



# LUND UNIVERSITY

Response patterns in finger and central body skin temperatures under mild whole body cooling in an elderly and in a young male – a pre-study

Kuklane, Kalev; Vanggaard, Leif; Smolander, Juhani; Halder, Amitava; Lundgren Kownacki, Karin; Gao, Chuansi; Viik, Jari; Alametsä, Jarmo

*Published in:*  
Environmental Ergonomics

2015

[Link to publication](#)

*Citation for published version (APA):*

Kuklane, K., Vanggaard, L., Smolander, J., Halder, A., Lundgren Kownacki, K., Gao, C., Viik, J., & Alametsä, J. (2015). Response patterns in finger and central body skin temperatures under mild whole body cooling in an elderly and in a young male – a pre-study. *Environmental Ergonomics*, XVI, 48-48. <http://www.environmental-ergonomics.org/>

*Total number of authors:*  
8

## General rights

Unless other specific re-use rights are stated the following general rights apply:

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

Read more about Creative commons licenses: <https://creativecommons.org/licenses/>

## Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

LUND UNIVERSITY

PO Box 117  
221 00 Lund  
+46 46-222 00 00



## Response patterns in finger and central body skin temperatures under mild whole body cooling in an elderly and in a young male – a pre-study

Kalev Kuklane, Leif Vanggaard,  
Juhani Smolander, Amitava Halder,  
Karin Lundgren, Chuansi Gao,  
Jari Viik and Jarmo Alametsä

## Introduction

- At thermoneutrality and in warmth the fingers usually exhibit the warmest skin of the whole human surface.
- In a cold person with closed AVAs (arteriovenous anastomoses) the fingers soon become the coldest part of the body.
- The “AVA organ” may provide for around one third of the total skin surface area for heat exchange.
- The temperatures over acral skin sites are seldom taken into account - the actual heat loss may be underestimated, especially, in studies employing mild whole-body cooling.

Lund University / Faculty of Engineering / Dept. of Design Sciences, Ergonomics and Aerosol Technology



## Aims and objectives

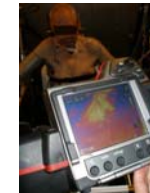
- To study the response pattern of finger skin temperature (rich in AVAs) to transient whole-body cooling as compared to skin temperatures in non-acral body sites (without AVAs) in elderly and in young.



Lund University / Faculty of Engineering / Dept. of Design Sciences, Ergonomics and Aerosol Technology

## Materials and methods

- |            | old    | young |       |
|------------|--------|-------|-------|
| • age      | 78     | 31    | years |
| • weight   | 73     | 70    | kg    |
| • height   | 174    | 171   | cm    |
| • clothing | shorts |       |       |



Old subject



Young subject



Lund University / Faculty of Engineering / Dept. of Design Sciences, Ergonomics and Aerosol Technology

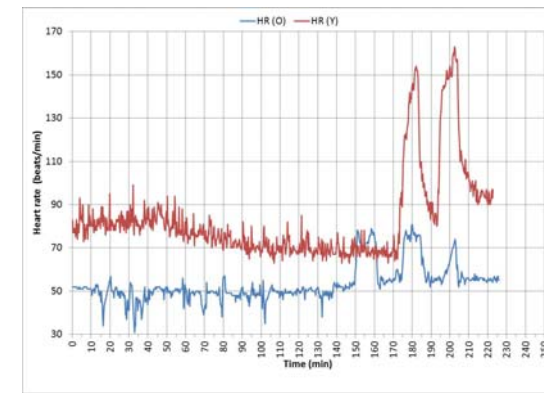
## Materials and methods

- body core temperature, rectal (each 10 seconds)
- skin temperature at 8 body parts and fingertips (10 s)
- pulse (15 s)
- cold discomfort/thermal sensation (10 min)
- IR-imaging (10 min)
- instrumentation was carried out in the chamber at about 29 °C and took about 20-25 minutes
- ballistocardiographic measurements with pressure-sensitive films around the neck and ankle, and under the seat (Alametsä et al. 2014, 2015)

Lund University / Faculty of Engineering / Dept. of Design Sciences, Ergonomics and Aerosol Technology



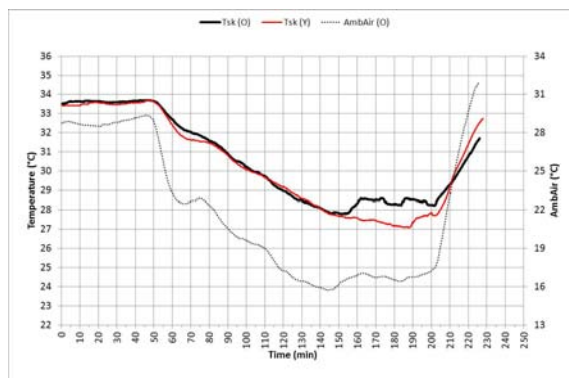
## Results – heart rate change during exposure



Lund University / Faculty of Engineering / Dept. of Design Sciences, Ergonomics and Aerosol Technology



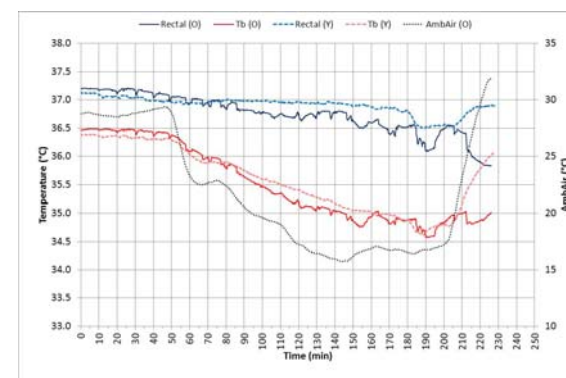
## Results – mean skin temperatures



Lund University / Faculty of Engineering / Dept. of Design Sciences, Ergonomics and Aerosol Technology



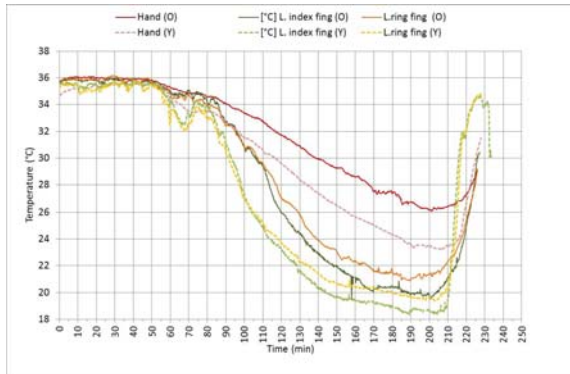
## Results – body core (rectal) and mean body temperature



Lund University / Faculty of Engineering / Dept. of Design Sciences, Ergonomics and Aerosol Technology



## Results – left hand



Lund University / Faculty of Engineering / Dept. of Design Sciences, Ergonomics and Aerosol Technology



## Conclusions

- Classical mean skin temperature in the old and in the young person did not show differences.
- Body core temperature and, thus, body heat content in the old person reduced at a quicker rate than in the young person.
- Old subject reported less discomfort and cold sensation than the young one.
- The temperature in extremities (hands, feet -> AVAs areas) dropped quicker and lower in the young subject than in the old.

Lund University / Faculty of Engineering / Dept. of Design Sciences, Ergonomics and Aerosol Technology



## Conclusions

- Due to cold exposure, notable amplitude elevations were detected, both in systolic and diastolic seat BCG amplitudes being more heightened with the older person. Workload of the heart increased markedly with the older person.
- Blood pressure increased with both being modest with the younger person and more pronounced with the older person.
- Although ankle pulse amplitude started to recover with the younger one due to cycling and room temperature rise, recovery with the older person seemed to be more gradual. This was seen as non-returning ankle pulse amplitude and cold limbs in thermal images.

Lund University / Faculty of Engineering / Dept. of Design Sciences, Ergonomics and Aerosol Technology



## Conclusions

- These observations indicate clear age-related differences in the circulatory response to a mild whole-body thermal challenge. This circulatory response may be associated with normal aging process.
- These findings may help to develop 'smart clothes' applications to compensate ambient temperature changes concerning especially people having age-related differences in the circulatory response to thermal challenge.

Lund University / Faculty of Engineering / Dept. of Design Sciences, Ergonomics and Aerosol Technology

