SLIMCOOL EFFICIENT IN BAT ACTIVATION

Professor Michael Symonds, University of Nottingham shows BAT activity for COOLINE SX3© textiles

Following the rediscovery of functional brown adipose tissue (BAT) in humans [1-3], interest lies in elucidating the mechanisms underlying the non-shivering thermogenic (NST) component of the physiological response to acute cold. Cold-induced activation of uncoupling protein (UCP)1 on the inner mitochondrial membrane of thermogenic brown adipocytes uncouples oxidative phosphorylation from the generation of ATP, and the excess chemical energy is dissipated as heat [4]. As a result, fat depots containing an abundance of thermogenic adipocytes generate heat and expend energy. It is estimated that cold-induced BAT activation could increase resting energy expenditure by at least 2.5-5% [5].

BACKGROUND

The most superficial thermogenic BAT depot in humans is found in the neck and upper thorax [2], and supraclavicular skin temperature can be used as a proxy measure of thermogenesis [6]. As a highly metabolic tissue, BAT has a high glucose requirement, and radio-labelled glucose uptake is often used as an indicator of BAT activity.

18F-fluorodeoxyglucose (FDG) positron emission tomography (PET) is frequently used for clinical purposes, and warming patients prior to scanning is recommended to reduce FDG uptake in BAT (which may obscure the region of clinical interest [7]. Retrospective studies of clinically indicated FDG-PET scans have identified that BAT is less frequently observed in individuals who have been subject to a range of pre-warming procedures [8-10] and, prospective BAT dedicated studies confirm an acute BAT response to both warming and cooling [11].

The present study aimed to examine whether wearing a cooling vest with COOLINE SX3 material* stimulated the temperature of brown fat.

METHODOLOGY

All studies were conducted at a room temperature of 22°C. Baseline imaging then took place over a period of 15 minutes, during which time participants were asked to remain seated and still with their head in a fixed upright position facing the camera directly. After 15 minutes participants were requested to remove their loose fitting vest top and wear the selected COOLINE SX3 garment

COOLINE SX3 is included in SlimCOOL© products. The used Shirtvest was used to realize the study situation but has the same cooling technology and similar shape as the SlimCOOL T-Shirt.

References

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The garment had been previously submerged in cold water and dried as per manufacturer's instructions. Participants where then requested to retake their fixed seated position and a second session of thermal imaging took place over the course of 40mins. This concluded the study session.

Supraclavicular skin temperature was measured using infrared thermography (FLIR T530, thermal resolution 320x240 pixels; FLIR Systems, Danderyd, Sweden) as described previously [12-14] and used as an indicator of BAT activity. In brief, the camera was positioned so that the lens was perpendicular to the larynx and the field of view included, as a minimum, the full width of the shoulders laterally, the manubriosternal joint inferiorly and angle of the mandible superiorly.

The distance from the camera required to achieve this was measured and entered alongside ambient and reflective temperatures into the thermal camera during setup as per the manufacturer's instructions. Images were taken at 1 minute intervals during baseline and cooling.

During thermographic image analysis, a region of interest (ROI) was defined as that bounded by the left sternocleidomastoid muscle, clavicle and lateral contour of the neck using ThermaCAM Researcher Pro 2.10 (FLIR systems AB, Taby, Sweden) as described previously [12, 13].

ROIs were exported into Excel (Microsoft, Redmond, WA, USA) and a custom written script in R (A Language and Environment for Statistical Computing, version 3.4.3 (R Core Team)) was used to calculate the 87.5th percentile temperature value (TSCR).

The primary outcome was the difference in BAT activation (ΔT) at baseline and following stimulation by the COOLINE SX3 garment. This was calculated by measuring the change in the median temperature of the upper percentiles of temperature points in the region of interest, the supraclavicular region (Figure 1).

Figure 1. *Example of changes in thermal imaging of the supraclavicular region before and after wearing the cooling Shirtvest with COOLINE SX3 material. A. shows the initial image and B. shows the image after processing, with the blue triangles representing the individual regions of interest, within which are contained the red areas within each region that represent the 5% upper percentile of temperature points.*

Results

There was a clear increase in both absolute (Figure 2) and relative temperature (Figure 3) of the supraclavicular region after wearing the cooling shirtvest with COOLINE SX3 material.

Discussion

Wearing the cooling vest with COOLINE SX3 material resulted in an immediate increase in relative temperature within the supraclavicular region when compared to baseline temperature. This change in relative temperature is co-located with the main site of brown adipose tissue. The cooling effect of the cooling vest with COOLINE SX3 material is likely to have been sufficient to initiate a sympathetic response and short term activation of brown adipose tissue based on this data. Further studies should now be conducted in order to verify these findings.

**COOLINE SX3 material is included in SlimCOOL® products*

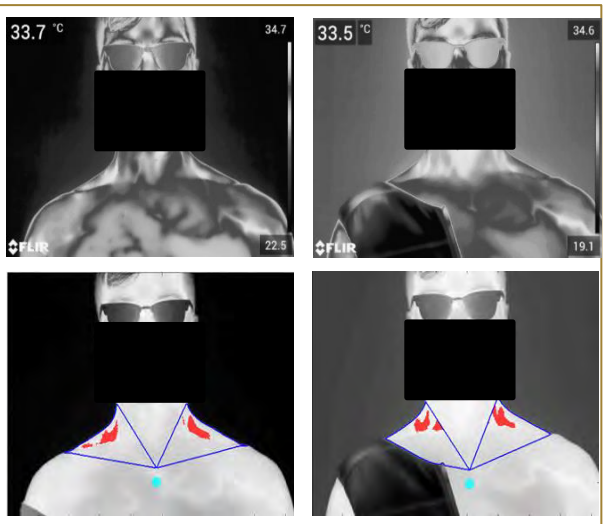

Figure 1

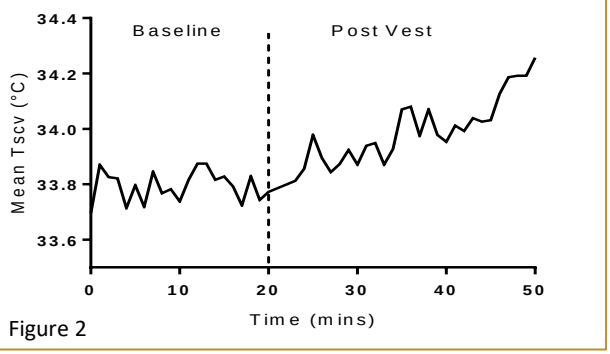

Figure 2

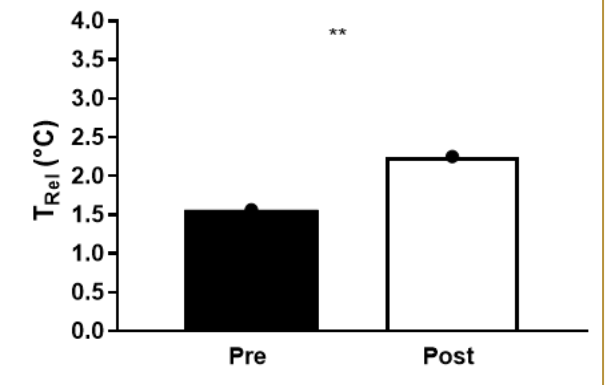

Figure 3

Michael Symonds, University of Nottingham in U.K., is an international expert in adipose tissue development and has pioneered the use of thermal imaging as a non-invasive technique for measuring brown adipose tissue function in children, adolescents and adults. He is now providing training and guidance in the use of this technique to many groups around the world. His group is also using this technique to complement other approached for assessing brown fat function such as MRI as well as using it to directly examine the influence of environmental, dietary and pharmacological interventions. These in vivo studies in humans are complemented by the detailed analysis of human adipose tissue together with the use of translatable animal models. His research is focused on the BAT development and function.

COOLINE® SX3

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