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Heart Rate Response to Vinyasa Yoga in Healthy Adults

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Abstract

Background: Yoga is a popular exercise, but the heart rate (HR) response to specific styles of yoga is unknown.

Primary Study Objective: To determine if vinyasa yoga is an aerobic physical activity based on the HR response of participants.

Methods/Design: Observational study using a convenience sample

Setting: Exercise room on a university campus

Participants: Forty-two adults aged 21-54 years with prior yoga experience completed the yoga session with no adverse events. Equipment malfunction precluded data analysis for 4 participants.

Intervention: A 50-minute vinyasa yoga class that included 10 minutes of pre-activity rest, 35 minutes of asanas, and 5 minutes of meditation. Participant HR was recorded continuously during the class.

Primary Outcome Measures: Mean HR response and time spent at each intensity level during asanas.

Results: The data of 38 participants were analyzed. Mean (SD) HR for all participants during asanas was 107 (23) beats per minute (bpm), and 44% of the asana time was considered light-intensity aerobic physical activity. The mean response (expressed as a percent of maximal HR or $\%HR_{max}$) was considered very light intensity (<50% of HR_{max}) for 6 participants, light intensity (50-63% of HR_{max}) for 21 participants, moderate intensity (64-76% of HR_{max}) for 10 participants, and vigorous intensity (77-93% of HR_{max}) for 1 participant.

Conclusions: In the current study, vinyasa yoga was primarily a light-intensity aerobic physical activity, but individual responses varied. This information adds to the body of literature regarding the physiological response to yoga and specifically addresses the aerobic response to vinyasa yoga.

Introduction

Yoga is an increasingly popular mode of exercise. In the United States, yoga generally refers to classes in which participants place themselves in specific poses called asanas. Different styles of yoga emphasize different aspects, such as breathing techniques, relaxation, flexibility, strength, or the flow of poses into sequences. Vinyasa is a generic term for any style of yoga in which participants follow an instructor in a sequence of asanas that are linked by a flow of movements and active breathing [1]. This class format is typically found in fitness centers and this style of yoga has become increasingly popular. The flowing sequence of poses uses large body movements and is usually fast-paced, so vinyasa yoga may increase heart rates and lead to cardiovascular benefits.

Many benefits of yoga have been reported, including a reduction in stress levels and improvements in cardiovascular fitness, flexibility, balance, endurance, body composition, muscular strength, and emotional well-being [2-32]. In spite of suggestions that yoga can improve cardiovascular fitness, few studies have measured the heart rate response to specific styles of yoga. Rzesutko et al. [33] measured heart rate and rate of perceived exertion (RPE) in young adults with no prior yoga experience during power yoga classes, a type of vinyasa yoga that emphasizes strength and flexibility. The exercise intensity of the classes did not sustain heart rates within aerobic ranges and RPE did not correlate with heart rate. Carroll et al. [34] measured heart rate, oxygen consumption, and lactate production during a 15-minute video tape of 6 ashtanga yoga asanas. They concluded that this type of yoga induces a moderate cardiovascular response through a combination of aerobic and anaerobic energy requirements. Similarly, Blank et al. [35] measured heart rate and whole body metabolic responses in 6 healthy participants during a 60-minute power yoga class and found that participants were able to achieve and maintain 60%-70% of maximal heart rate (HR_{max}). Finally, Anders [2] compared the aerobic intensity of a hatha yoga and a power yoga class, using a 50-minute videotape for both classes. The hatha yoga class elicited heart rates below the recommended range for improving cardiovascular fitness according to the American College of Sports Medicine (ACSM) guidelines [36], while the power yoga class elicited heart rates in the lower end of the beneficial heart rate range. Although these results suggest that some forms of yoga are an aerobic physical activity, the findings are not consistent and it remains unclear which ones meet the ACSM and American Heart Association (AHA) physical activity guidelines [37].

Understanding the heart rate response to specific types of yoga would support recommending a particular style as a very light-intensity (<50% of HR_{max}), light-intensity (50%-63% of HR_{max}), moderate-intensity (64%-76% of HR_{max}), or vigorous-intensity (77%-93% of HR_{max}) aerobic exercise [36]. Additionally, such information would be useful in helping individuals determine how to meet the current

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ACSM and AHA physical activity guidelines of at least 30 minutes of moderate-intensity aerobic physical activity 5 days per week or 20 minutes of vigorous-intensity aerobic physical activity 3 days per week [37]. Therefore, the purpose of this study was to determine whether vinyasa yoga taught by a live instructor in a realistic class setting produced heart rate responses in ranges that constitute very light-intensity, light-intensity, moderate-intensity, vigorous-intensity, or very hard-intensity aerobic physical activity.

Methods

Participants

Potential participants were recruited by convenience sampling via flyer advertisement and verbal announcement at local fitness centers, yoga studios, and universities. Inclusion criteria were participants aged between 18 and 54 years and prior yoga experience. Prior yoga experience was required so participants would be familiar with the practice and able to perform the instructed asanas without loss of time during the class. Potential participants were excluded from the study if they had never participated in yoga or had known heart conditions, a history of stroke, joint conditions or replacements, arthritis, pulmonary conditions, skin lesions, or sensitivities to heart rate monitor electrodes. Potential participants taking medications that alter heart rate, such as beta-blockers, were also excluded. The Institutional Review Board of the local university approved the study. Prior to the class, each participant gave written informed consent and completed a demographic questionnaire for age, sex, height, weight, medications, subjective flexibility, exercise habits, and yoga experience, including frequency of yoga sessions per week and length of time they had participated in yoga. Participants were instructed not to smoke or ingest coffee or other sources of caffeine for the 3 hours preceding participation in the study.

Yoga class protocol

Each participant completed one yoga class taught by a live instructor in a realistic class setting. Twelve 50-minute vinyasa yoga classes were conducted in a quiet exercise room on a university campus with 1-5 participants in each class. The class instructor (NF) was an American Council on Exercise (ACE) certified group fitness instructor who had taught yoga in fitness settings for over 5 years. The instructor designed the class as a vinyasa yoga class. Each class began with 10 minutes of supine rest to reduce the heart rate toward resting level and ended with a 5-minute meditation period, also in supine. The active component of the class, approximately 35 minutes, followed the same sequence of asanas (Supplement) with the same verbal and visual cues in all 12 classes. Room conditions were consistent for all 12 classes with the same low volume instrumental background music and decreased lighting during pre- and post-asanas supine rest periods, and an ambient temperature of 23°C.The start and stop time of each asana and any transitions between asanas were measured and recorded by one researcher (SSW) who observed each class to insure relative consistency between all classes.

Participants were advised to perform asanas to their own ability, and modifications were suggested when appropriate to reduce risk of injury. Each participant was fitted with a Polar S810 heart rate monitor (Polar Electro Inc., Lake Success, NY) prior to the start of the class, and heart rate was measured continuously throughout the class. Yoga mats were placed at least 1 meter apart to reduce the risk of interference from other heart rate monitors.

Data Analysis

Heart rate (HR) was recorded on a beat-to-beat basis and was averaged every 5 seconds. After each class, participants' heart rate data were downloaded to a computer for later analysis. Analyses included calculating the mean HR and the mean intensity stratification for the asanas, or active portion of the session, for each participant. Mean HR intensity stratifications were based on the ACSM aerobic physical activity ranges [36], which are defined as: very-light intensity (<50% of HR_{max}), light-intensity (50%-63% of HR_{max}), moderate-intensity (64%-76% of HR_{max}), vigorous-intensity (77%-93% of HR_{max}) and very hard-intensity (≥ 94% of HR_{max}).HR_{max} was not measured directly in this study because it was not feasible to perform a test of maximal aerobic capacity on each participant. However, estimations of HR_{max} are commonly used when formulating an exercise prescription. For this study, each participant's HR_{max} was calculated using the equation of Tanaka et al. [38] (HR_{max}=208–0.7×age). This equation was used rather than the traditional equation (HR_{max}=220–age), which may underestimate HR_{max} and thus underestimate the true level of physical intensity for some participants. In addition, percentage of HR_{max} for each 5-second average HR interval was calculated to determine the percentage of time each participant spent in the 5 HR intensity stratification ranges throughout the active portion of the yoga class [38]. Finally, the relationship between mean HR and age and between mean HR and BMI were assessed using the Pearson *r*.

Microsoft Excel (Microsoft Corporation, Redmond, WA) was used to calculate HR means and standard deviations (SD). SPSS (IBM SPSS Statistics 19.0, IBM, Chicago, IL) was used to calculate the amount of time spent in each intensity level throughout a class and for correlation analyses.

Results

Demographic characteristics

Forty-three individuals initially volunteered to participate in the study. One potential participant did not meet the inclusion criteria and four were excluded from analyses due to heart rate monitor malfunction. Thirty-eight participants (8 males, 30 females) completed the study without adverse events. Participants had a mean (SD) age of 31.4 (8.7) years and mean (SD) BMI of 23.3 (4.4). Not all participants responded completely to questions about yoga participation, but 9 participants reported doing yoga infrequently (less than 1 time per week), 23 participants reported doing yoga 1 or 2 times per week, and 3 participants reported doing yoga 3 or 4 times per week. Twenty-seven participants reported that they had "years of experience," and 8 participants reported having "several months of experience".

Mean percent of maximal heart rate and time in exercise intensity ranges

The group mean (SD) HR for the asanas was 107 (23) beats per minute (bpm). The group mean (SD) $\%HR_{max}$ was 58% (12), which is light-intensity aerobic activity according to the ACSM intensity stratification ranges [36]. Six participants achieved a mean $\%HR_{max}$ of very light-intensity (<50% of HR_{max}), 21 a mean $\%HR_{max}$ of light-intensity (50%-63% of HR_{max}), 10 a mean $\%HR_{max}$ of moderate-intensity (64%-76% of HR_{max}), and 1 a mean $\%HR_{max}$ of vigorous-intensity (77%-93% of HR_{max}) aerobic physical activity (Table 1). Mean HR was not correlated with age (r=0.19, p=.26) or with BMI (r=0.23, p=.17).

The mean percentage of time spent in each intensity stratification range for all participants is shown in Figure 1. The mean for all

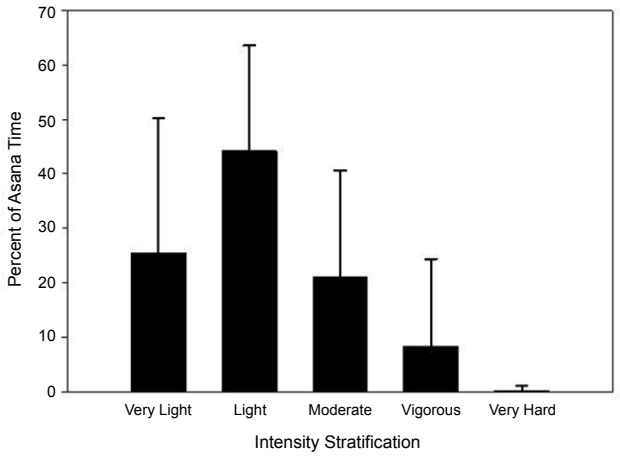

Figure 1: Percentage of Time Spent in Each Intensity Stratification Range by All Study Participants.

participants shows that 44% of the asanas time was spent in light-intensity aerobic physical activity. The percentage of time individual participants spent in each intensity stratification range is shown in Table 1.

Discussion

The purpose of this study was to determine whether vinyasa yoga taught by a live instructor in a realistic class setting produced heart rate responses in ranges that constitute very light-intensity, light-intensity, moderate-intensity, vigorous-intensity, or very hard-intensity aerobic physical activity. Our findings indicate that this style of yoga can be considered a light-intensity aerobic physical activity as evidenced by the group mean $\%HR_{max}$ and because more than half the participants achieved a mean HR response in the light-intensity aerobic physical activity range. This information adds to the body of literature regarding the physiological response to yoga and specifically addresses the aerobic response to vinyasa yoga. By describing the HR response according to intensity stratification guidelines, those who practice or educate others about vinyasa yoga should have an increased understanding of how this activity contributes to one's weekly exercise volume.

Several investigators have measured the HR response to power yoga, with results ranging from an inability to sustain an aerobic HR [33] to an HR in the low end of a beneficial range [2,33,35] or one in a moderate-intensity aerobic range [35]. Similarly, there are conflicting findings about the HR response to ashtanga yoga, which has been shown to elicit a moderate aerobic response during a 15-minute videotape session [34] but a low-level aerobic response to a 56-minute DVD session [39]. Hatha yoga has also been shown to be a low-level aerobic activity [40]. Using 30-minute hatha yoga videotape sessions with 19-40 year old females, Clay et al. [40] measured a mean HR response of 105 bpm and a mean $\%HR_{max}$ of 57%, remarkably similar to the findings of the current study. We anticipated that a yoga class with a live instructor might affect the HR response, but this does not appear to be the case. Otherwise, both of these studies had participants of a similar age, and the inclusion criteria required some past yoga experience. Taken together, these studies support the classification of a flow-type yoga, like hatha or vinyasa yoga, as a light-intensity aerobic activity.

Even though we measured a mean response to vinyasa yoga that categorizes it as a light-intensity aerobic activity, we noted variability in the HR response and further research is needed to understand the relationship between yoga activity and HR response. For example, of the 10 participants who achieved a mean HR in the moderate-intensity range, 8 spent the majority of the class in that level while the remaining two spent the majority of the class in the vigorous-intensity range. Only one participant achieved a mean HR in the vigorous-intensity range during the class; this individual also spent the majority of the class in that level. These results are difficult to interpret as this one participant was similar to several other participants in age, yoga experience, and self-reported exercise habits and had a BMI similar to the group mean (23.0). Perhaps this participant's regular walking and yoga regimens allowed more effort to be expended during the class compared to those participants with less yoga experience. It would be of value to compare the HR response to vinyasa yoga of highly experienced practitioners with that of novice practitioners.

Current ACSM guidelines indicate that regular participation in moderate-intensity physical activity, even if it is less than 20 minutes per session, has numerous health benefits [36]. A report from the Surgeon General [41] also suggests that people can improve in cardiorespiratory fitness by accumulating short bouts of physical activity throughout the day or by participating in one longer session. Furthermore, the ACSM reports that unfit or deconditioned individuals may experience cardiovascular improvement at light aerobic physical activity intensities of 50%-63% of their HR_{max} [36]. The results of the current study support the use of yoga to meet these recommendations. For example, individuals who experienced short bouts of light- or moderate-intensity aerobic activity in a yoga class could combine this activity with other types of exercise to meet the 30-minute guideline. Additionally, participation in yoga addresses multiple fitness components (strength, flexibility, cardiovascular endurance, stress reduction) and adds variety to an individual's exercise regimen, all of which may promote adherence to an exercise program. However, our findings are based on participation in a single class and further research should be conducted to determine the HR response to routine vinyasa yoga participation.

There were a number of limitations in the current study. We designed the vinyasa yoga class to resemble a typical yoga class in a fitness setting by using a live instructor and by providing a consistent environment with naturally occurring variations in age, sex, degree of yoga experience, and degree of physical fitness in the participants. This demographic variability among the participants was used to improve the generalizability of results. However, these demographics may have contributed to the variability in heart rate response to the yoga session. Future studies could include a larger population with subgroups of sedentary and fit individuals, as well as those with more or less yoga experience. Another limitation is that the study's demographic questionnaire provided limited usable data because ranges of numbers were given for answer choices instead of discrete variables. Unfortunately, existing standardized questionnaires were inadequate for the current study since they lacked specific questions about yoga practice. These difficulties suggest the need for a questionnaire that collects information specific to yoga practice for use in data analysis. Finally, the HR responses and assignment to the aerobic physical activity stratification ranges were based on age-predicted estimations of maximal heart rate and may not represent the heart rate needed to reach a certain exercise intensity level [42-44]. However, most individuals are not able or willing to participate in testing that measures true HR_{max}; therefore, target exercise HR ranges are generally derived using formulas similar to what was used in the current study.

Table 1: Percentage of Time in Each Intensity Stratification Range and Predominant Intensity Level.

Participant	Percentage of Maximal Heart Rate					Predominant
	Very Light	Light	Moderate	Vigorous	Very Hard	Intensity Level
3	2.1	37.0	57.5	3.4	0.0	Moderate
4	21.5	73.5	5.0	0.0	0.0	Light
5	3.0	26.4	40.9	29.7	0.0	Moderate
6	27.6	58.6	13.1	0.7	0.0	Light
7	3.1	47.0	45.5	4.4	0.0	Light
9	0.0	26.4	41.4	32.2	0.0	Moderate
10	22.2	58.6	19.2	0.0	0.0	Light
11	0.0	2.3	20.3	71.3	6.1	Vigorous
12	73.4	26.6	0.0	0.0	0.0	Very Light
13	1.4	37.7	45.6	15.3	0.0	Moderate
14	22.1	73.4	4.5	0.0	0.0	Light
15	2.4	43.3	52.0	2.4	0.0	Moderate
16	39.8	54.4	3.1	0.9	1.9	Light
17	9.9	28.4	41.8	19.9	19.9	Moderate
18	22.6	69.7	7.6	0.0	0.0	Light
19	2.1	32.6	54.5	10.9	0.0	Moderate
20	1.4	20.3	30.9	47.3	47.3	47.3
21	24.2	72.9	2.9	0.0	0.0	Light
22	4.6	31.0	36.5	27.9	0.0	Moderate
23	18.0	32.4	48.0	1.6	0.0	Moderate
24	17.6	49.8	31.9	0.7	0.0	Light
25	65.2	33.7	1.1	0.0	0.0	Very Light
26	91.8	8.2	0.0	0.0	0.0	Very Light
27	36.9	59.5	3.6	0.0	0.0	Light
28	31.9	66.3	1.8	0.0	0.0	Light
29	38.1	55.2	6.7	0.0	0.0	Light
30	29.9	53.6	16.6	0.0	0.0	Light
31	36.2	59.3	4.5	0.0	0.0	Light
33	26.6	71.0	2.5	0.0	0.0	Light
34	58.5	41.5	0.0	0.0	0.0	Very Light
35	20.0	54.5	25.5	0.0	0.0	Light
35	84.1	15.9	0.0	0.0	0.0	Very Light
36	71.7	28.3	0.0	0.0	0.0	Very Light
37	12.4	52.7	35.0	0.0	0.0	Light 13.3
38	13.3	22.1	30.4	34.3	0.0	Vigorous
39	13.1	73.8	13.1	0.0	0.0	Light
40	8.3	32.2	49.0	10.4	0.0	Moderate
41	13.2	41.6	43.1	2.2	0.0	Moderate

Very light=<50% of HR_{max}; light=50%-63% of HR_{max}; moderate=360 64%-76% of HR_{max}; vigorous=77%-93% of HR_{max}; very hard = _ 94% of HR_{max}.36

Conclusion

Yoga is a popular mode of exercise with many benefits that are supported by research, but little is known about the heart rate response of practitioners to certain styles of yoga. The results of the current study support the use of vinyasa yoga as a light-intensity aerobic physical activity. This information may be useful for individuals who want to use yoga to contribute to weekly physical activity levels according to currently recommended ACSM and AHA guidelines [37]. However, further research is needed to characterize the individual response to this type of exercise, and to characterize individual responses over multiple sessions.

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