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Original Research Article

Safety of Hot Yoga in Pregnant Women

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Abstract

Introduction: One of the concerns surrounding the practice of hot yoga is a potentially dangerous increase in core temperature, particularly in pregnant women. Previous research has shown that a core temperature in excess of 102°F, or an increase in core temperature greater than 3°F from rest, may result in abnormal fetal development. **Purpose:** The main purpose of this study was to evaluate and compare core temperature responses in pregnant and non-pregnant women during a 60-minute hot-yoga class. **Methods:** Four pregnant and five non-pregnant women served as subjects. All were regular participants in hot yoga. Prior to the class, subjects ingested a CorTemp Ingestible Core Body Temperature Sensor (HQ Inc, Palmetto, FL). Core temperature was recorded every 10 minutes during the class. **Results:** Room temperature and humidity during the class averaged 95.7°F and 56.7% respectively. The highest core temperature recorded during a class averaged 99.5°F in the pregnant subjects and 99.9°F for the non-pregnant subjects. The highest single core temperature in a pregnant subject was 100.1°F, while one non-pregnant volunteer reached 101.4°F. None of the pregnant subjects had a change in core temperature during a class in excess of 1.2°F and the largest change for a non-pregnant subject was 2.8°F. **Conclusion:** Based upon the results of this study, it appears that women who are participating in hot yoga prior to their pregnancy can safely continue their practice. The ultimate decision, however, should be a joint decision with the expectant mother and her health care provider.

Key Words: Core Temperature, Heat, Humidity.

Introduction

Yoga is an extremely popular form of group exercise. A 2016 survey estimated that 36 million Americans practice some form of yoga, with women making up 72% of participants. There are many known health benefits of yoga including improvements in strength, flexibility, respiration, and

exercise capacity². Yoga has also been shown to help decrease symptoms of anxiety and depression and improve “mindfulness”³.

Hot yoga has also become increasingly popular in recent years. Hot yoga is conducted in a room heated to between

90°F to 100°F, with humidity ranging between 40-60%⁴. Practitioners of hot yoga feel that heat of the room makes it easier to stretch deeper into certain poses and allows them to focus more intently on breathing and postures, further improving the mind-body connection. One of the main concerns surrounding hot yoga is the potential for overheating and associated heat-related illnesses, since thermoregulation becomes increasingly difficult in hot and humid environments secondary to reductions in both radiative and evaporative heat loss⁵. Despite these concerns, a previous study in our laboratory found no significant difference in the change in core temperature when subjects participated in identical regular yoga (average room temperature = 70.8°F) and hot yoga (average room temperature = 92.7°F) classes⁶. Core temperature increased by 1.1°F during the regular yoga class and 0.9°F during the hot yoga class.

One group of participants for whom an exaggerated increase in core temperature may be contraindicated is pregnant women. There is evidence to suggest that a maternal core temperature in excess of 102°F or a change in maternal core temperature greater than approximately 3°F, especially during the first trimester, may result in a variety of central nervous system developmental disorders^{5,7-8}. Hyperthermia during the latter stages of pregnancy may result in a decrease in uterine blood flow, resulting in fetal distress. For these reasons, it is recommended that pregnant women

avoid prolonged or intense exercise that may elevate core temperature above these thresholds. It is also recommended that they avoid using hot tubs or saunas while they are pregnant⁹.

Even though the aforementioned study by Nereng et al.⁶ did not see a potentially dangerous increase in core temperature during hot yoga in non-pregnant women, thermoregulation may be different in pregnant women compared to their non-pregnant counterparts. Maternal resting core temperature is approximately 0.3-0.5°F higher during pregnancy, consequent to the increased metabolic requirements of the developing fetus coupled with the thermogenic effects of increased progesterone levels during pregnancy¹⁰. This higher resting core temperature would reduce the safety margin between resting core temperature and the temperature at which fetal abnormalities could occur. However, the rise in core temperature during exercise could potentially be offset by an approximate 45% increase in plasma volume that occurs during pregnancy¹¹. The increased plasma volume could serve as a heat “sink,” thereby buffering the rise in core temperature during exercise.

While there are well-established exercise guidelines for pregnant women in regard to aerobic exercise⁸⁻⁹, there are no guidelines or recommendations regarding whether or not they can safely participate in hot yoga. Therefore, the main purpose of this study was to evaluate the core temperature

responses of pregnant women during hot yoga classes in comparison to non-pregnant women. Heart rate and perceived exertion were also assessed to further quantify responses to exercise during hot yoga.

Methods

Participants

Four apparently-healthy, pregnant women and five apparently-healthy, non-pregnant women participated in this study. All subjects were between 22 to 33 years of age. All of the women were regular practitioners of hot yoga for at least 3 months prior to enrolling in the study. The participants did not have a history of gastric problems, which is a contraindication for ingestion of the core temperature pill. The study was approved by the University's Institutional Review Board for the Protection of Human Subjects and subjects provided written informed consent prior to participating in the study.

Procedures

During each yoga session, core temperature was measured using an ingestible CorTemp pill. (HQ, Inc., Palmetto, FL). The pill was ingested 6 hours prior to the start of the yoga class. Previous research has established the validity and reliability of the CorTemp pill¹². Prior to beginning the yoga class, subjects completed a questionnaire asking about their yoga habits, specifically focusing on changes to their practice due to their pregnancy. Subjects were then weighed using a Rice Lake Digital Scale (Rice Lake Weighing Systems, Rice Lake, WI) and

had a heart rate monitor attached (Polar, HRM USA INC., Warminster, PA). The yoga classes were ~ 60 minutes in duration. Throughout the class, the researcher sat next to the subjects. Every 10 minutes during the class, heart rate, core temperature, and Rating of Perceived Exertion (RPE) using the Borg 6-20 scale¹³ were assessed. Additionally, the temperature and humidity of the room were recorded at this time using a Model 45815 Hydro-thermometer Humidity Alert II (Nashua, NH). At the conclusion of the class, subjects were weighed again to determine changes in body weight. The amount of fluid consumed during the class was also recorded.

Statistical analyses

Standard descriptive statistics were used to characterize the subject population and to summarize exercise responses during the yoga class. Because of the low number of subjects in each group and because some subjects completed multiple yoga sessions, quantitative analyses were not performed. Data were simply collapsed across all sessions for each subgroup for comparison.

Results

Descriptive characteristics of the subjects are presented in Table 1. For the pregnant women, Subject 1 completed 3 sessions, Subject 2 completed 1 session, Subject 3 completed 2 sessions, and Subject 4 completed 1 session. For the non-pregnant women, Subject 5 completed 3 sessions, Subject 6 completed 2 sessions, and

subjects 6-8 each completed 1 session. Since two of the pregnant women completed multiple sessions at different points in their pregnancy, the actual weight of subjects is presented for each session. Overall, there was no change in average body weight of the pregnant subjects during the yoga classes (pre=144.7 ± 15.36 lbs; post=144.7 ± 15.19 lbs). The change in body weight ranged from -0.6 to +0.8 lbs for the pregnant women during individual classes. There was also very little change in the average body weight of the non-

pregnant women during the classes (pre=156.0 ± 15.11 lbs; post=156.1 ± 15.15 lbs). The change in body weight during a class for individual non-pregnant women ranged from -1.4 to +1.0 lbs. The amount of water consumed by the pregnant and non-pregnant women is presented in Table 2. One pregnant woman did not consume any water during one of the yoga sessions (thus the range of 0-24 oz), which is a consistent practice for her. She did consume approximately 8-10 ounces of fluid immediately prior to the class, however.

Table 1. Descriptive characteristics of the subjects.

	Age (years)	Height (in)	Gestational Term	Pre-Weight (lb)	Post-Weight (lb)
Pregnant					
Subject 1 Session 1	33	63	27 weeks	139.6	139.2
Subject 1 Session 2	-	-	30 weeks	142.4	141.8
Subject 1 Session 3	-	-	32 weeks	146.2	146.6
Subject 2 Session 1	29	66	37 weeks	170.8	170.6
Subject 3 Session 1	27	62	30 weeks	124.8	125.6
Subject 3 Session 2	-	-	32 weeks	132.5	132.4
Subject 4 Session 1	26	68	25 weeks	157.2	157.2
Non-Pregnant					
Subject 5 Session 1	27	69	-	154.0	152.6
Subject 5 Session 2	-	-	-	154.0	154.2
Subject 5 Session 3	-	-	-	155.0	156.0
Subject 6 Session 1	22	68	-	138.4	138.4
Subject 6 Session 2	-	-	-	137.6	138.0
Subject 7 Session 1	26	65	-	155.4	155.0
Subject 8 Session 1	29	66	-	171.0	171.8
Subject 9 Session 1	22	68	-	182.8	182.6

Table 2. Volume of fluid consumed during the yoga sessions by pregnant and non-pregnant subjects.

	Ounces During	Ounce Range
Pregnant	9.1 ± 8.15	0 – 24 oz
Non-Pregnant	9.2 ± 6.94	3 – 20 oz

Average room temperature and humidity of the hot yoga studio are presented in Table 3. As can be seen, the temperature and humidity of the room increased steadily throughout the class and averaged 95.7°F and 56.7% humidity.

Average HR and RPE for the pregnant and non-pregnant subjects are presented in

Table 4. Heart rate during the class averaged 105 bpm and 99 bpm for the pregnant and non-pregnant subjects, respectively. For the pregnant subjects, RPE averaged 10.5 and RPE averaged 9.9 for the non-pregnant subjects. Both pregnant and non-pregnant subjects recorded their highest RPE values (13.1 and 13.4, respectively) 30 minutes into the class.

Table 3. Average temperature and humidity of the yoga studio.

	0 min	10 min	20 min	30 min	40 min	50 min	60 min
Temp (°F)	93.6 ± 3.04	94.5 ± 2.71	95.8 ± 2.44	96.1 ± 1.91	97.0 ± 2.00	96.3 ± 1.88	97.2 ± 1.77
Humidity (%)	50.1 ± 6.91	51.0 ± 6.61	53.7 ± 6.66	57.1 ± 6.35	59.7 ± 6.72	62.6 ± 6.28	62.6 ± 6.97

Table 4. Average HR and RPE during the yoga sessions for the pregnant and non-pregnant subjects.

	0 min	10 min	20 min	30 min	40 min	50 min	60 min
Pregnant							
HR	90±11.0	105±8.0	100±16.8	118±10.6	109±16.0	104±11.4	99±9.4
RPE	6.0±0.00	8.8±2.27	11.7±1.79	13.1±1.78	12.4±1.78	10.4±1.51	6.7±1.13
Non-Pregnant							
HR	76±6.7	87±11.6	116±23.7	115±16.1	104±15.2	84±14.3	81±16.9
RPE	6.0±0.00	7.9±1.46	11.0±1.93	13.4±1.30	13.0±3.29	7.7±1.75	6.4±0.74

Core temperatures of the pregnant subjects for each individual session are presented in Figure 1. Core temperatures of the non-pregnant for each session are presented in Figure 2. Average core temperatures for the pregnant and non-pregnant women, collapsed across sessions, are presented in Figure 3. The average highest core temperature (recorded at any time during a class) for the non-pregnant women was

higher than the pregnant women (99.9 ± 0.53°F vs. 99.5 ± 0.47°F, respectively). The highest core temperature recorded in a pregnant woman was 100.1°F, while one non-pregnant woman reached a core temperature of 101.4°F. The change in core temperature for the pregnant women in any one class ranged from -0.19 – 1.2°F and for non-pregnant subjects ranged from 0.29 – 2.8°F.

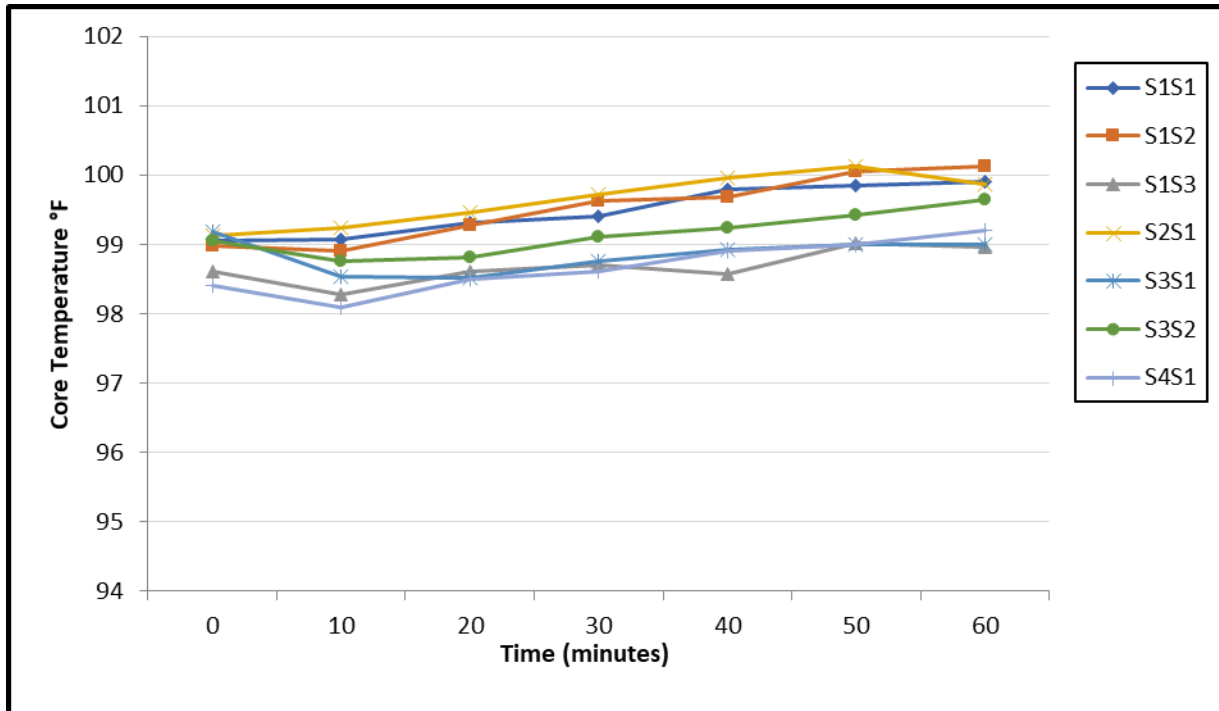


Figure 1. Core temperatures of the pregnant women during each yoga class.

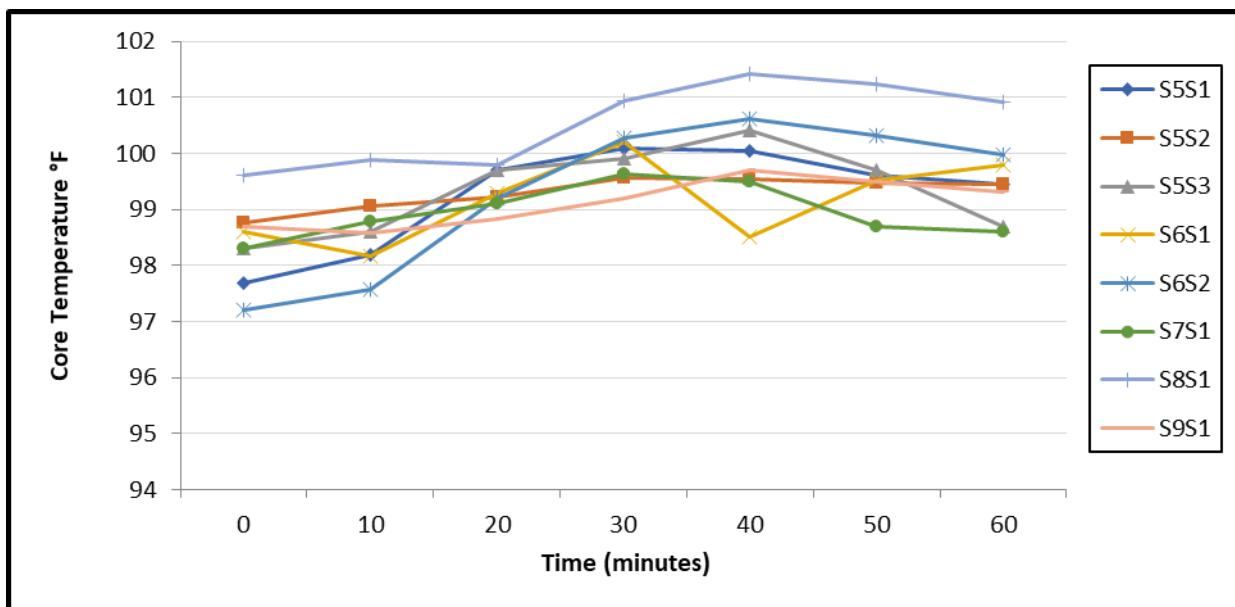


Figure 2. Core temperature of the non-pregnant women during each yoga class.

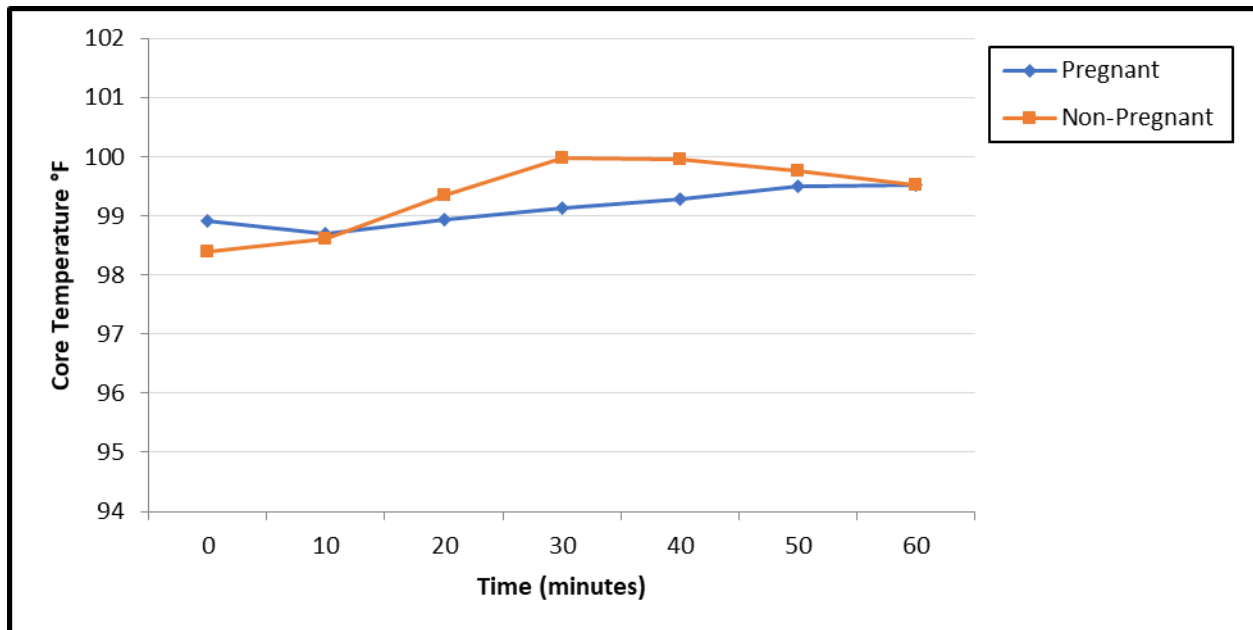


Figure 3. Mean core temperatures of the pregnant and non-pregnant subjects collapsed across all sessions for each group.

Discussion

One concern regarding the practice of hot yoga by pregnant women is a potentially dangerous increase in core temperature. A maternal core temperature exceeding 102°F or an increase of 3°F from baseline has been suggested to increase the risk for abnormal fetal development⁷⁻⁸. The highest core temperature recorded in pregnant subjects averaged 99.5°F, compared to a value of 99.9°F for the non-pregnant subjects. The single highest core temperature observed in a pregnant woman was 100.1°F, while one non-pregnant woman reached 101.4°F. In addition, none of the pregnant women had a change in core temperature during a single class in excess of 1.2°F. The non-pregnant women did not reach a change in core temperature exceeding 2.8°F. It is interesting to note that in

Figure 3 there were several notable differences in the pattern of core temperature changes over the course of the class for the pregnant and non-pregnant women. At rest, the pregnant women had a resting core temperature that was 0.4°F higher than non-pregnant women. This is consistent with the literature and is attributable to the increase maternal metabolic rate due to the thermogenic effects of progesterone coupled with the higher metabolic rate of the expectant mother, due to the metabolic needs of the fetus¹⁰. It is also interesting to note the drop in core temperature in the pregnant women from rest to the 10-minute measurement period (Figure 3). Pregnancy results in an average 45% increase in plasma volume and a decrease in venous compliance (i.e., resulting an increased storage capacity)¹¹.

At the start of exercise, venous constriction shunts blood to the core, which would have an initial cooling effect⁷. It can also be seen that non-pregnant women reached a peak 30 minutes into the class, but the core temperature of pregnant women continually increased over the entire session. Whether or not this has any significance could be explored in future studies.

There was virtually no change in body weight for both the pregnant and non-pregnant subjects from pre to post yoga sessions. This was most likely due to the fact that all but one of the subjects drank water throughout the yoga sessions, which compensated for the sweat lost during the class. One pregnant woman, who is also an instructor at the studio, did not drink water during one of the yoga sessions. She mentioned that this is common for her, but she also stated that she drank approximately 8-10 ounces of water just prior to the class. Several of the other subjects also did this (i.e., drank a considerable amount of fluid just prior to a class). Because they drank after they were weighed, but before the class started, the hydration status of all subjects was probably underappreciated.

One other factor that undoubtedly limited the rise in core temperature in the pregnant women was that all of the subjects spontaneously modified their practice because of their pregnancy. Based on the questionnaire data, it was found that the pregnant subjects either modified or avoided specific poses. Poses that were avoided were upward facing dog, wheel or bridge, and any pose involving

core work or twists. The poses that were most commonly modified were high-to-low plank (subjects preferred to do this from their knees) and straight leg/forward fold. The fact that pregnant women modified their practice is consistent with data from a study in runners¹⁴. When asked to run for 20 minutes at a self-selected pace, they ran at 77% of VO_2max prior to conception, 57% of VO_2max at 20 weeks of gestation, and 47% of VO_2max at 37 weeks of gestation. The corresponding increases in core temperature were 2.7°F preconception, 1.3°F at 20 weeks of gestation, and 0.7°F at 37 weeks of gestation. Thus, the women spontaneously down-regulated their exercise intensity as their pregnancy progressed, which might reasonably have served to mitigate the rise in core temperature with exercise.

Heart rate and RPE values were relatively low and are indicative of the intensity of the class. The average HR values of the pregnant and non-pregnant women were 105 and 99, respectively. These values were very similar to those seen during the study by Nereng et al.⁶, whose subjects achieved an average HR of 103 bpm during a hot yoga class. The average RPE in the current study (average of 10.9) was somewhat lower than those recorded by Nereng et al. (average of 13.2), and are probably reflective of the nature of class instruction. In the previous study, the instruction focused on constant, flowing movements, whereas the instruction in the current study focused on controlled breathing and slower, more controlled poses. The hot yoga classes in the current study also ended

with 5-7 minutes of supine relaxation, which is reflected in the 60-minute RPE values that approximate resting values (Table 3).

The present study includes several limitations. The small sample size coupled with the fact that several subjects completed multiple sessions made statistical analyses impossible. Thus, this was mainly an observational study. Additionally, the earliest stage of pregnancy where a woman was tested was 27 weeks. One of the key recommendations regarding hyperthermia during pregnancy is to avoid a core temperature in excess of 102°F, especially during the first third (14 weeks) of their pregnancy^{5,7-8}. Because we did not test anyone during this time frame, it is not possible to make generalizations regarding the safety of practicing hot yoga during that time frame. Additionally, during the early stages of pregnancy individuals may not even know they are pregnant, and may not spontaneously limit their practice, as was seen in the women in the current study. By design, this study also included only women who had been practicing hot yoga for a minimum of three months prior to becoming pregnant. Thus, they were acclimatized to the activity. Previous research in pregnant women indicates that they acclimatize to exercise in the heat by a greater degree of skin vasodilation and a lowered sweat threshold, both of which would help to cool the body and reduce the rise in core temperature during exercise^{5,7,10}.

Conclusions

In summary, the main purpose of this study was to evaluate core temperature in pregnant women during a hot yoga class. None of the pregnant women had an increase in core temperature that was over the critical threshold of 102°F and none of the subjects had a change in core temperature from baseline that would be considered dangerous. While it is still not recommended that women *start* a yoga practice after they become pregnant¹⁵, based on the results of this study it appears that women who are already participating in hot yoga at the time of their pregnancy can safely continue their practice. However, the final decision to do so should be made jointly by the expectant mother and her healthcare provider.

Disclosures

This study was funded by the American Council on Exercise (ACE). However, ACE was not involved in the design of this study, collection or analysis of the data, or the preparation of this manuscript.

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