heart rate zones, with an elevation in skin temperature and associated fluid loss via reduction in body mass.

## 2. Methods

### 2.1. Participants

Twenty-seven men and women (n = 4/23; Mean age & BMI = 23.3 ± 3.3 years; 23 ± 3 kg m$^{-2}$) participated in ~45 min of yoga, in a university Human Performance Lab. The class was led by a 500-h Registered Yoga Teacher (ASC). All participants were educated on risks and benefits and provided informed consent before participation. The study was approved by the institutional Human Subjects Review board and conformed to the guidelines set forth under the Declaration of Helsinki.

### 2.2. Procedures

Participants were instructed to arrive hydrated and at least 3 h after their last exercise bout. Upon arrival, they voided and were then weighed nude on a digital scale accurate to 0.05 kgs (Bluetooth Smart Scale Model #0375, Greater Goods Brand, St. Louis, MO, USA) behind a curtain. After this, they were fitted with a heart rate monitor and skin thermistor (described subsequently). We measured heart rate and % $HR_{MAX}$ as our marker of physiological intensity as we lack portable metabolic equipment, and presently there is no "gold standard" for prescribing exercise intensity [8]. The instructor took participants through the yoga sequence (Table 1). Most poses were held for ~6 breaths (~30 s), while others were conducted "breath to movement", which occurs when participants completed one pose per inhale or exhale (~3 s). Upon completion of the yoga sequence, participants stopped the recordings, turned in the monitors, and reweighed themselves.

Testing was conducting in a classroom in our Human Performance Lab. Participants were tested in groups of 5–10 individuals during 5 separate measurement sessions conducted over a 1-month period. All sessions were completed at the same time of day (1000–1130). Lab temperature and humidity were recorded at the beginning and end of each data collection day. Participants were instructed to report to the lab well hydrated and approximately 3 h post-prandial, and this was verified through self-report. They were not permitted to consume any fluid during the sequence. The convenience sample was recruited by word of mouth. Some participants had experience with yoga, but as a whole, participants were inexperienced (< 20 attended sessions per [10]).

**Table 1**
Power Yoga sequence with English names of asanas.

| Asana/movement |
|---|
| Child's Pose |
| Cat/Cow |
| Bird/Dog |
| Downward dog→Forward Fold→half way lift→ mountain pose→side bend both directions |
| Sun Salutation A x 2 repetitions[a] |
| Sun Salutation B x 3 repetitions[a] |
| Downward Dog→ 3-legged dog→ knee-to-nose x 3 repetitions[a] → high lunge twist ×4 repetitions[a] |
| Chaturanga |
| Downward Dog→ 3-legged dog→ knee-to-nose x 3 repetitions[a] → high lunge twist ×4 repetitions[a] (opposite side) |
| Chaturanga |
| Downward Dog→3-legged dog→ knee-to-triceps→ high lunge → warrior II → side angle pose → side angle pose with fly arms → reverse triangle pose |
| Chaturanga |
| Downward Dog→3-legged dog→ knee-to-triceps → high lunge → warrior II → side angle pose → side angle pose with fly arms → reverse triangle pose (opposite side) |
| Chaturanga |
| Downward Dog→High lunge → twisted lunge → high lunge → warrior I → humble warrior → warrior III → standing split → chair pose → twist chair (twist right and left) |
| Chaturanga |
| Downward Dog→High lunge → twisted lunge → high lunge → warrior I → humble warrior → warrior III → standing split → chair pose → chair with heels lifted (opposite side) |
| Chaturanga |
| Downward Dog→high plank→ side plank→high plank→ low plank→ high plank→ side plank (opposite side)→ high plank→ low plank→ high plank |
| High plank→ one legged high plank→switch legs→forearm plank→ one legged forearm plank→ switch legs |
| Child's pose |

[a] Denotes breath-to-movement. All other poses held for 6 breaths (~30 s).

### 2.3. Devices

The Polar® OH1 is a new optical heart rate sensor from Polar® (Polar Electro Inc., Bethpage, NY, USA). In contrast to other photoplethysmography (PPG) sensors typically worn on the wrist, the OH1 is worn on an armband on the lower or upper arm. For the present study, the device was worn on the upper right arm, distal to the biceps brachii. The OH1 records at 1-s intervals using 6 LED sensors. We operated the OH1s in standalone recording mode. Validation testing, completed concurrently, revealed that the device had excellent agreement with a standard Polar chest sensor (r = 0.987; mean bias = −0.76 bpm) [21]. For analysis, data were averaged in 30-s "bins".

The iButton thermistor (DS1921G; Thermocron Inc., Baulkham Hills, NSW, Australia) was used to record skin temperature. The iButton was placed on the upper left arm, medial to the triceps, and secured with Tergaderm™ (3 M Inc., Minneapolis, MN, USA). The iButton was programmed to record at 30-s intervals during exercise and was downloaded immediately after the yoga sequence for analysis (eTemperature, Thermocron, Inc., Baulkham Hills, NSW, Australia) and exported to Microsoft Excel.

### 2.4. Statistical analysis

Data were exported into a Microsoft Excel spreadsheet for initial examination and integrity checks. Thereafter, data were analyzed in