

Thermal Response to a Combination of a Lipolytic Cream, an Elastic Abdominal Belt and Abdominal Exercise

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KEY WORDS: fat, adipose, slimming, weight loss, ultrasound

ABSTRACT

Study

Aminophylline and caffeine have been shown to reduce subcutaneous fat. As lipolytic agents, subcutaneous metabolism should increase after application. To test this, 28 subjects participated in these experiments. In the first series of experiments, one group of 10 was the experimental group and one group of 10 served as the controls. In the second series, eight subjects were experimental subjects. In the first series, either the lipolytic cream or a placebo was rubbed into the abdominal area within a 30-45 sec period, and an elastic belt was put in place. All subjects immediately performed 2 minutes of intense isometric exercise, and then rested for another 8 minutes. The belt was then removed. Repeat thermal measurements were made at 15 minutes, 30 minutes, 45 minutes, and 1 hour. In the experimental group, there was no statistical difference in

temperature of the skin after the first 15 minutes. However, at 30, 45, and 60 minutes, the temperature was significantly higher than that initially shown for the resting data ($p < 0.01$). The increase in temperatures seen in these studies averaged 2.08 ± 1.03 °C in the lipolytic cream group. Temperature was still rising at 60 minutes. Therefore, in eight subjects, data was collected at 1, 2, and 3 hours. Here, temperature continued to rise such that at 3 hours, the temperature increase averaged 3.4 °C for the eight subjects. The control group had a small increase in skin temperature during the initial 30 minutes due to the abdominal exercise, but temperature returned to baseline by 60 minutes. Thus, the cream was associated with a rise in skin temperature, due to an increase in fat burning in subcutaneous tissue.

INTRODUCTION

Most recommendations for exercise focus on steady exercise between 30 minutes and 1 hour per day with a minimum of five days a week.¹ However, exercise alone,

while increasing muscle activity,^{2,3} has shown lower results in itself as a means of weight loss compared to the combination of exercise and diet.^{4,5} Recently, high intensity intermittent exercise has been used to “burn fat” and cause weight loss.¹ For example, in the Wingate exercise method, work consists of 30 seconds of all out sprinting.⁶ Subjects perform this four to six times, separated by 4 minutes of recovery. However, this exercise protocol is difficult to perform for most individuals.⁷ But even a brief 2 minute bout of heavy exercise increases hormones, such as catecholamines, cortisol, and growth hormone, and has been shown to liberate fatty acids in the body.^{8,9} Even after a very brief bout of exercise, these hormones remain elevated minutes following exercise.¹⁰ Thus, brief exercise, in itself, can increase muscle temperature and muscle metabolism substantially.

In addition, various lipolytic agents have been used to mobilize fat and increase its metabolism subcutaneously.^{11,12} Creams that penetrate the skin and increase the mobilization of lipids have been shown to be effective in reducing the thickness of the fat layer subcutaneously.¹² In the present investigation, a short bout of abdominal exercise involving isometric contractions (2 minutes) while subjects were wearing an elastic belt with a lipolytic cream applied topically was used to assess their effect on metabolism in the abdominal area. This assessment was accomplished by using a thermal camera to determine the thermal effects of exercise, belt, and cream combination. That is, the greater the metabolic change the greater the rise in skin temperature for that defined area of the body.

SUBJECTS

There were 28 subjects in these experiments. Ten were in the 1-hour experimental group, eight in the 3-hour experimental group, and ten were the controls. The average age of the 1-hour experimental group was 27.4 ± 4.4 years old. The average height was 167.3 ± 6.4 cm, the average weight was 67.9 ± 16.7 kg, and the average BMI

was 24.0 ± 4.4 . For the control group, the average age was 27.5 ± 3.8 years old. The average height was 167.1 ± 5.1 cm, the average weight was 68.2 ± 15.9 kg, and the average BMI was 24.3 ± 3.6 . For the eight subject 3-hour group, the average age was 26.0 ± 3.5 years old. The average height was 173.4 ± 9.2 cm, the average weight was 75.1 ± 5.6 kg, and the average BMI was 25.1 ± 2.6 . There was no statistical difference between the groups.

All subjects were free of cardiovascular disease, neurological injuries, and orthopedic injuries. No subject was taking any type of beta agonists or antagonists or alpha agonists or antagonists. Individuals with hypertension (maximal blood pressure 145/90 mmHg) were excluded. Subjects were also excluded if they had hypotension (blood pressure less than 90/50 mmHg). All subjects had all procedures explained to them and the protocol was approved by the Solutions IRB.

METHODS

Lipolytic thermal accelerator cream.

The thermal accelerator cream was a proprietary formulation with aminophylline and caffeine in a cream base. Subjects rubbed the thermal accelerator cream in a circular motion around the abdominal waist area and then wore an elastic band covering the area for 10 minutes. They accomplished 2 minutes of standing abdominal contractions to increase tissue metabolism. The belt was worn for 8 minutes after the exercise was finished.

Placebo cream

The placebo cream was a skin cream with lanolin. Subjects rubbed the placebo cream in a circular motion around the abdominal waist area and then wore an elastic band covering the area for 10 minutes. They accomplished 2 minutes of standing abdominal contractions to increase tissue metabolism. The belt was worn for 8 minutes after the exercise was finished. The placebo cream had no known ingredients that increased lipolysis or metabolism.

Thermal Camera

To measure temperature of the skin, a FLIR module E6 thermal camera was used. The camera measures temperatures to 0.01 degrees C and self-calibrates continuously. FLIR software was used to assess the temperature at five different locations on the abdominal area. Data in this paper is reported as the average of the five measurements.

Blood pressure and Heart rate-

Blood pressure and heart rate were measured by an automated blood pressure cuff (Omron) over the left wrist.

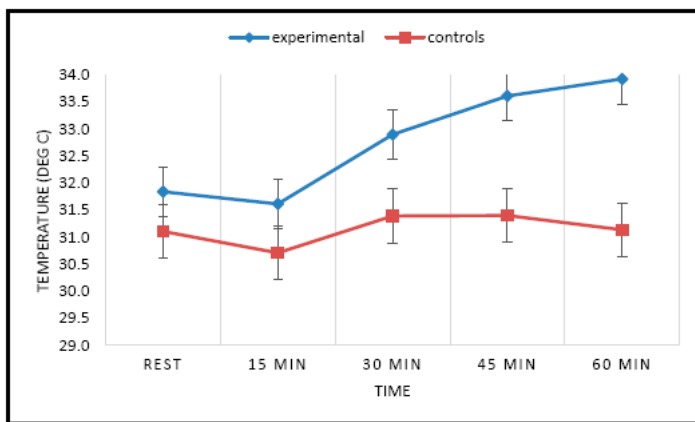
Statistical Analysis

Statistical analysis of data involved the calculations of means, standard deviations, and t-tests. The level of significance was $p \leq 0.05$.

PROCEDURES

There were 20 subjects that participated in the 1-hour experiments (10 active and 10 placebo). Eight additional subjects participated in a 3-hour experiment. After the subjects rested for 20 minutes in a thermally neutral room, a resting infrared photograph was taken of their abdominal area. The lipolytic or placebo cream was then rubbed into the abdominal area within a 30-45 sec period, and the elastic belt was put in place. Subjects immediately performed 2 minutes of standing abdominal isometric exercise and then rested for another 8 minutes while wearing the belt. The belt was then removed for the remainder of the test period. Repeat thermal measurements were made at 15 minutes, 30 minutes, 45 minutes, and 1 hour in experimental group 1, and the controls with a placebo cream and at 1, 2, and 3 hours in a group of eight subjects. The

Figure 1: Illustrated here is the skin temperature of ten subject \pm the appropriate standard deviation measured at rest, 15, 30, 45, and 60 minutes after the application of the thermal accelerator cream and the isometric exercise just after the rest period in the experimental group and data with a placebo cream in the control group.



camera was placed at 1 meter and perpendicular to the subject, and only LED lighting was used while the camera was on. The subjects remained in a seated position at rest in a thermally neutral room during the test period and did not eat or drink during the test period.

RESULTS

The results of the experiment are shown in Figures 1 and 2. The average data for the 10 controls (placebo cream) and 10 experimental subjects for the temperatures of the abdominal area are shown in Figure 1.

In the lipolytic cream group, as shown in this figure, there was no statistical difference in temperature of the skin after the first 15 minutes. However, at 30, 45, and 60 minutes, the temperature was significantly higher than that initially shown for the resting data ($p < 0.01$). For the controls, there was no significant change in skin temperature except at 30 and 45 minutes, where it increased by 0.3 degrees C. The increase in temperatures seen in these studies in the experimental group averaged 2.08 ± 1.03 0 C.

One subject had an increase of 4.0 0 C in skin temperature, while most subjects showed an average increase of only 2 0 C.

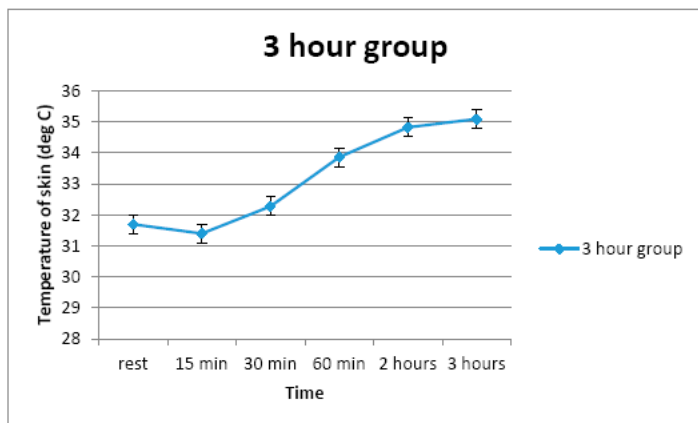
Clearly, as shown in Figure 1, temperature was still rising at 60 minutes. Therefore, in eight of the subjects, data was collected at 1, 2, and 3 hours. For the eight subjects, temperature continued to rise such that at 3 hours, the temperature increase averaged 3.07 0 C for the two subjects. One subject, for example, started with an average skin temperature of 31.2 0 C and, after 1 hour, his skin temperature was 34.0 0 C, after 2 hours 34.8 0 C, and after 3 hours also 34.8 0 C. Whereas in another subject, skin temperature started at 31.4 0 C, and after 1 hour it was 33.1 0 C, and after 2 hours 33.4 0 C, and at 3 hours 34.1 0 C and seemed to continue to rise.

The results of the 3 hour group are shown in Figure 2. The temperature showed a uniform increase across the area where the lipolytic cream was rubbed. After 3 hours, the temperature was still not at its peak and was beginning but not at its plateau.

For the control group, there was a small increase in skin temperature during the 30-45 minutes, but returned to baseline after 60 minutes. This was only 0.3 degrees C and showed the effect of exercise and the garment alone on skin temperature and muscle metabolism.

Since the skin temperature kept increas-

Figure 2: The increase in skin temperature over 3 hours after the crème was rubbed into the skin. Each point is the mean of 8 subjects +/- the standard deviation.



ing after the first hour, a final group of eight subjects were evaluated over 3 hours after the cream was rubbed in. This is shown in Figure 2.

As shown in Figure 2, the temperature was still rising after 3 hours. The increase in temperature at each time period was significantly higher than the previous time period temperature ($p < 0.01$). The final group temperature was 3.4 degrees C above rest at 3 hours.

The initial systolic blood pressure was 116 ± 17 mmHg and diastolic pressure was 80.4 ± 14.9 mmHg. At the end of the 1 hour period, the average systolic was 105.7 ± 16.1 mm Hg and average diastolic pressure was 69.6 ± 11.1 mmHg, reduction of 10.3/10.8 mmHg. This reduction in blood pressure was significant ($p < 0.05$). No such change was seen in the control group.

DISCUSSION

The use of the system, that is the combination of the cream plus the belt and abdominal isometric exercise, demonstrated a significant increase in temperature following the 10 minute treatment. On eight subjects, this increase in temperature was monitored past the initial hour, and was still increasing 3 hours later. The rise in temperature cannot be due to the thermal insulating effect of the belt itself, because the belt was removed after 10 minutes.

While exercise alone does cause a temperature increase in the skin, exercise alone would not cause such a dramatic increase and continuous increase in muscle temperature after the 10 minute procedure is over. The controls had no such rise in skin temperature after exercise and use of the belt. Typically, with exercise alone, temperature will increase in the first few

minutes, and then, over a period of an hour or so begin decreasing. A modest rise such as this was seen in the controls with it returning to baseline within the hour. However with the experimental group, temperature increased and continued increasing not just for the first hour, but, continued increasing for hours after the experimental procedure was over.

There was no statistical difference in the temperature of the skin comparing the resting data to the 15 minute measurements. After the first 15 minutes, temperature continually increased showing enhanced thermal activity (increased metabolism in the abdominal area and subcutaneous tissue) for hours after the application of the cream, and only 2 minutes of abdominal exercise. Further, the temperature increase was fairly uniform across the abdominal area, and was not just due to one or two small areas increase in temperature. The increase in temperature translates to an increase in metabolism and an increase in caloric expenditure. The fact that the placebo control group had only a small change in skin temperature after exercise and the garment but with placebo cream shows the largest cause of the increase in skin temperature for the experimental group was due to the lipolytic cream.

The mechanism of this dramatic increase in tissue temperature is certainly related to and consistent with published literature on the two principal agents in the lipolytic cream, caffeine, and aminophylline. Caffeine activates cyclic amp kinase in tissue and increases tissue metabolism, increasing caloric expenditure.¹⁴ This certainly accounts for both the rise in skin temperature and the lipolytic effect of caffeine locally, and on whole body metabolism quickly after the belt is removed. In addition, aminophylline, is well known to increase local fat metabolism and liberate fat from the subcutaneous area.^{12,13} Exercise also increases metabolism.¹⁵ With both agents used together plus exercise, it is of no surprise that there was such a dramatic rise in tissue temperature and, as demonstrated in a

companion study, a reduction in subcutaneous fat verified by girth loss and ultrasound imaging. The long-term fat loss seen in this companion study is reasonably related to the fact that the skin temperature, after application of the lipolytic agent, continued to rise after 3 hours. Thus a single application of the agent had long lasting effects on fat metabolism. A temperature increase occurred in every participant indicating the metabolic effect occurs to everyone after each application. Subjects, during the 3-hour test period, did not complain of heat, perspire nor were there any adverse events.

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