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2006

## Temperature effects on human leptin physiology: possible implications for the regulation of body composition

Annerieke Zeyl  
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**TEMPERATURE EFFECTS ON HUMAN LEPTIN PHYSIOLOGY: POSSIBLE  
IMPLICATIONS FOR THE REGULATION OF BODY COMPOSITION**

A thesis submitted in (partial) fulfilment of the requirements for the award of the degree

Doctor of Philosophy

from

The University of Wollongong

Annerieke Zeyl, M. Sc

Department of Biomedical Science

2006

## CERTIFICATION

I, Annerieke Zeyl, declare that this thesis, submitted in partial fulfilment of the requirements for the award of Doctor of Philosophy, in the Department of Biomedical Sciences, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

\_\_\_\_\_  
Annerieke Zeyl

Date \_\_\_\_\_

# **TEMPERATURE EFFECTS ON HUMAN LEPTIN PHYSIOLOGY: POSSIBLE IMPLICATIONS FOR THE REGULATION OF BODY COMPOSITION**

## **ABSTRACT**

In this study evidence has been sought for physiologically-significant, direct, local effects of reduced subcutaneous adipose tissue temperature on leptin as a possible mechanism for body composition regulation in response to environmental temperature. Twelve healthy males participated in 15 repeated cold-water immersions (study 1), human subcutaneous adipose tissue fragments ( $n=7$ ) were incubated at 27°, 32° and 37°C (study 2) and fourteen healthy subjects underwent two cold-water immersions with and without the beta-adrenergic antagonist propranolol (study 3).

The first series of *in vivo* immersions were conducted over 15 days (60-90 min at 18°C). Acute cold exposure suppressed plasma leptin concentration (25 min: -14%, 60 min: -22%,  $P<0.05$ ), whilst repeated cold-water immersion was associated with an increase of plasma leptin concentration relative to test day 1 (+19% day 8, +13% day 15, overall  $P<0.05$ ). Leptin secretion *in vitro* decreased 3.7-fold as the incubation temperature decreased from 37° to 27°C ( $P<0.05$ ). In a compartmental model of leptin turnover *in vivo*, the measured (local) temperature effect on leptin secretion *in vitro* was more than able to account for the observed cold-induced decrease in leptin concentration *in vivo*. In the second series, of cold-water immersions beta-adrenergic blockade by propranolol, which almost completely abolished cold induced release of non-esterified fatty acids ( $P<0.05$ ), did not prevent the cold-induced decrease in plasma leptin concentrations ( $P>0.05$ ). This latter result suggests that the sympathetic nervous system may be less important in cold-induced regulation of plasma leptin concentration than previously assumed.

The presented studies provide several lines of evidence for a role of leptin in energy balance regulation in response to environmental temperature. It is concluded that that local and direct effects of reduced subcutaneous adipose tissue temperature may be a more important contributor to the acute effects observed *in vivo*, than the sympathetically-mediated suppression of leptin secretion.

### **Publications arising from this thesis**

1. Zeyl, A., Stocks, J.M., Taylor, N.A.S. and Jenkins, A.B. (2004). Interactions between temperature and human leptin physiology *in vivo* and *in vitro*. *European Journal of Applied Physiology and Occupational Physiology* 92: 571-578.
2. Zeyl, A., Haley, C.D., Thoicharoen, P., Welschen, L.M.C., Sinnema, N.C.A., Taylor, N.A.S., and Jenkins, A.B. Increased post-immersion afterdrop during beta-adrenergic blockade. *The 10th International Conference on Environmental Ergonomics September 23-27, 2002 Fukuoka, Japan*.
3. Zeyl, A., Haley, C.D., Thoicharoen, P., Taylor N.A.S. and Jenkins, A.B. Beta-adrenergic blockade does not prevent cold-induced decrease in circulating leptin. *9th International Congress on Obesity, August 24-29, 2002, Sao Paolo, Brazil*.
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