



ACE STUDY EXAMINES EFFECTS OF BIKRAM YOGA ON CORE BODY TEMPS

ACE-sponsored research examines heart-rate and core-temperature responses to Bikram yoga.

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A TYPICAL BIKRAM YOGA SESSION IS 90 MINUTES LONG

and consists of 26 poses and two breathing exercises, all performed in a room heated to 105° F with 40 percent humidity. Practitioners often find themselves absolutely drenched in perspiration by the end of a session, their yoga mats puddled with sweat. For many Bikram enthusiasts, having the mental strength and focus to overcome this type of challenge is a big part of the draw. It is primarily advocates of this extreme version of “hot yoga” who claim improved mindfulness, flexibility, strength, muscle tone and general fitness as a direct result of practicing this form of yoga.



Research conducted in the past few years has provided some support for these claims, while also finding benefits in the form of lower perceived stress levels, improved cardiorespiratory endurance and improved balance (Hewett et al., 2001), as well as increased dead lift strength and shoulder flexibility, and modestly decreased body-fat percentages (Tracy and Hart, 2013). In addition, Hunter and colleagues (2013) found that Bikram yoga improved overall glucose tolerance and insulin resistance in older adults who were at high risk of developing metabolic disease.

Despite all of these proven benefits, the question of whether or not it is safe to practice yoga in such a hot and humid environment has remained. To better understand the body's response in such a setting, ACE enlisted John P. Porcari, Ph.D., and his team of researchers at the University of Wisconsin–La Crosse's Department of Exercise and Sport Science to investigate.

THE STUDY

The research team recruited 20 apparently healthy volunteers, seven males and 13 females, ranging in age from 28 to 67 years old. All of the participants were regular practitioners of Bikram yoga, which means they were familiar with the 26 standard poses and acclimatized to the hot and humid exercise environment. Participants in the study provided written informed consent, and approval from the University of Wisconsin–La Crosse Institutional Review Board for the Protection of Human Subjects was obtained prior to the study.

Before participating in the session, which was conducted at a Bikram yoga studio by a certified instructor, each participant swallowed a core body

temperature sensor (CorTemp Ingestible Core Body Temperature Sensor, HQ Inc., Palmetto, Fla.) and was given a heart-rate monitor (Polar HR monitor, HRM USA Inc., Warminster, Pa.) to wear during the Bikram yoga class.

Core temperature was recorded prior to the start of class, as well as every 10 minutes throughout the session. Heart rate was recorded every minute during the class and session ratings of perceived exertion (RPE) were recorded at the end of class using the Borg 1 to 10 scale.

THE RESULTS

While heart rate fluctuated throughout class depending on the difficulty of the pose being performed, core temperature steadily increased throughout the 90-minute class for both men and women. It is important to note that heart rate, maximum heart rate and RPE were consistent between genders, but when the average heart rate and highest heart rate attained were presented as a percentage of maximum heart rate, men had significantly higher values than women. The average heart rate was about 80 percent of the predicted maximum heart rate for men and 72 percent for women. The highest heart rate recorded during the class among the male participants was 92 percent of the predicted maximum heart rate, while it was 85 percent for the female subjects.

The average highest core temperature was $103.2 \pm 0.78^\circ \text{F}$ for men and $102.0 \pm 0.92^\circ \text{F}$ for women, with men having a significantly higher core temperature overall. Of the individuals in this study, one male participant had a core temperature of 104.1°F by the end of the 90-minute class, and seven of the 20 subjects had a core temperature greater than 103°F . While none of these subjects exhibited signs or symptoms of heat intolerance, core temperatures such as these can pose concern for some participants, as the risk for heat-related illness increases at 104°F . [Note: The National Athletic Trainer's Association (NATA) and the American College of Sports Medicine (ACSM) both state that exertion-related heat illness and heat stroke can occur at a core temperature of 104°F .]

Interpreting the Results

Emily Quandt, M.S., who led the study, says that the fact that the core temperature saw a steady increase during the class raised her concern for participants, especially given that the postures performed in a Bikram class focus primarily on balance and strength rather than cardiovascular training. “The dramatic increases in heart rate and core temperature are alarming when you consider that there is very little movement, and therefore little cardiovascular training, going on during class,” says Quandt. She goes on to explain that, while the excessive perspiration that participants experienced during class is often cited by those who practice this style of yoga as a benefit in terms of the release of toxins, the results of this study show that this sweating was insufficient to cool down the body.

Quandt offers three recommendations to improve the safety of Bikram yoga sessions: Shorten the class, lower the temperature and focus on hydration. Let’s look at each of these suggestions individually.

Duration

Quandt points out that the participants started to experience dangerous core temperatures about 60 minutes into the session (remember, core temperature was not posture-specific, but instead rose steadily over the duration of the class). Shortening the class to 60 minutes or less could help to minimize the potential for heat intolerance among students.

Temperature

Lowering the temperature of the room might seem obvious to some, but as a signature aspect of this style of yoga, many believe the high temperatures are what help drive the benefits. Like Quandt’s suggestion regarding the duration of the session, such changes would significantly alter the very essence of Bikram yoga, given that the 26 poses, a room temperature of 105° F with 40 percent humidity and 90 minutes in duration are the very things that define this particular style of yoga.

Which brings us to hydration...

Hydration

Hydration lies at the heart of the Bikram yoga controversy, as in many classes there is commonly

just one designated water break. However, many teachers acknowledge that students should hydrate as needed throughout the 90-minute session. For some Bikram enthusiasts, minimizing the number of times water is consumed during class is perceived to add to the mindful aspects of the practice, as fewer water breaks decreases the potential for mental distraction. Of course, most exercise scientists could not disagree more.

“Nothing is gained from withholding water in any setting,” argues Dr. Porcari, head of the University’s Clinical Exercise Physiology program. “Exercise leaders must actively encourage hydration, particularly when classes take place in extreme environments like those seen in Bikram yoga classes.”

Bikram yoga teachers should be familiar with essential exercise science principles and concepts, says Dr. Porcari, as a clear understanding of the physiology of thermoregulation is important. “Knowing the risks associated with things like blood pooling and vasodilation, as well as the signs and symptoms of heat-related illness, is absolutely essential.”



Cedric X. Bryant, Ph.D., Chief Science Officer at ACE, agrees with Dr. Porcari. “Bikram teachers should recognize that participants’ thermoregulatory systems will be challenged in this environment,” says Dr. Bryant. “It is essential that they are aware of the early warning signs of heat intolerance.” These signs include cramps, headache, dizziness and general weakness. It is important that teachers respond appropriately and are trained in what to do in the event of an emergency to keep the participant’s safety as the top priority (see Table 1).

THE BOTTOM LINE

Although there are potential benefits associated with practicing Bikram yoga, the potential for heat intolerance among some students, including those who may not yet be acclimatized to the heat, should not be entirely overlooked. Although an extreme core temperature was not seen in all participants in the study and no signs of heat-related illness were observed, a large number of the participants reached a core temperature greater than 103° F, with one man exceeding 104° F.

Exercising in hot and humid environments—whether inside a studio while practicing Bikram yoga or outside running during the warm months of summer—can place participants at risk for heat-related illness, especially if those individuals do not adequately hydrate before, during and after exercise. Instructors of Bikram yoga, fitness professionals who lead outdoor exercise sessions, and physical-activity participants who simply like breaking a sweat in hot and humid conditions should all be educated on the risks, and recognition and prevention of heat-related illness. Not only does it take time for the body to acclimate to activity performed in hot and humid environments, proper hydration is crucial.

“Given the popularity of Bikram yoga and its proven benefits, it is likely here to stay,” says Dr. Bryant. “It is our job to make sure it is done safely.”

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Heat Exhaustion and Heat Stroke		
	Signs and Symptoms	Treatment
Heat Exhaustion	<ul style="list-style-type: none"> Weak, rapid pulse Low blood pressure Fatigue Headache Dizziness General weakness Paleness Cold, clammy skin Profuse sweating Elevated body core temperature ($\leq 104^{\circ}$ F or 40° C) 	<ul style="list-style-type: none"> Stop exercising Move to a cool, well-ventilated area Lay down and elevate feet 12–18 inches (30–46 cm) Give fluids Monitor temperature
Heat Stroke	<ul style="list-style-type: none"> Hot, dry skin Bright red skin color Rapid, strong pulse Change in mental status (e.g., irritability, aggressiveness, or anxiety) Labored breathing Elevated body core temperature ($\geq 105^{\circ}$ F or 41° C) 	<ul style="list-style-type: none"> Stop exercising Remove as much clothing as feasible Try to cool the body immediately in any way possible (wet towels, ice packs/baths, fan) Give fluids Transport to emergency room immediately

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Practical Tips for Teaching a Bikram Yoga Class

Jessica Matthews, M.S., E-RYT 500, senior advisor for health and fitness education for ACE, offers the following practical tips for certified practitioners teaching Bikram yoga or any form of hot or heated yoga.

Create a class culture that encourages adequate hydration. While some yoga teachers and styles of yoga strongly dissuade students from consuming water at any point during a class, in a hot and humid environment in which classes range from 60 to 90 minutes in length (Bikram classes are typically 90 minutes in length; hot and heated yoga classes can vary from 60 to 90 minutes) ongoing hydration is imperative from an exercise physiology perspective. Increased sweating results in a greater reduction of water in the body, which can lead to dehydration. In addition to encouraging students to adequately hydrate before and after class, you should also extend to students an invitation and permission to consume water as needed throughout the hot yoga class experience as they deem appropriate.

Offer students the time and space to acclimate. It is important to remind students, whether they are newcomers to yoga or experienced Bikram practitioners, that it takes time for the body to acclimate and re-acclimate to performing physical movements in a heated environment. On average, it takes approximately 10 to 14 days for most healthy individuals to acclimate to engaging in physical activity in a heated environment. It is also important to offer students options to regress poses throughout the class and to encourage them to perform resting, grounding postures as needed.

Remain present in your teaching and cognizant of signs of heat-related illness. Mindfulness is such an important aspect of a yoga practice, and it is imperative that you remain present and are able to identify any signs of heat-related illness that may arise during a Bikram or hot yoga class experience. While heavy sweating is

not unusual in a hot or heated environment, profuse sweating coupled with other symptoms (as summarized in Table 1) warrants moving the individual outside of the room to a cooler location to lie down and apply cool, wet towels to the body, and having the participant consume water while you contact emergency personnel.

If a student exhibits signs of heat stroke, which can come on very suddenly and quickly become life threatening, emergency medical attention must be contacted immediately. Being fully present and aware during each class ensures your students' safety and well-being.

Embrace the process of sweating and encourage students to do the same. In Bikram and hot yoga classes, it is not uncommon to encounter students who feel embarrassed or ashamed about how much

they sweat. It is important that you ease anxieties about how students feel they will be perceived by others by educating them about the importance of sweating. While sweating is important, the process of sweating alone does not cool the body; rather, it is the evaporation process that ultimately protects the body from overheating. Therefore, you can encourage students not only to embrace the natural process of sweating during hot yoga classes, but also encourage them to avoid

becoming distracted in their practice by constantly wiping sweat from their skin, which, from a safety perspective, can lessen the amount of evaporative cooling that occurs, resulting in retained body heat and, in turn, an increased risk of dehydration and overheating.

To promote student safety, you can encourage them to utilize a yoga mat that has absorbent qualities and/or to place a specifically designed yoga mat towel—such as those made by Gaiam (Gaiam Americas, Inc., West Chester, Ohio) or YogiToes (YogiToes, LLC, El Segundo, Calif.)—atop their existing yoga mat to help absorb the moisture to reduce the risk of slipping while practicing.

