ABSTRACT

Effects of Heat Retention on Gross Metabolism and Perceived Effort During Exercise

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As an athlete and personal trainer, I have frequently encountered individuals who believe that utilizing mechanisms that increase heat retention can improve workouts. However, when heat is not properly released from the body, other mechanisms of body temperature regulation must compensate. The human body has many ways to regulate temperature. Sometimes the temperature state of the body has an impact on which type of energy source is preferentially metabolized. In the present study, we examined the effects of heat retention on human gross metabolism during moderate to intense exercise. Each subject underwent three trials on a cycle ergometer. The first trial was an Astrand protocol, used to find the work load needed to push each subject to 70% maximum heart rate. During the next two trials, subjects pedaled at 60-70 rpm to reach target heart rate for 25 minutes. During one of these two trials, the subject wore a sweater/d in order to increase heat retention. In the other trial, the subject did not wear the sweater/d, decreasing heat retention. Gross metabolism was quantified by measuring the subjects’ CO₂ consumption and CO₂ production. We predict that while wearing the sweater/d, increasing heat retention, the subjects will have a higher degree of perceived effort. Preliminary data indicates that heat retention shifts energy source utilization from lipid to carbohydrate oxidation at an increased rate. By spending less time burning fat, subjects are predicted to burn fewer calories since fat contains more calories per gram than does carbohydrates.

RESULTS

The immediate/temporal conditions between the exercise conditions is controlled, one might question whether or not the heat retention itself had any effect. Internal body temperatures seem to be concerned both with and without the increased heat retention. This suggests that either the sweater/d did not adequately increase heat retention, or that when heat increased, the body compensated in such a way that the body did not increase heat retention. Our hypothesis was that the data would indicate that body temperature, salt loss, and weight loss would be increased. This hypothesis was not supported. Our data suggests that the data does not support our hypothesis that the data would indicate that body temperature, salt loss, and weight loss would be increased.

DISCUSSION

We hypothesized that individuals who utilize heat retention practices do not actually achieve a ‘better’ workout (i.e., increased intensity, weight loss…) and that the prevalence of this idea was due to an increased RPE (RPE), as opposed to an actual increase in intensity. Thus, we anticipated that there would be a significant difference in RPE, but not many other variables that indicate exercise performance. The data acquired indicates that the RPE of the experimental trials are consistently higher than those of the control, but statistical analysis indicates that these differences are not large enough to be of significance. Thus, our findings do not appear to support the original hypothesis.

One possible explanation for this is that the subjects decreased their intensity of exercise; the RPE remained the same but the “work” being done decreased. This possibility is unlikely, given the fact that the subjects were able to maintain their revolutions per minutes between 60 and 70 and the resistance placed on the pedals was the same for each trial. Additionally, other variables (heart rate, calories burned, body temperature, weight loss) indicate that exercise between control and experimental conditions remained similar.

Having stated that the intensity of workout between the conditions has been controlled, one might question whether or not the heat retention itself had any effect. Internal body temperatures seem to be concerned both with and without the increased heat retention. This suggests that either the sweater/d did not adequately increase heat retention, or that when heat increased, the body compensated in such a way that the body did not increase heat retention. Our hypothesis was that the data would indicate that body temperature, salt loss, and weight loss would be increased. This hypothesis was not supported. Our data suggests that the data does not support our hypothesis that the data would indicate that body temperature, salt loss, and weight loss would be increased.

METHODS

Before entering into the experiment, subjects were required to pass a physical evaluation conducted by a licensed physician and sign a consent form. Subjects underwent three experimental trials each. Exercise is conducted on a bike during 60-70 rpm. Subjects are randomly assigned to wear a sweater/d during one of these last two trials. At this point, the subject is hopped up to a level that measures CO₂ consumption and CO₂ production, both of which are used to calculate metabolic rates and source of fuels. Also being monitored are heart rate, ventilation rate, and ventilation volume. During these last two trials, temperature and perceived effort are taken at 5-minute intervals between the 30-minute mark. This is the time the subject is working at 70%-load.

The second and third trials are each 35 minutes in length. Subjects warm up for 5 minutes, pedal 60-70 rpm at their 75% load for 25 minutes, and then cool down for 5 minutes. Subjects are randomized to wear a sweater/d during one of these last two trials. At this point, the subject is hopped up to a level that measures CO₂ consumption and CO₂ production, both of which are used to calculate metabolic rates and source of fuels. Also being monitored are heart rate, ventilation rate, and ventilation volume. During these last two trials, temperature and perceived effort are taken at 5-minute intervals between the 30-minute mark. This is the time the subject is working at 70%-load.

In all three trials, measurements of subject’s body temperature, heart rate, blood pressure, and heart rate are taken both before and after the trial.”These data were obtained using a scale with an electrode.” At the end of each trial, subjects consume 20 oz of Gatorade in order to rehydrate and replenish electrolytes.

ACKNOWLEDGEMENTS

This research has been made possible by:

1. Internal grant funds for Scholarly and Creative Transformational Experiences from Washburn University.
2. The equipment used in this study was purchased using funds from a Federally funded grant from the U.S. Department of Education.

SUMMARY

- In opposition to our hypothesis, data indicates that there is no significant difference in RPE between conditions of increased heat retention.
- In support of our hypothesis, data indicates that there is no significant difference in temperature, total calories burned, or peak heart rate under conditions of increased heat retention.
- Larger deviations between control and experimental trials were observed when subjects were pushed to a greater percentage of their maximum heart rate during exercise. This may be of significance for future research.