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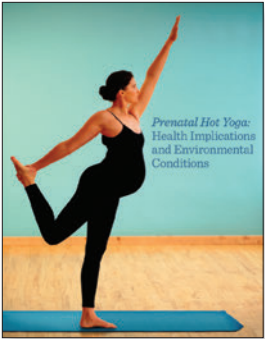
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Hot Yoga Establishments in Local Communities Serving Pregnant Women: A Pilot Study on the Health Implications of its Practice and Environmental Conditions

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Abstract Hot yoga establishments have been increasing in popularity in local communities. Studios may support participation among pregnant women though no clinical studies currently exist that examine prenatal hot yoga effects. The pilot study described in this article aimed to assess the spread of prenatal hot yoga and to provide information on the environmental conditions and practices of those who engage in hot yoga within a local community. A thermal environment meter was used to measure ambient air conditions during three 90-minute hot yoga classes. Mothers who practiced prenatal hot yoga were more likely than non-hot yoga practitioners to have someone aside from an obstetrician/gynecologist discuss prenatal exercise safety with them. Prenatal public health education campaigns need to be refined. Public health officials and obstetricians/gynecologists need to be aware that those who engage in a hot yoga practice are more likely to trust someone other than their health care provider or public health professional regarding safety of this practice.

Introduction

The practice of yoga consists of eight limbs encompassing physical practice, meditation, breathing, and more. As yoga was popularized and spread west to the Middle East and Europe in the 1800s, the physical benefits of the practice were more closely explored (American Yoga Association, 2006). Today, the *Yoga Journal*, the largest circulation yoga magazine in the U.S., estimates that 6.9% of Americans, or 15.8 million people, practice yoga (*Yoga Journal*, 2008). Many local

health departments undoubtedly have these establishments within their jurisdictions. Clinical studies have shown that yoga can mitigate low back pain, improve outcomes in asthma and chronic obstructive pulmonary disease, and improve birth outcomes (Hayes & Chase, 2010). The benefits of yoga extend beyond physical measures, as other studies have also found yoga to decrease stress and anxiety, increase quality of life in the elderly, and be beneficial in patients with eating disorders (Hayes & Chase, 2010).

Fewer studies have been conducted on the health benefits of hot yoga, created by Bikram Choudhury in the early 1970s. In this form of yoga, which Choudhury named after himself, one practices in a room set to 105°F (Choudhury, 2007). Instead of following Bikram yoga's own sequence of 26 postures, some Western yoga studios have simply transferred the idea of practicing yoga in a hot room. This newfound yoga style is referred to as "hot yoga," the practice of any type or sequence of stationary yoga in a heated room (Fish, 2006). Only a handful of studies on Bikram yoga have been recorded to date (Bikram Yoga, 2014) with the results reflecting the current knowledge of yoga practice. One of the studies noted that short-term practice of Bikram yoga could result in substantial improvements in balance and modest improvements in leg strength as compared to a control group who did not practice any form of yoga. That study did not state whether the accrued benefits were from yoga or specifically from Bikram yoga, but it seems as though the heat did not hinder results when compared to a control group (Hart & Tracy, 2008). Studies comparing and contrasting hot yoga and room-temperature yoga have not yet been conducted.

Comparatively few studies have examined the effects of room-temperature yoga during pregnancy, and no studies to date have examined prenatal hot yoga. The few existing prenatal room-temperature yoga studies have

demonstrated positive effects of the practice. Narendran and co-authors (2005) conducted a prospective study on the effects of prenatal yoga on pregnancy outcomes. That study consisted of an intervention group of 169 pregnant women who were trained to practice yoga one hour daily, and that group was matched to a control group of 166 pregnant women who walked for 30 minutes twice daily. The researchers found that the yoga group had significantly fewer underweight births, less preterm labor, lower rates of intrauterine growth retardation, and lower risk of pregnancy-induced hypertension than the control group. Importantly, the authors found that practicing yoga during pregnancy was not associated with any adverse effects on the mother or baby. That study was confounded in that the women in the yoga group received more attention as they were trained to practice yoga for one week and had their techniques reviewed during each antenatal visit. In addition, most women in the yoga group lived within 15 minutes of the study center (a hospital), while most women in the control group lived farther than 15 minutes travel, raising the possibility of socioeconomic and environmental factors affecting study outcomes.

In a similar randomized control trial with 90 participants, Satyapriya and co-authors (2009) found that pregnant women who received the yoga intervention experienced significantly more stress reduction and reduced sympathetic tone as measured by changes in heart rate as compared to a control group with normal prenatal exercise. The authors similarly found no increase in adverse outcomes in the yoga group. In addition, a number of smaller studies have shown that prenatal yoga is associated with reductions in stress and anxiety as well as improved sleep and maternal comfort during labor (Beddoe, Lee, Weiss, Kennedy, & Yang, 2010; Beddoe, Yang, Kennedy, Weiss, & Lee, 2009; Chuntharapat, Petpichetchian, & Hatthaki, 2008). These studies suggest that increased fitness and stress reduction may be the primary mechanisms behind the positive benefits of prenatal yoga.

Although no published studies currently exist on the effects of hot yoga on pregnancy outcomes, a number of expectant mothers practice hot yoga (Choudhury, 2011; Nguyen, Babbar, Rankins, & Blando, 2012). In the absence of specific research, the American Congress of Obstetricians and Gynecologists

(ACOG) provides guidelines for pregnant women with more intense exercise regimens. In particular, ACOG suggests that expectant mothers avoid contact sports and activities that involve extended periods of time in the supine position (ACOG, 2002), which is why prenatal yoga poses are modified to avoid lying on one's back. In addition, hot tubs, spas, and other heat-inducing environments have been associated with adverse birth outcomes, including neural tube defects and spontaneous abortions (Chambers, 2006). No research suggests that prenatal hot yoga has an adverse effect on the mother or baby; however, the research in this area is lacking, both clinically and observationally. Our pilot study aims to make inferences in the field of prenatal hot yoga that may be relevant to public health officials and obstetricians.

Methods

To assess the spread of prenatal hot yoga, Old Dominion University (ODU) distributed knowledge, attitudes, and beliefs (KAB) surveys to hot and non-hot yoga studios (studio participation rate: 43%) and parent-teacher associations (PTAs) (organization participation rate: 45%) in southeastern Virginia. Additionally, a thermal environment meter was used to measure ambient air conditions during three 90-minute hot yoga classes at one studio in southeastern Virginia.

The prenatal hot yoga KAB online self-report surveys were written by ODU researchers, screened by surveying experts at the ODU Social Sciences Research Center, and pilot tested before distribution. The surveys were 14 to 26 questions in length, depending on how respondents answered certain questions. Surveys asked about demographic data, risk and benefit perceptions, pregnancy experiences, general exercise information, and other beliefs. Hot and non-hot yoga studios and PTAs in southeastern Virginia distributed the surveys via e-mail or social media. Females who were reachable through these means were considered as the target population and as representative of the normal population who practices yoga. Females were included regardless of current pregnancy status. Females who had practiced hot yoga at least once were placed in the experimental group while females who had never practiced hot yoga were placed in a control group.

Informal interviews with the studio owner and yoga teachers were conducted in order

to assess normal hot yoga studio heating procedures, ventilation, and heat exchange rate. The thermal environment meter was calibrated three days before the air measurements as well as immediately after the measurements. Calibration proved within the acceptable 0.5 tolerance. Measures were taken approximately three feet above ground in the back of the class at equi-distance between the door and the side wall. Yoga students were in near proximity of the meter. Inside wet bulb globe temperature (WBGT), dry globe temperature, and dry bulb temperature readings were recorded approximately every 10 minutes during the three 90-minute class sessions. Each class consisted of 26 identical poses and two breathing exercises in an identical sequence in order to keep the physical exercise effect on ambient air temperature consistent among classes.

Results

Three out of seven (43%) of yoga studios and 9 out of 20 (45%) of PTAs in southeastern Virginia agreed to participate. PTAs and non-hot yoga studios were recruited to be included in the control group. Seventy individuals were in the experimental group and 59 individuals were in the control group who began the online survey. Of those individuals, 53 (76%) in the experimental group and 21 (36%) in the control group completed all permissible questions. In total, 74 respondents were included in the data analysis, with 53 hot yoga practitioners and 21 non-hot yoga practitioners. Survey respondents tended to be white, college-educated females in the upper-30s age range; age was demonstrated to be normally distributed with both a mean and median of 37 years. More than 8 in 10 women reported that their obstetrician/gynecologist (OB/GYN) had asked about their exercise regimen.

Independent samples *t*-tests were conducted in order to analyze differences between means of the continuous variables whereas Chi-square tests were conducted for the categorical variables (Table 1). The demographic characteristics between groups were similar. Of the hot yoga group, 77% identified as white and 55% reported themselves to be a college graduate. Of the non-hot yoga group, 91% identified as white and 43% reported themselves to be a college graduate.

In regards to prenatal health and beliefs, groups were also similar except hot yoga prac-

titioners were statistically significantly ($p < .05$) more likely to currently be pregnant; desire to be pregnant if not currently pregnant; and have someone, not necessarily an OB/GYN, discuss prenatal exercise safety with them. Most notably, 25% of the hot yoga practitioners reported themselves to be currently pregnant as opposed to 5% of the non-hot yoga practitioners.

Non-hot yoga practitioners trusted their OB/GYN as a source of prenatal hot yoga safety knowledge (rating: 9.3/10) more than themselves (rating: 7.1/10). By contrast, hot yoga practitioners trusted themselves (rating: 8.7/10) more than their OB/GYN (rating: 7.7/10). Hot yoga practitioners also ranked OB/GYNs below a friend or acquaintance who had practiced yoga while pregnant (rating: 7.9/10) as a trusted source of health information. Of the sources who discussed prenatal hot yoga safety with respondents, OB/GYNs were listed fourth for prenatal hot yoga practitioners, behind a friend or acquaintance who practices hot yoga, yoga studio employees, and a friend or acquaintance who practiced prenatal hot yoga.

Of the 39 females who had practiced prenatal hot yoga, 87.5% would do so again. Excluding the individual who practiced prenatal hot yoga while unaware of her pregnancy status, this figure rises to 90.5%. An equal distribution occurred of prenatal hot yoga practice prevalence among the three pregnancy trimesters. All respondents who practiced prenatal yoga for one pregnancy and not the other reported benefits of the yoga.

The exercise room dimensions were approximately 8' x 30' x 60', or 14,400 cubic feet. The building was new with no visible molds. For the three yoga classes in which measurements took place, one set the heat manually while the other two used the automatic settings. Overall, the dry bulb, representing actual air temperature, ranged from 102.3°F to 131.7°F. The relative humidity ranged from 23% to 50% over the three classes. The WBGT, which is an integrated measure of environmental heat stress that accounts for convective heat, humidity, and radiant heat, ranged from 86°F to 104°F (Figure 1).

Discussion

This article provides new, quantitative information on the potential burden of exercising in a heated room and knowledge, attitudes, and beliefs about prenatal hot yoga, which can be used in public and environmental health edu-

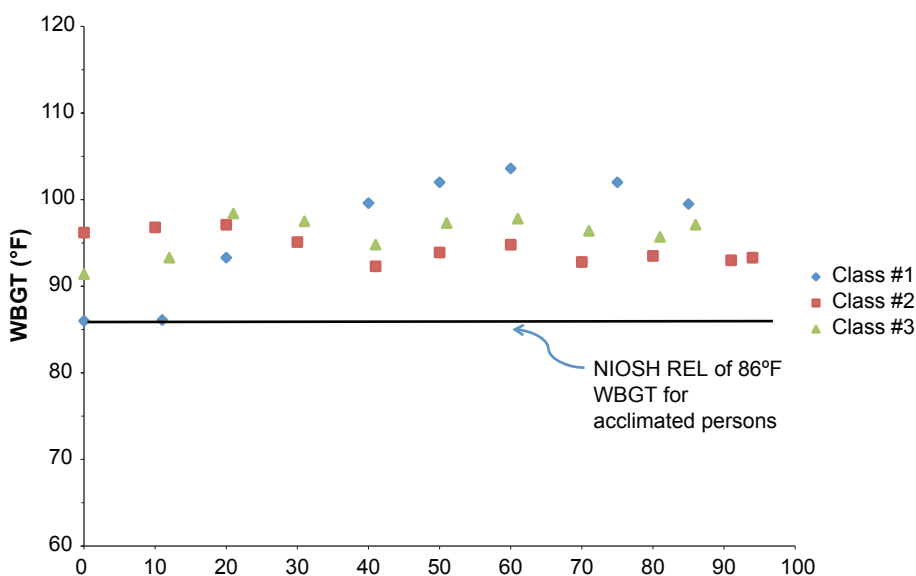
TABLE 1

Demographics of Hot Yoga and Non-Hot Yoga Practitioner Survey Respondents, Old Dominion University, 2013

Characteristic	Study Group		p-Value
	Hot Yoga Practitioner	Non-Hot Yoga Practitioner	
Sample size	53	21	–
Average age (years)	35.6	42.0	.273
White	77%	91%	.137
College graduate	55%	43%	.358
Currently pregnant	25%	5%	.011
Not pregnant, but would like to be	11%	0%	<.001
Obstetrician/gynecologist has asked about exercise	83%	81%	.842
Would practice prenatal hot yoga	77%	10%	<.001
Ever been pregnant	76%	100%	<.001

FIGURE 1

Wet Bulb Globe Temperature (WBGT) (°F) Over the Duration of Hot Yoga Class, Old Dominion University, 2013



This figure shows WBGT readings over the course of three 90-minute hot yoga classes at a studio in southeastern Virginia. A horizontal line on the chart signifies the National Institute for Occupational Safety and Health (NIOSH)-recommended exposure level (REL) for acclimated persons.

cation. Public health officials and OB/GYNs may need to be aware that those who engage in prenatal exercise other than traditional yoga are less likely to be receptive to receiving safety information. Likewise, because hot yoga practi-

tioners are more likely to trust other individuals who have experience with hot yoga than their public health official or OB/GYN in regards to prenatal hot yoga advice, public health officials and OB/GYNs should redefine their approach

when discussing prenatal exercise with this patient population.

Individuals practicing hot yoga should be aware that the ambient air temperature would most likely change during practice and may be higher than the temperature advertised. In general, occupational health recommendations state that for persons acclimated to high heat exercising at approximately 200 Kcal/hour (National Institute for Occupational Safety and Health, 1986), which is typical of yoga, the maximum recommended WBGT exposure is approximately 86°F averaged over a one-hour period (Ray, Pathak, & Tomer, 2011). This recommended exposure limit is less for persons who are not acclimated to the hot environment. All of the measured temperatures collected by the researchers were at or above a WBGT of 86°F, as displayed in Figure 1.

Pregnant individuals or individuals with certain health conditions should discuss this practice with their physician in order to adequately prepare and to maximize safety. Public health officials may wish to engage in an educational campaign to encourage participants to actively discuss this practice with their health care provider. Another method public health departments can implement to maximize safe exercise conditions is to make hot yoga studios aware of the large temperature fluctuations within a class so that they may monitor and adjust the temperature accordingly. Though some studios maintain

the thermostat at a certain set degree, others attempt to keep the ambient air temperature to “feel” a certain temperature. As demonstrated in Figure 1 for a studio with a set temperature, as well as a studio that bases their temperature on “feel,” it is reasonable to assume that neither method results in temperatures that are carefully controlled. Studios may benefit from careful control of their temperatures by assuring that the WBGT does not exceed recommended heat exposure limits. In this way, participants can gain the benefits of yoga while minimizing their risk of heat-related complications.

Conclusion

This pilot study provides a unique descriptive analysis on prenatal yoga practices in a local community. Relatively few studies on hot yoga have been published. Though Hart and Tracy (2008) compared Bikram yoga against no form of yoga and other researchers (Beddoe et al., 2009, 2010; Chuntharapat et al., 2008; Nareendran et al., 2005; Satyapriya et al., 2009) have studied prenatal room-temperature yoga benefits, no studies have been published comparing prenatal hot yoga to room-temperature yoga.

These findings are subject to several limitations. The survey has a small sample size that makes the results difficult to generalize to the entire yoga population. Many groups did not want to participate, fearing that it may indicate the group's support for prenatal hot

yoga, a practice with benefits that have not been scientifically proven. Thus, the study population was merely a convenience sample with a probable response bias. Those with stronger opinions on or experience in prenatal hot yoga may be more likely to respond than those without strong opinions or experiences. This is demonstrated by the stronger response rate from hot yoga practitioners compared to non-hot yoga practitioners. This participation difference skews the results towards the group with a higher response rate, the hot yoga sample. Additionally, the ambient air measurements were also subject to limitations since they were only conducted at one site for only three classes, in which one class was heated manually instead of the using the normal automatic method.

Future clinical studies are needed to make inferences about the safety and potential benefits or risks of prenatal hot yoga. Studies are needed to quantifiably determine if physiological differences exist between practitioners of prenatal hot yoga and other forms of yoga. The physiological differences between practicing hot yoga, practicing room-temperature yoga, and exercising in another form are still unknown and warrant exploration. 🙏

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