

Effects of Bikram Yoga on Body Composition, Blood Pressure, and Sleep Patterns in Adult Practitioners

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Abstract: Studies have demonstrated positive results for people who practice traditional yoga, specifically in body mass index, depression, cancer, sleeping patterns, and diabetes. Most forms of traditional yoga are held in a temperate climate between 293 Kelvin (K) to 295 K; a temperature that is calming and places little stress on the body. Bikram yoga, however, is a more intense form of yoga performed in a hotter climate, typically at 314 K with 40% humidity. The purpose of this study was to determine how Bikram yoga affected blood pressure, body composition, and sleep patterns in beginner and intermediate/experienced practitioners. Participants (N=16) completed 8 weeks of sessions, ranging between 2 to 7 classes per week in a local Bikram yoga program conducted by certified instructors. All participants were assessed prior to the study and again at the end of the eight weeks. A BOD POD (an air displacement plethysmography) was used for body composition assessments, while a digital blood pressure cuff was used to assess blood pressure. In addition, participants were also surveyed on sleep parameters pre and post yoga participation. In combining all subjects, results showed there was a significant improvement ($p=0.054$) in faster time to fall asleep (27.66 min pre and 23.967 min post), and a trend ($p=0.057$) towards improved mean arterial pressure (92.20 mmHg pre and 88.33 mm Hg post). There were no differences in weight loss or percent body fat in subjects. This study indicates that there is a trend towards improved blood pressure and significant improvement in sleep parameters after 8 weeks of Bikram yoga for both intermediate/experienced and beginners, but no differences in body composition.

Keywords: Bikram yoga, body composition, blood pressure, sleep, BOD POD.

INTRODUCTION

Yoga has become a popular form of meditation and low intensity exercise within the United States and worldwide. It is estimated that over 20 million Americans practice this form of exercise for improved health [1]. Yoga is an ancient exercise, which dates back to 500 BC, requiring different forms of postures and controlled breathing [2]. Examples of postures include downward and upward facing dog, hare pose, and bridge pose. Controlled breathing exercises focus on calm breathing through the nose via use of diaphragm muscles and slowly exhaling [3]. There are many different types of yoga such as the vigorous and fast-paced Ashtanga; the relaxed slower-paced practice of Hatha; Ananda which focuses on spiritual growth; Iyengar which uses props and focuses on proper alignment; the highly meditative Jivamuki; and hot yoga [4].

Another form of yoga gaining popularity is Bikram yoga, a trademarked yoga founded in 1973 by Bikram Choudhury. Most forms of yoga are held in an environment set between 293 to 295 Kelvin (K), however, Bikram yoga is the only practice performed at 314 K and 40% humidity inside the studios. Bikram

yoga specifies 26 asanas (poses) performed twice with participants performing pranayanas (breathing techniques) throughout the session. Typically each session lasts for 90 minutes. The heat is touted as increasing flexibility [5], with yoga instructors stating that the high temperature is a way to promote detoxification and remove impurities through perspiration. Personal accounts include weight loss, decreases in blood pressure, insomnia, disease risks and increased peace of mind [6].

Ross and colleagues state yoga "has recently shown promise as an intervention targeting a number of outcomes associated with lifestyle-related health conditions" [7]. Research supports this by finding a number of positive health outcomes with the practice of yoga such as decreases in the following: depressive and anxiety disorders, high cholesterol, hypertension, insomnia, body weight, osteoporosis, and sleep disturbances [7-14]. Seo and colleagues had obese, adolescent boys practice Asana yoga (yoga allotting more movements between postures) three times a week for eight weeks [12]. The yoga intervention showed significant decreases in body fat percent (4.3% decrease) and total cholesterol (14.3%) in the yoga group. Dietary changes were not measured and researchers suggested a larger sample size was needed [12]. Using skin fold measures, Singh and colleagues found a significant difference in body composition in females between 18-25 years old after a daily 45 minute yoga session for 6-weeks. Specifically,

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they found a significant improvement in body composition, with mean pre values at 25.60% and post values at 19.40% [15]. They also cited significant improvements in cardiovascular endurance, muscular strength and endurance, and flexibility [15]. These improvements were rather large and the researchers did not clarify if there were dietary changes which could have contributed to the differences in body composition. However, Bhutkar *et al.* (2011) cited smaller decreases (7.4%) in percent body fat in females as measured by a bioelectrical impedance, yet no differences were found in males. In this study all subjects practiced Suryanamaskar yoga for 6 days a week for 24 weeks [16]. Thus, the differences between these studies and their findings may be due to the number of days practiced per week, the type of yoga practiced, and the methods to analyze body composition. Specifically, Singh and colleagues measured body composition using skin fold, while Bhutkar and colleagues used bioelectrical impedance [15,16].

In addition to positive physiological changes with yoga practice, yogis have experienced better quality of sleep; this being primarily described in the yoga literature as time to sleep, total wake time, degree of fragmentation, and sleep efficiency [8,17]. Hariprasad and colleagues used a traditional yoga intervention on elderly participants and found a significant improvement (11%) in sleep quality for yoga versus control group, with sleep quality being measured using the Pittsburgh Sleep Quality Index (PSQI) [8]. Fang and Li supported this finding when comparing sleep patterns in nurses with and without yoga, citing that yogis had better quality of sleep [13]. More recently Halpern and colleagues studied the effect of yoga on insomnia in older adults, finding that the 12-week yoga program improved the subjects' overall sleep quality based on decreased sleep latency, efficacy and fatigue [18].

As it relates to Bikram yoga, minimal research has been conducted, with most of the research focusing on improved sleep, flexibility, body composition and blood pressure differences [2,19-23]. Hewett and colleagues [21] evaluated changes in mindfulness and perceived stress after an 8-week Bikram yoga intervention. Fifty-one individuals completed the Five Facet Mindfulness Questionnaire and the Perceived Stress scale resulting in overall increased mindfulness and a reduction in perceived stress. In addition, they also found flexibility significantly improved by 25%, with balance significantly improving by 73% after eight weeks of Bikram yoga [21]. Studies have reported an

improvement in blood pressure parameters with Bikram yoga, potentially due to the stress reduction. Researchers cite reductions in heart rate and blood pressure regardless the number of Bikram sessions attended per week. In addition, research has cited significant improvements in insulin resistance in older participants (ages 53 +/1 year) and reduced arterial stiffness and increased carotid artery compliance in younger participants (ages 30+/1 year) [9,22]. To determine effect on body composition, Tracy and Hart assessed subjects before and after an 8 week program but found no significant differences in percent body fat, with a small significant increase in lean body mass of 1.1% [23]. Frtiz and colleagues also studied physiological effects on subjects by quantifying the metabolic costs of this practice, finding that men and women burn approximately 460 and 330 calories, respectively, in a 90 minute Bikram yoga session [20]. Finally, Kudesia and Bianchi measured changes in sleeping patterns with a Bikram yoga intervention by using an elastic headband sleeping monitor and self-records. Subjects participated in two or more Bikram sessions within a 14-day period. Through an analysis of sleep stages, they found that on the days subjects practiced Bikram yoga they experienced shorter wake-out duration (25% improvement) as compared to days in which Bikram yoga was not practiced [2].

The results of these few studies reveal varied outcomes. Thus, the purpose of this study was to expand the literature focusing on Bikram yoga using a population of both novice and intermediate/experienced Bikram yoga practitioners. Specifically the hypothesis of this study was that Bikram yoga would have a positive effect on sleep patterns, body composition and blood pressure in both novice and intermediate/experienced practitioners.

MATERIALS AND METHODS

Participants

Twenty-five participants were recruited through campus flyers and advertising by the Bikram studio. Subjects varied in practice from beginners (those who had never practiced Bikram yoga) and intermediate to experienced (those who had practiced yoga for at least a month or more). All recruited subjects were prescreened through a questionnaire via email assessing any potential cardiovascular health risk, with exclusion criteria including diabetes, myocardial infarction, coronary thrombosis, coronary occlusion, heart block, arteriosclerosis, rheumatic heart disease,

heart valve disease, heart failure aneurysm, heart disease, heart murmur, angina, or thyroid disease.

Before the start of the study, the Institutional Review Board reviewed and approved the human experimental procedures. Participants provided written consent in accordance with the ethical principles as mandated by federal law. Participants were notified that physical exertion such as perspiration, overstretching muscles, muscle fatigue, dehydration and exhaustion may be expected while participating in yoga sessions. In addition, subjects were informed that if yoga sessions caused discomfort they could terminate the study at any time. When individuals chose to withdrawal from the study, records were removed from the research. After the initial visit with the primary investigator, participants attended local Bikram yoga classes for 90 minute sessions, 2 to 7 times a week for 8 weeks. Certified Bikram yoga instructors led the sessions to ensure proper form during all yoga sessions. A code number was assigned to each individual to keep participation in the study confidential. Though the study began with 25 subjects, due to attrition, 16 subjects completed the study, with 4 beginner and 12 intermediate/experienced practitioners. Of those who completed the study, 3 were Caucasian males, 1 African American female, and 12 Caucasian females.

Procedures

After the questionnaire confirmed healthy individuals, participants scheduled a pre health evaluation located at the laboratory. Participants were asked to abstain from water, food, and exercise for two hours prior to health screening. Each subject was measured for height, weight, fat-free mass, fat mass, percentage body fat, and blood pressure. Body composition was measured by the BOD POD (COSMED, Rome, Italy) which assesses body composition via air displacement. Blood pressure was taken with individual's arm in a cuff attached to an Omron digital blood pressure monitor (Omron Healthcare, Shimogyo-ku, Kyoto, Japan). Current physical activity levels were recorded via Framingham Physical Activity Index (FPAI), which focused on average hours of sleep, added rest, job activity level and extracurricular activity levels. All participants filled out the Stanford University Center Sleep Questionnaire to measure sleeping patterns. After 8 weeks, participants returned for a post health evaluation following the same protocol, with post measurements of body composition, blood pressure, and sleeping patterns taken.

Data Analyses

The purpose of the study was to assess whether 8 weeks of Bikram yoga had significant effects on body composition (percent body fat, fat mass, and total body weight) blood pressure (MAP and systolic) and sleep patterns. All data was entered into Microsoft Excel for management and exported to IBM SPSS 22.0 (Armonk, New York) for statistical analysis. Sample paired t-tests (comparing pre and post data), means and standard deviations were calculated on all parameters.

RESULTS

Characteristics for both the beginner and intermediate/experienced groups were combined and provided in Table 1. Sixteen of 25 recruits completed the 8-week Bikram yoga program, with 4 of those subjects being beginner and 12 being intermediate/experienced. Results for blood pressure, body composition and sleep parameters are summarized in Table 2. When combining all data, only one parameter was significant: improvement in time to fall asleep (27.7 min pre and 23.97 min post, $p=0.05$). There was also a trend towards significance in mean arterial blood pressure (MAP) (pre = 92.21 mm Hg versus post = 88.33 mm Hg, $p=0.056$). This difference in MAP may be attributed to improvements in systolic blood pressure (pre= 123.38 mm Hg versus post = 118.25 mm Hg, $p=0.09$). There was no significant difference in combined groups for percent body fat (pre = 28.02 and post = 27.19, $p=0.09$). (See Table 2 and Figure 1).

Table 1: Subject Characteristics

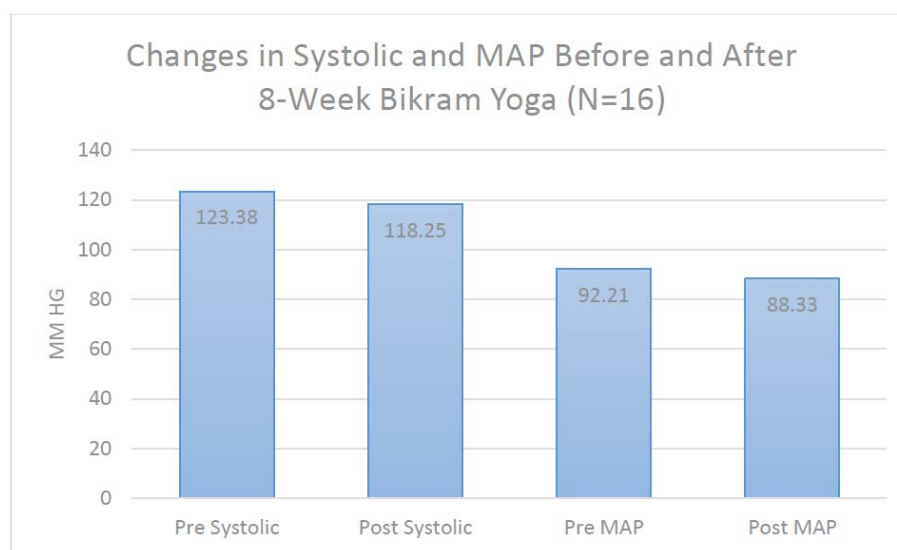
Characteristics of Subjects (N=16)	
Characteristics	Means (SD)
Age (years)	45 (12.5)
Height (inches)	66.2 (4.12)
Race/Ethnicity Caucasians, 1 African American	11
Gender	10 F, 2 M
Number of Bikram Sessions (days/week)	4.63 (2.5)

All numbers are mean and standard deviation (in parentheses).

When dividing out the groups between intermediate/experienced (N=12) and beginners (N=4), interesting trends emerged. Although the beginners were a small group due to attrition, these differences should be noted. Specifically, beginners resulted in significant differences in MAP and systolic blood

Table 2: Summary of Results in Combined Versus Group Means

	Time to Fall Asleep (min.)		Systolic Blood Pressure (mm Hg)		MAP (mm Hg)		Percent Body Fat		Fat Mass (kg)		Weight (kg)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Combined (N=16)	27.65	23.97	123.38	118.25	92.21	88.33	28.02	27.19	20.03	19.11	68.71	68.05
Experienced (N=12)	17.71	15.29	117.92	116.67	87.03	86.11	25.97	25.38	16.64	15.95	63.38	62.97
Beginners (N=4)	57.5	50.0	139.75	123.00	107.75	95.00	34.18	32.65	30.20	28.59	84.69	83.28

**Figure 1:** Changes in systolic blood pressure and mean arterial pressure before and after an 8-week Bikram yoga program in combined groups (N=16).

pressure between pre and post, with MAP pre value at 107.75 mm Hg and post value at 95.00 mm Hg ($p=0.00$) and systolic blood pressure at pre value of 139.75 mm Hg and 123.00 mm Hg post value (0.05). Yet no significant differences occurred with body composition measures nor time to fall asleep when separating out the groups (Figure 2).

DISCUSSION

Our findings demonstrate no change in percent body mass, fat mass, and total body weight in the combined or divided groups which is in line with other research assessing body composition in Bikram yoga practitioners [20, 23]. Without strict adherence to some dietary guidelines, it is difficult to ascertain the effect of Bikram yoga on percent body fat, fat mass, and total body mass. In addition, we did not determine the physical activity subjects performed apart from the Bikram yoga practice. Limitations of this study are that

subjects were able to attend between 2 and 7 sessions of Bikram yoga per week, inability to regulate subject's diet, and not controlling for activity apart from the Bikram yoga practice; all factors which could affect body composition. Thus, future studies should account for these factors in order to elucidate the effect Bikram yoga may have on body composition.

Although no differences in body composition were observed, one significant finding of this study was improved time to fall asleep in the combined group. Participants' questionnaires did show changes in sleeping patterns as it related to time to fall asleep, citing a 15% improvement from pre to post yoga practice. Hariprasad and colleagues also noted an improvement in sleep quality with yoga practice, citing an 11% improvement in sleep quality using the PSQI, while our sleep assessment came from the Stanford University Sleep Questionnaire [8]. Although our findings support a significant improvement in one sleep parameter (time to fall asleep), it should be noted that

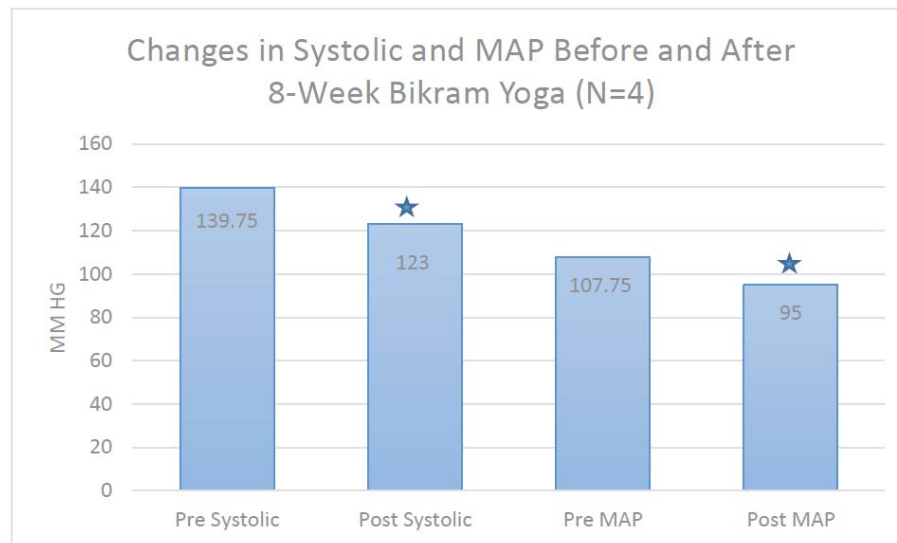


Figure 2: Changes in systolic blood pressure and mean arterial pressure before and after an 8-week Bikram yoga program in beginners group (N=4).

external factors such as use of substances including caffeine and alcohol could have affected these results and these factors were not accounted for in this study. Thus, further research is suggested to assess the same parameters on a larger group of participants and to account for external factors that could affect time to fall asleep.

Finally, our results cited significant differences in MAP (mean arterial pressure) and systolic blood pressure with the beginner group, as well as a trend towards significance in the MAP in the combined group. Even though there were only 4 beginners, it was interesting to note that the beginners across the board responded positively and significantly with the introduction of Bikram yoga, while the intermediate/experienced group had little change in these parameters. The beginners started at higher values of MAP and systolic pressure, while the intermediate/experienced practitioners had initial lower levels of both of these parameters, which were not significantly affected by the study. The initial systolic blood pressure of the beginners (139.75, rounded to 140 mm Hg) placed them in the stage 1 high blood pressure category; with post levels of (123.0 mm Hg), moving them to the pre-hypertensive category. The intermediate/experienced practitioners had systolic levels with both pre and post evaluations, which identified them as having normal systolic blood pressure. This is similar to the findings by Abel and colleagues [19] who cited improved blood pressure parameters with long-term practice. However, the research did not compare blood pressure readings in a pre and post-test design, thus it is impossible to

compare our results to their outcomes. Hunter and colleagues cited a 3% improvement in systolic blood pressure in the older participants, while we noted a 4% improvement in the combined group [22]. Thus, it appears from the results of this study that 8 weeks of Bikram yoga practice in our subjects lowered systolic blood pressure as well as MAP. This may be an important consideration for individuals who are able to practice under these extreme conditions in order to lower systolic blood pressure with use of exercise. It is an important variable to study with more subjects for longer periods of time to determine if the systolic blood pressure continues to decrease to normal levels.

The purpose of this study was to assess the effects of Bikram yoga on the variables of body composition, blood pressure and sleep patterns. Although 25 participants consented to participate in this study, only 16 were able to complete the 8 weeks and return for a post test data evaluation. Dropouts from the study were attributed to illnesses, scheduling conflicts and dislike of the hot environment. Traditional yoga has been proven to be beneficial both psychologically and physiologically, particularly if people do not partake in regular physical activity [24]. Based on the findings of these studies, it may be important to ascertain the effect of Bikram yoga on those experiencing levels of pre-hypertension. It was evident from our study that intermediate/experienced practitioners had lower starting levels of systolic blood pressure, with beginners being positively affected by the practice. Yet future studies, under medical supervision, should verify the impact of Bikram on beginners in various systolic blood pressure categories. Bikram yoga is a yoga

practice that continues to grow in popularity, and understanding its impact on physiological function is a needed area of research.

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