THE EFFECTS OF WEARING A COLD VEST ON CALORIC EXPENDITURE

A Manuscript Style Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Clinical Exercise Physiology

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College of Science and Health
Clinical Exercise Physiology

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THE EFFECTS OF WEARING A COLD VEST ON CALORIC EXPENDITURE

By Samuel M. Hartinger

We recommend acceptance of this thesis in partial fulfillment of the candidate's requirements for the degree of Master of Science in Clinical Exercise Physiology.

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ABSTRACT

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Purpose: To determine changes in caloric expenditure and heart rate when wearing the Cool Fat Burner and the Cool Gut Buster. Methods: Twelve male (aged 20.9 ± 1.78 years) and eight female (aged 22.4 ± 2.00 years) subjects sat quietly for a total of 90 minutes while heart rate and VO₂ were recorded. Data collection was separated into three 30-minute phases: rest, low-intensity and high-intensity. Results: Average VO₂ increased significantly across all three phases (rest: 295.6 ± 69.1 ml/min; low intensity: 333.0 ± 83.2 ml/min; high intensity: 372.8 ± 87.5 ml/min). Average heart rate decreased significantly across all three phases (rest: 67 ± 8.2 bpm; low intensity: 65 ± 7.1 bpm; high intensity: 59 ± 6.8 bpm). When VO₂ was converted to caloric expenditure, it was found that 11.2 additional kcals were burned in the low-intensity phase compared to rest, and 23.1 additional kcals were burned during the high-intensity phase compared to resting values. Conclusion: Wearing a cold vest does significantly increase caloric expenditure. However, the magnitude of the increase may not be practically useful as a weight loss tool.
ACKNOWLEDGEMENTS

This last year has given me more than I thought possible. Even now as I type these words, it is still hard to believe I am in graduate school for something I have an enormous passion for. I would like to thank John Porcari, my thesis advisor, without his support and guidance I would be lost. I would also like to thank Kimberly Radtke and Scott Doberstein for being a part of my thesis committee and helping me with everything. Thanks to Sue Bramwell who helped me with recruiting my participants. Thanks to Chris Dodge who helped me in the lab when everything went wrong. Thanks to Chelsea Hahn for answering all my dumb questions I was scared to ask anyone else.

I have to thank my family for their unyielding support. Special thanks to Gary Arnet, without him I would have never discovered exercise physiology or made it as far as I did. I would like to also thank Jack Azevedo for showing me the best way to learn is to have the drive within and seek answers through your own efforts. Thanks to Michael Smith for encouraging me by being impressed with my willingness to learn. Thanks to Melissa Mache, who showed me I could be successful while at the same time not really knowing what I’m doing. I would also like to thank Roxsanne Rarick, for not even being able to imagine a situation where I wasn’t successful. And finally, Thanks to my friends and classmates, I cannot imagine completing this year without you.
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INTRODUCTION

Obesity is an epidemic that affects over half of the U.S. population. The American College of Sports Medicine (ACSM) defines obesity as a body mass index (BMI) greater than 30 kg/m$^2$. Being obese increases the risk of diabetes, heart disease, blood pressure, and even the risk for some cancers (Bray, 2004). Many of these risks can be reduced or even eliminated by decreasing one’s percentage of body fat. It is well known that exercise and diet result in weight loss. However, many people still have difficulty adhering to an exercise and diet program (Dishman, Sallis, & Orenstein, 1985). Thus, alternative ways for people to lose weight are always being proposed.

The association between cold exposure and lower body weight has been recognized for several years (Celi et al., 2010). A lower ambient temperature is associated with an increase in energy expenditure that purportedly leads to a decrease in body fat (Chen et al., 2013). Exercising in cold weather has also been shown to burn significantly more calories compared to warm weather (O’Hara, Allen, Shephard, & Allen, 1979). Exposure to colder temperatures when exercising in the cold purportedly stimulates brown adipose tissue (BAT), which is responsible for the increase in energy expenditure. Brown adipose tissue is different from a person’s body fat, which is called white adipose tissue. Brown fat is a type of fat that, when activated by cold temperature, burns body fat in order to generate heat. Therefore, it is probable that the increase in energy expenditure is caused by the stimulation of BAT, not just a decrease in ambient temperature.
A new product on the market, which is designed to stimulate BAT, is the cold vest. There are multiple manufacturers of cold vests. The manufacturers of one type of cold vest, The Cold Shoulder, claims that individuals can burn up to 500 additional calories per day by wearing the vest (Hayes, 2015). The Cool Fat Burner, another manufacturer, claims an individual can burn 500 calories per day by wearing the vest for 2 hours (Cool Fat Burner, LLC). The Cool Fat Burner makes two types of cold vests: The Cool Fat Burner, which is attached over the shoulders and the Cool Gut Buster, which is attached around the abdomen.

The cold vest places ice packs strategically against the shoulder blades and the back of the neck, the site of brown fat deposits in adults (van Marken et al., 2009). Wearing a cold vest may mimic lower ambient temperatures, which activates brown fat and increases energy expenditure. During a 6-week study in Sweden, it was found that the cold vest increased both energy expenditure and BAT (Romu, 2016). Another study claimed that exposure to the cold increased metabolic rate and BAT volume (Yoneshiro, 2013). There is not universal agreement on the length of time a cold vest should be worn, but most studies seem to agree that wearing a cold vest will increase metabolic rate, increase BAT activation, and burn more calories (O’Hara et al., 1979). To our knowledge, no research study has validated the number of calories expended while wearing a cold vest. The purpose of this study is to measure changes in energy expenditure that occur from wearing both the Cool Fat Burner and the Cool Gut Buster.
METHODS

Subjects

The subjects included 20 male and female volunteers, aged 18-40 years, from the University of Wisconsin - La Crosse and the surrounding community. All subjects were overweight or obese, which is defined as a body mass index (BMI) greater than 25 kg/m$^2$. Approval was be obtained from the University of Wisconsin-La Crosse Institutional Review Board for Protection of Human Subjects prior to the study. The subjects will be provided written informed consent before undergoing testing and procedures.

Procedures

Data collection took approximately 2 hours for each subject. Subjects arrived at the Human Performance Laboratory in Mitchell Hall in a 10-hour fasted state. Subjects also abstained from exercise, caffeine, and stimulants for the past 10 hours. The subjects removed any jacket or sweatshirt they were wearing prior to testing. Clothing was not standardized provided their shirt prevented the vest from making contact with skin. The subject had a Polar heart rate (HR) monitor (Polar Elector, Woodbury, NY, USA) attached and then were hooked up to a Moxus Metabolic Cart (AEI Technologies, Pittsburgh, PA, USA) to measure their expired air (VO$_2$). The subjects sat quietly for 5 minutes. Data was then collected for 30 minutes with the subject sitting comfortably. After the 30 minutes, the subject was disconnected from the metabolic cart. The subject was then instructed to put on the Cool Fat Burner vest and the Cool Gut Buster. They also
put on fleece gloves and socks in an attempt to keep their extremities warm. The subject was then reconnected to the metabolic cart and again sat quietly for 5 minutes to allow their metabolic rate to stabilize. Then metabolic rate was measured for 30 minutes while the subject was again sitting comfortably. This was considered the “low-intensity phase” of testing. At the conclusion of the “low-intensity phase,” the mouthpiece was quickly removed, the subject drank two 8-ounce glasses of cold water and the mouthpiece was reinserted. This was the beginning of the “high-intensity phase” of testing, during which the metabolic rate was collected for 30 minutes. At the halfway point of this phase, the subject quickly removed the mouthpiece, drank an additional two 8-oz glasses of cold water and reinserted the mouthpiece. At the conclusion of the “high-intensity phase” the mouthpiece, heart rate monitor, gloves, and socks will be removed and the subject was free to leave.
STATISTICS

Average HR, VO₂, and caloric expenditure (kcal) during each phase were compared using a one-way ANOVA with repeated measures. There was a significant F ratio. Pairwise comparisons were made using Tukey’s post-hoc tests. Alpha was set at 0.05 to achieve statistical significance.
RESULTS

The descriptive characteristics of the subjects are displayed in Table 1. Height and weight were significantly different between males and females.

Table 1. Descriptive characteristics of the 20 subjects.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Males (n=12)</th>
<th>Females (n=8)</th>
</tr>
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<tr>
<td>Age (years)</td>
<td>20.9 ± 1.78</td>
<td>22.4 ± 2.00</td>
</tr>
<tr>
<td>Height (in)</td>
<td>70.5 ± 2.49</td>
<td>65.0 ± 2.46*</td>
</tr>
<tr>
<td>Weight (lbs)</td>
<td>196.0 ± 35.18</td>
<td>165.5 ± 20.80*</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>27.6 ± 3.86</td>
<td>27.5 ± 2.45</td>
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* Significantly different from males (p < .05).

Minute-by-minute VO₂, kcal, and HR responses during the rest, low-intensity, and high-intensity phases are presented in Figures 1-3, respectively. Average VO₂ (Figure 1) was 295.6 ± 69.1, 333.0 ± 83.2, and 372.8 ml/min ± 87.5 ml/min for the rest, low-intensity, and high-intensity phases, respectively. Oxygen consumption was converted to kcals/min assuming a constant of five kcal per liter of oxygen consumed. Average caloric expenditure (Figure 2) was 1.47 ± .35, 1.67 ± .42, and 1.86 ± .44 kcals/min during the rest, low-intensity, and high-intensity phases, respectively. Extrapolated to one-hour values, these equate to 88.7, 99.9, and 111.8 kcal for the same time points.
Figure 1. Average VO$_2$ during the three phases of testing.

Figure 2. Average caloric expenditure (kcals/min) during the three phases of testing.
Average HR (Figure 3) was 67 ± 8.2, 65 ± 7.1, and 59 ± 6.8 bpm for the rest, low-intensity, and high-intensity phases, respectively. There was a statistically significant difference between all three phases for VO\textsubscript{2}, caloric expenditure, and HR.

Figure 3. Average heart rate (bpm) during the three phases of testing.
DISCUSSION

The main purpose of this study was to assess changes in caloric expenditure when wearing the Cool Fat Burner in conjunction with the Cool Gut Buster. Claims made by the manufacturer suggest that individuals can increase their metabolic rate up to 300% and burn at least an additional 500 kilocalories per day while wearing the vest for 2 hours (Cool Fat Burner, LLC). The Cold Shoulder, another cold vest competitor, also claims the vest results in an increase in caloric expenditure of 500 kcals per day (The Cold Shoulder, 2015). In the current study, we had participants wear the Cool Fat Burner and the Cool Gut Buster for one hour based on the company’s website video. The subject wore the vest for 1 hour, split into a low-intensity and a high-intensity phase. During the high-intensity phase, the subject drank four 8-oz glasses of ice water to further decrease core temperature.

It was found that there was a significant increase in both VO₂ and caloric expenditure, as well as a significant decrease in heart rate. Although statistically significant, these changes in caloric expenditure were very small. The number of additional calories expended amounted to an average of 23.1 kcals in 1 hour. When extrapolated to 2 hours, this would total approximately 46 additional kcals, which is less than 10% of what is suggested by the manufacturer.

Very little research has been done on the effects of wearing any cold vest on caloric expenditure. Although this study found an increase in the number of calories
burned, the increase was much less than advertised. When looking at possible reasons why our results were different than the manufacture’s claims, there are several possibilities. It is possible that subjects in the current study had low levels of BAT. Cypess et al. (2009) found wide variability in BAT levels in both men (.5-42.0 g) and women (1.1-170 g). Since cold vests purportedly work by activating BAT, if subjects had low levels of BAT, the increase in caloric expenditure would be less than expected. Yoneshiro et al. (2013) also showed that being cold-acclimated results in a greater activation of BAT with greater levels of caloric expenditure. Romu et al. (2016) found that after 6 weeks of cold-acclimation, there was a significant increase in supraclavicular BAT deposits. In the current study, subjects were likely not cold-acclimated, suggesting they probably had very little BAT. Another potential limitation of the study was that caloric expenditure was not recorded after the vest was taken off. The manufacturer showed increase in metabolic rate of 232% during the first 15 minutes after the vest was removed (Cool Fat Burner, LLC).

These questions open the door for potential future research. An additional study in which subjects wear the vest for 1-2 hours a day for several weeks, in order to become cold-acclimated could be conducted. Since we did not measure the caloric expenditure after the vest was removed, another study could assess when metabolic rate returns to baseline.

Heart rate was shown to decrease in response to wearing the cold vest. When comparing HR at rest to HR during the final phase of testing, there was an 8 bpm decrease. These results are similar to what was seen in baseball players who wore a cold vest (Bishop, Szymanski, Ryan, Herron, & Bishop, 2017). They also saw a decrease of 8
bpm. The normal response to cold would be vasoconstriction, with an increase in HR to compensate for the decrease in stoke volume resulting from the increase in afterload. It is possible that wearing the cold vest induces a response similar to that in hibernating animals, where HR decreases and heat is produced from BAT activation.

There were varying levels of comfort while wearing the vest, which decreases the practicality of using the vest as a weight loss tool. Anecdotally subjects did not enjoy being “chilled” for that long a period of time. Given the fact that it is recommended that the vest be used for 2 hours each day, compliance could be an issue.
REFERENCES


APPENDIX A

INFORMED CONSENT FORM
INFORMED CONSENT

Protocol Title: The Effects of Wearing a Cold Vest on Caloric Expenditure

Principle Investigator: Sam Hartinger
Graduate Student
University of WI-La Crosse
(650) 291-2958

Emergency Contact: Sam Hartinger
(650) 291-2958

Purpose and Procedure:
- The purpose of this study is to determine whether wearing a cold vest increases caloric expenditure.
- I will be wearing both the Cool Fat Burner, which goes over my shoulders and the Cool Gut Buster, which is worn around my abdomen.
- I will be asked to sit for approximately 30 minutes while wearing a facemask to measure my expired air and a chest strap to analyze my heart rate.
- I will then put on the Cool Fat Burner and the Cool Gut Buster and have my expired air and heart rate measured for another 30 minutes.
- Following this, I will drink two 8-oz glasses of cold water and have my expired air and heart rate measured for an additional 30 minutes while still wearing the Cool Fat Burner and the Cool Gut Buster. I will also drink an additional two 8-ounce glasses of cold water 15 minutes into this segment

Potential Risks:
- I may experience shivering or a fast heart rate during the data collection. These symptoms are more likely to occur with the vest on.
- I understand I can choose to end the test at any time for any reason.
- Individuals trained in CPR, Advanced Cardiac Life Support, and First Aid will be in the laboratory during all phases of the test, and the test will be terminated if complications occur.

Rights and Confidentiality
- My participation in this study is voluntary and I can withdraw from the study at any time for any reason without penalty.
- All information will be kept confidential through the use of the number codes and password protected computer files. The data gained from my participation in this study will not be linked to any personal identifiable information.
- The results of this study may be published in scientific literature or presented at professional meetings using grouped data only.
Possible Benefits
- I will gain knowledge of my current heart rate and resting caloric expenditure.
- I will gain knowledge about a new potential weight loss product.

Questions regarding study procedures may be directed to Sam Hartinger (650-291-2958), the principal investigator, or the study advisor Dr. John Porcari, Department of Exercise and Sport Science, UW-La Crosse (608-785-8684).

Questions regarding the protection of human subjects may be addressed to the UW-La Crosse Institutional Review Board for the Protection of Human Subjects, (608-785-8124 or irb@uwlapex.edu).

Participant: ________________________________ Date: ____________

Researcher: ________________________________ Date: ____________
APPENDIX B

PAR-Q FORM
PAR-Q & YOU
(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

### YES

1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
   - [ ] YES
   - [ ] NO

2. Do you feel pain in your chest when you do physical activity?
   - [ ] YES
   - [ ] NO

3. In the past month, have you had chest pain when you were not doing physical activity?
   - [ ] YES
   - [ ] NO

4. Do you lose your balance because of dizziness or do you ever lose consciousness?
   - [ ] YES
   - [ ] NO

5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?
   - [ ] YES
   - [ ] NO

6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
   - [ ] YES
   - [ ] NO

7. Do you know of any other reason why you should not do physical activity?
   - [ ] YES
   - [ ] NO

### NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you:
- start becoming much more physically active — begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal — this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

No changes permitted. You are encouraged to photocopy the PAR-Q but only if you use the entire form.

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DELAY BECOMING MUCH MORE ACTIVE:
- If you are not feeling well because of a temporary illness such as a cold or a fever — wait until you feel better.
- If you are pregnant — talk to your doctor before you start becoming more active.

PLEASE NOTE: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

APPENDIX C

REVIEW OF LITERATURE
REVIEW OF LITERATURE

The purpose of this paper is to review the literature concerning the effects of brown adipose tissue and cold thermogenesis on caloric expenditure, and then to relate these concepts to the legitimacy of a cold vest product.

Observation of Cold Effects

The relationship between cold exposure and weight loss has been observed globally. For instance, the population of Germany has an obesity rate of 16%, while the population of Switzerland has an obesity rate of only 8%. Both Germany and Switzerland have virtually the same diet, yet there is this large difference in the rate of obesity. Switzerland is cold and at a high altitude, while Germany is warmer and at a lower altitude (Lustig, 2013). It is felt that the difference in temperature and altitude are potential anti-obesity factors.

In the 1970’s, the United States army observed that soldiers returning from the cold region of Alaska inexplicably had less body fat and more muscle. This lead to a cross-over study of 15 obese males walking for 2.5 hours a day for 1 week at room temperature, and then 1 week at -40°C. The cold conditions caused the subjects to lose 5 pounds of body fat, determined by skinfold caliper (O’Hara et al., 1979).

Brown Fat

Brown fat, also called brown adipose tissue (BAT), was first discovered by Dr. Hammar in 1895 (Hammar, 1895). Under a microscope he noticed that unlike white fat, BAT did not grow or shrink based on how much an animal was fed. This suggested that brown fat does not store energy like white fat. However, Dr. Hammar admitted he had no idea what the purpose of BAT was.
Brown fat expresses substantial amounts of UCP1 protein, which allows the body to produce heat instead of ATP. Normally, hydrogen ions pass through ATP synthase to make energy, but if UCP1 is present, the ions can bypass ATP synthase in order to produce heat. Therefore the more BAT someone has, the more heat they can produce. Brown fat is mitochondria-dense compared to white adipose tissue, which has relatively few mitochondria (Viranen et al., 2009).

The first study of BAT in rats noted that brown fat had more in common with glands than it did white fat, specifically the adrenal gland (Cramer, 1920). Brown fat seemed to become “activated” by the same stimulus as other glands in the body. It was also noted there were greater deposits of brown fat in younger rats, most of which seemed to turn into white fat as the rats aged.

Hart and Jansky (1963) studied rats in order to figure out how the rats weren’t freezing to death during hibernation in temperatures as low as -31°F. It was found that oxygen consumption increased when the rats were in a cold environment, although they did not make the connection to BAT. They also found that rats placed in a cold environment for 4-6 weeks before the test became cold acclimated, meaning they were able to maintain their body temperature without shivering. In rats that had acquired non-shivering thermogenesis, the rate at which calories were burned was greatly increased (Hart & Jansky, 1963). The peak rate of caloric expenditure in cold acclimated rats was nearly double that of warm acclimated rats. Thus, it was concluded that rats left in the cold adapt by burning more calories without shivering.

Plattner et al. (1997) studied how human infants defend themselves against hypothermia and found that non-shivering thermogenesis occurs at 34°C, which is just a
few degrees lower than the temperature at which cold thermogenesis occurs in adults. Research shows nonshivering thermogenesis is a process that occurs in BAT (Himms-Hagen, 1984).

In 1964, the connection between BAT and cold thermogenesis was made. While studying non-shivering thermogenesis in hibernating rodents, BAT was shown to protect the hibernating animal by contributing heat to vital organs (Smith, 1964). Talan, Kiroy, and Kosheleva (1996) found that mice housed at 22°C had greater BAT, UCP1 levels, and non-shivering thermogenesis compared to mice housed at 29°C. This indicated a direct relationship between non-shivering thermogenesis and a decrease in temperature.

It was not until the 1950’s that BAT was studied in humans. Wegener (1951) found that babies have substantial amounts of brown fat, and that some adults have brown fat. The mechanism for why some adults still had brown fat and some didn’t was unknown at the time. A few decades later, autopsies found that the brown fat in human babies almost completely disappeared by adulthood (Heaton, 1972). It was appealing to discover a way to activate BAT in humans using a pill. However, that failed during testing due to side effects of cardiac arrest in rats. Also, if BAT was responsible for the increase in caloric expenditure during non-shivering thermogenesis, it was thought that due to the small amount of BAT found in adults, the calories expended would not be significant. Since the exact amount of BAT in adults could not be determined, BAT research was abandoned for a few years.

Based on the research at the time, it was thought that BAT would almost completely disappear as humans and mammals aged into adulthood. Then Nedergaar, Bengtsson, and Cannon (2007) found unexpected evidence for BAT in adults using
positron emissions tomogram (PET) scans. During a routine PET scan the doctor noticed dark regions in the neck, back, and shoulders of a patient. However, these dark regions were only present when the temperature of the room was cold. If the temperature of the room increased, the dark regions disappear and this indicated that brown fat in adults could be activated by cold thermogenesis. It was felt that if an effective way to stimulate brown fat could be found, it could be a powerful way to combat obesity. As a result, interest in cold thermogenesis as a way to treat obesity increased.

**Cold Thermogenesis**

Yoneshiro et al. (2011) compared the effects of cold exposure in subjects who had confirmed BAT deposits via a PET scan (BAT-positive) to subjects who had no BAT deposits via a PET scan (BAT-negative). After 2 hours of cold exposure, the BAT-negative group had an increase in caloric expenditure of only $42 \pm 114$ kcals/day, whereas the BAT-positive group increased caloric expenditure by an astounding $410 \pm 293$ kcals/day. This shows that having more BAT increases caloric expenditure in response to cold thermogenesis. However, the rate of caloric expenditure was not statistically different between groups before cold exposure. This indicates that brown fat plays a large role in caloric expenditure when exposed to cold thermogenesis. In a 10-day cold acclimation study, BAT was found to increase in parallel to the increase in non-shivering thermogenesis, independent of gender (van der Lans et al., 2013). After acclimation, the subjects reported that they felt more comfortable in the cold environment and shivered less frequently.

The calories expended from non-shivering thermogenesis suggested cold thermogenesis might become a major part in the fight against obesity. Yoneshiro et al.
(2013) studied the effects of daily 2 hours of cold exposure for 6 weeks. It was found that the effects of cold thermogenesis on caloric expenditure were present even without changes in BAT levels. This was discovered to be due to skeletal muscle also being capable of non-shivering thermogenesis. It was also found that individuals could recruit BAT even if they had low initial BAT stores. Changes in brown fat and white fat were inversely correlated; meaning an increase in brown fat caused white fat to be reduced.

**Caloric Expenditure**

Obesity is a battle of energy equilibrium that is difficult to balance. Normally the hormone leptin, also know as the satiety hormone, signals your body to stop eating when your body’s fat stores are full. When your stored fat decreases, so do leptin levels, which send signals to your body that you are hungry. Eating replenishes the energy stored in the body and increases leptin levels, which signals the body that it is no longer hungry. Leptin acts as a moderator to keep your body mass constant by increasing appetite when the body’s fat stores are low. This way energy input and output are balanced and body weight remains the same. However, cold thermogenesis has been shown to work against this by increasing leptin sensitivity, which decreases the signals that would normally cause a person to eat more when they lose weight. Cannon and Nedergaad (2009) discovered that the calories expended from cold thermogenesis are not always fully compensated by the increased food intake. This means cold thermogenesis may counteract obesity without dietary intervention.

Cypess et al. (2012) tested ephedrine as a potential activator of BAT and potential obesity treatment in 10 healthy subjects. While ephedrine was shown to increase blood pressure, HR, and caloric expenditure, it accomplished this by a broad stimulation of the
sympathetic nervous system. Cold exposure also caused an increase in blood pressure and caloric expenditure, but showed a decrease in HR and had fewer systemic effects. Positron emissions tomogram scans showed that cold exposure stimulated BAT while ephedrine does not. This shows a promising method to treat obesity while minimizing systemic effects. Based on all the current research, Lichtenbelt Kingma, van der Lans, and Schellen (2014) suggested regular cold exposure might prove an efficient strategy for increasing caloric expenditure and combating obesity.

**Cold Vests**

Recently, cold vests have been thought of as a method to induce cold thermogenesis. Cold vests work by placing ice packs in strategic locations so that while wearing the vest, the ice packs line up with sites of BAT deposits on the neck, back and shoulders. There has been little research done on the effects of cold vests. Romu et al. (2016) studied the effects of cold exposure using a cold vest in both cold-acclimated and warm-acclimated subjects. Thirteen subjects were told to achieve cold exposure for 1 hour a day for 6 weeks; this was the cold-acclimated group. The other 12 subjects were told to avoid being cold at all costs; this was the warm-acclimated or control group. Metabolic rate was measured before and after in both groups. At room temperature, it was found that in the cold acclimated group increased their metabolic rate by 74 kcals/day while the control group showed a decrease in metabolic rate of 46 kcals/day. During the cold provocation test, which consisted of drinking cold water and wearing a cold vest, the cold-acclimated group increased caloric expenditure by 46 kcals/day compared to a decrease of 107 kcals/day in the warm-acclimated group. The cold-acclimated group also had a significant increase in supraclavicular BAT deposits. It is
unknown what type of vest was used in this study.

The makers of one type of cold vest suggest that when worn twice a day for as long as it takes for the ice to melt, the user can expect to lose an additional 1 pound of body weight a week, which approximately equals an additional 500 calories burned per day (Hayes, 2015). Another popular cold vest manufacturer suggest that individuals can increase their metabolic rate up to 300% and burn at least an additional 500 calories per day from 2 hours of wearing the vest (Cool Fat Burner, LLC).

Normally, when exposed to cold, HR increases due to a sympathetic response. Additionally, shivering increases blood flow and HR. Celi et al. (2010) found that during a twelve-hour cold exposure at 19°C, HR was shown to increase by 6 bpm, and is most likely a primary cause of an increase in caloric expenditure. In some responses to cold HR actually is shown to decrease. Bishop, Szymanski, Ryan, Herron, and Bishop (2017) found that wearing a cold vest for baseball catchers decreases HR. Normally heat causes an increase in HR so cooling the body down from a high temperature may result in a decrease in HR. Another way HR decreases is due to cold in response to the face being submerged in water. This is called the diving reflex. The diving reflex, triggered by the vagus nerve, slows HR in order to decrease oxygen demand. Cypess et al. (2009) saw a decrease in HR of approximately 5 bpm when subjects experienced 2 hours of cold exposure. This decrease can potentially be caused by a hypothermic response in order to maintain the body’s core temperature, but the exact mechanism is unknown.

Srámek, Simecková, Janský, Savlíková, and Vybiral. (2000) researched subjects performing 1-hour immersions in water of different temperatures. In 32°C water, HR was shown to decrease by 9 bpm. However, in 14°C water, HR was shown to increase by 3
bpm. It was hypothesized that the increase in HR at 14°C was caused by the increase in metabolic rate from shivering.

Summary

The effects of cold exposure on weight loss have been observed for many years. This appears to be a result of activations of BAT. Cold vests are a way to activate BAT, and potentially aid weight loss. Wearing the vest requires no change in diet or exercise habits, which makes it attractive as an anti-obesity agent. The ability of cold thermogenesis to activate brown fat and increase caloric expenditure has been heavily researched. However, it is unknown if wearing a cold vest will have the same effect.
REFERENCES


