Heart rate in yoga asana practice: A comparison of styles

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Summary Yoga is often recommended for stress relief, yet some of the more fitness-oriented styles of yoga can be vigorous forms of exercise. The purpose of this study was to investigate differences in heart rate during the physical practice of yoga postures, breathing exercises, and relaxation. Sixteen participants were led through three different styles of yoga asana practice. Polar S610 heart rate monitors were used to measure one minute average heart rates throughout each session. Repeated measures analysis of variance indicated that there was a significant difference (P < 0.05) in heart rate between astanga yoga (M = 95, SD = 12.84) and the other two styles, but not between the hatha (M = 80, SD = 9.32) and gentle (M = 74, SD = 7.41) yoga styles. These results indicate that there may be different fitness benefits for different styles of yoga practice.

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INTRODUCTION

There are different approaches to yoga including spiritual, therapeutic, and developmental (Herrick and Ainsworth, 2000). However, the underlying premise of mind–body exercise modalities—like yoga—is that the physiological state of the body can affect emotions, thoughts, and attitudes, which in turn have a reciprocal affect on the body (Ives and Sosnoff, 2000). Yoga research has generally indicated a positive impact of yoga practice on a variety of outcomes, but much of the research has focused on disease rather than fitness-related outcomes (Raub, 2002). Traditionally, the purpose of the postures is to prepare the body and mind to sit in stillness for periods of contemplation (Collins, 1998). Fitness industry reports indicate growth in yoga participation at health and fitness clubs (Sports participation trends, 2002), which suggests emphasis on the developmental approach to yoga—the practice of yoga for physical fitness benefits. Interestingly, widely recognized health
and fitness guidelines do not recommend yoga for fitness but rather for stress relief (Franklin, 2000). Given the many different approaches to yoga practice, the benefits and outcomes are likely different depending on the style. Some of the more fitness-oriented yoga styles can be vigorous forms of exercise, while styles that emphasize focus and self-awareness may provide more subjective benefits.

Research that has evaluated the energy expenditure of yoga indicates that yoga is essentially equivalent to moderate forms of exercise. (DiCarlo et al., 1995; Rai et al., 1994; Raju et al., 1986). The available evidence suggests that the practice of yoga may be associated with an improvement in cardiorespiratory fitness (Prasad et al., 2001; Tran et al., 2001), and both muscular strength and endurance (Birch, 1995; Lidell et al., 1983). While promising, these studies have involved only a few postures or exercises. A single study that evaluated heart rate for standing yoga postures found lower heart rate and higher rate of perceived exertion for the yoga posture sequence compared to treadmill walking (DiCarlo et al., 1995). All of this suggests the need for research on fitness-related outcomes associated with yoga practice.

In summary, while the existing evidence suggests that yoga may qualify as moderate exercise, no research on energy expenditure or heart rate response over an entire yoga asana session exists, nor has any study compared different styles of yoga asana practice. Therefore, the purpose of this study was to conduct a descriptive evaluation of the heart rate response among three styles of yoga all of which included the physical practice of postures (asana), breathing exercises (pranayama), and relaxation (savasana).

**Methods**

**Participants**

Potential participants responded to announcements advertising the study and were screened via the physical activity readiness questionnaire (PAR-Q). Sixteen volunteer participants completed data collection for all three yoga styles (see Table 1 for descriptive characteristics). Prior to participating in any of the study procedures, all participants read and signed an informed consent approved by the university’s human subjects institutional review board.

The majority of the participants ($N = 12$) reported engaging in an average of thirty minutes of physical activity per day in the week prior to the study. Eight participants had practiced yoga at least once in the week prior to the study, 6 participants had never done yoga. The participants represented a variety of physical fitness levels. Mean Body Mass Index was 22.3 (SD = 3.36), mean systolic blood pressure was 114.5 (SD 13.0), and diastolic blood pressure was 73.9 (6.5). Only two participants ranked above the 60th percentile for age/gender group in flexibility assessed with a sit and reach box, and 9 ranked above average or higher for age/gender graded cardiorespiratory fitness on an Astrand-Rhyming submaximal predictive VO2 max cycle ergometer test (Franklin, 2000).

**Instrumentation**

The primary data of interest was heart rate. Wireless heart rate monitors that use chest electrodes are considered reliable and valid measures of heart rate (Achten and Jeukendrup, 2003). All participants wore Polar S610 heart rate monitors for each yoga session. Each participant wore the chest electrode transmitter and a wrist receiver which recorded average heart rate in 1 min intervals for the entire session. Participants were placed approximately 5 feet apart to ensure that only their heart rate was recorded by the receiver on their wrist. Participants started and stopped the heart rate monitors simultaneously. Polar Precision Software was used to download data to computer for analysis.
Protocol
Participants were informed that the study would involve lead yoga sessions rather than comprehensive instruction in yoga asana. The postures, breathing exercises, and meditation were timed and lead from a script by the first author. Since touch is known to affect physiological variables such as heart rate (Field, 1998), only verbal corrections were made to individual participants if necessary to realign the body in a posture. Two 80-min sessions for each yoga style were held to allow participants to become familiar with the series of postures and exercises. The data from the second session for each style were used for analysis. Some advanced postures were included in the sessions, and participants were instructed to work to their own level of ability and to lie down for rest when necessary. Three different styles of yoga asana were used for the study: astanga, hatha, and a gentle class. All sessions began with a 5-min relaxation period and were adapted to fit within an 80-min time period.

Astanga yoga
The astanga yoga session was based on a published astanga yoga primary series (Birch, 1995; Swenson, 1999). In order to fit the session within an 80-min time period, a few postures were omitted (parsvottanasana, trianga mukhaikapada paschimottanasana, janu sirasana C, garbha pindasana, and marichyasana D), and final relaxation (savasana) was shortened. This session began with 10 min of warm-up (surya namaskara A and B). Participants were instructed to utilize ujjayi breathing (deep, steady breaths that make a swirling or “aahhh” sound on exhalation as the air brushes the soft palate on exhalation) throughout, and were instructed where to direct their gaze (drishti) while sustaining each posture. Vinyasa (a series of movements) was used between seated postures in the series.

Hatha yoga
The hatha yoga session was also based on a published yoga series (Lidell et al., 1983). This session began with 9 min of warm up (surya namaskara) and was adjusted for time by shortening the warm-up (surya namaskar) two breathing exercises (kapalabhati and anuloma viloma), two advanced postures (sirasana and sarvangasana), and final relaxation (savasana). Participants adopted a relaxation posture for 1 min after most of the postures in the session.

Gentle yoga
A gentle session was created based on information gathered from several sources (Farhi, 2000; Iyengar, 1979; Mehta et al., 1990; Satchidananda, 1998; Yee, 2002). This session was designed to be relaxing in nature and suitable for individuals who might have limitations but were able to get on and off the floor without assistance. It did not include a warm-up or any advanced postures, but instead emphasized breathing exercises, stretching, a few strengthening postures, and a 15-min final relaxation (savasana) period.

Statistical analysis
Data were analyzed using SPSS (version 11.0). Repeated measures analysis of variance (ANOVA) was used to compare heart rate for each yoga style. The level of significance was set at \( P < 0.05 \).

Results
A repeated measures ANOVA did not reveal a significant difference for beginning relaxation heart rate (measured during minute 4 of each session) or final resting heart rate (measured during minute 78) between any of the yoga styles (see Table 2). A significant difference was found for the entire 80-min session as well as the “Postures only” portion of the session—which occurred between the initial and final relaxation postures. Bonferroni post hoc tests revealed significance for the astanga yoga heart rate when compared to the other two styles. No significant difference was found between the hatha yoga and gentle styles.

The heart rates recorded for the sessions when compared to age-graded maximum recommended heart rate suggests that the astanga yoga may elicit increases in heart rate sufficient to improve cardiorespiratory fitness (see Table 2). No significant differences were noted in comparison of participants who attempted all postures \((N = 8)\) to participants who opted to rest during more advanced postures \((N = 8)\). Figure 1 illustrates the mean heart rates for all participants for the entire yoga session. As illustrated on the graph, all three yoga styles involved intermittent rather than steady-state activity. This was particularly apparent in the hatha class in which the relaxation posture (savasana) was adopted after the majority of postures.

Discussion
This study found a significant difference in heart rate among the three different styles of yoga asana.
practice evaluated. The power for the repeated measures ANOVA of the heart rates for the full session, the postures-only portion of the session, and the increase in heart rate from beginning relaxation was 1.00 and the effect size 0.96 indicating a highly reliable test. The results of this study suggest that a more vigorous style of yoga is the heart rate equivalent of moderate exercise and may contribute to increases in cardiorespiratory fitness for individuals who are de-conditioned or not physically active.

Research has identified that day-to-day variability in heart rate, and other factors such as hydration and cardiac drift influence heart rate response to exercise (Achten and Jeukendrup, 2003). Given the variety of postures and positions of the body involved in yoga asana practice, direct measure of energy expenditure via gas expiration would not be feasible for a full yoga asana session.

Even a small wrist receiver interfered with two yoga postures that required the hands to be placed on the mat underneath the body: fish (matsyasana) and locust (salabhasana). Removing the wrist receiver and replacing it mildly interrupted the flow of the session, but was necessary for execution of the postures.

A wide range of participants provided data for this study and all reported enjoying the yoga sessions, regardless of style. This was surprising since the sessions were somewhat impersonal due to the scripting and timing of postures and that participants were requested not talk or ask questions. None of the participants were able to maintain ujjayi breathing for the entire astanga posture series. It is possible that this breathing style—when executed successfully—may cause increased internal temperature and perspiration as suggested (Birch, 1995), eliciting a higher heart

### Table 2  Mean heart rate for yoga sessions.

<table>
<thead>
<tr>
<th>Heart rate (bpm)</th>
<th>Astanga session</th>
<th>Hatha session</th>
<th>Gentle session</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Beginning savasana</td>
<td>69.91</td>
<td>11.73</td>
<td>67.63</td>
</tr>
<tr>
<td>Full yoga session (80 min)</td>
<td>95.18*</td>
<td>12.84</td>
<td>80.17</td>
</tr>
<tr>
<td>Postures only</td>
<td>100.69*</td>
<td>13.81</td>
<td>83.37</td>
</tr>
<tr>
<td>Final savasana</td>
<td>67.25</td>
<td>14.33</td>
<td>62.13</td>
</tr>
<tr>
<td>Postures only(^\d) increase from beginning savasana (bpm)</td>
<td>30.77*</td>
<td>13.31</td>
<td>15.75</td>
</tr>
<tr>
<td>% of maximum heart rate</td>
<td>54%</td>
<td>0.09</td>
<td>45%</td>
</tr>
</tbody>
</table>

* Significant difference between sessions, \(P<0.05\).
\(^\d\) Portion of class between beginning relaxation and final relaxation: astanga = 64 min, hatha = 64 min, gentle = 58 min.

**Figure 1** Mean minute-by-minute heart rate for yoga sessions.
rate. With the exception of ujjayi breathing and minor adjustments to alignment, participants did not seem to have difficulty following the instructions to participate in the sessions.

In conclusion, data from this study indicate that there are varied physiological responses associated with different yoga asana styles, and suggests potential for different levels of physical fitness benefits depending on the style of physical practice. As yoga participation increases at health and fitness clubs, it will be important for research to assess physical fitness benefits, as well as changes in psychological, subjective health and well-being measures. It is important for clinicians and health educators who promote yoga to understand the difference between different styles of yoga asana practice.

References