

Northumbria Research Link

Citation: Barwood, Martin, Burrows, Holly, Cessford, Jess, Fraser, Liz, Goodall, Stuart and Griffiths, Scott (2015) Brain blood flow and hyperventilation on cold water immersion: can treading water help control these symptoms of cold shock? *Extreme Physiology & Medicine*, 4 (Sup 1). A40. ISSN 2046-7648

Published by: Springer

URL: <http://dx.doi.org/10.1186/2046-7648-4-S1-A40> <<http://dx.doi.org/10.1186/2046-7648-4-S1-A40>>

This version was downloaded from Northumbria Research Link:
<http://nrl.northumbria.ac.uk/id/eprint/28993/>

Northumbria University has developed Northumbria Research Link (NRL) to enable users to access the University's research output. Copyright © and moral rights for items on NRL are retained by the individual author(s) and/or other copyright owners. Single copies of full items can be reproduced, displayed or performed, and given to third parties in any format or medium for personal research or study, educational, or not-for-profit purposes without prior permission or charge, provided the authors, title and full bibliographic details are given, as well as a hyperlink and/or URL to the original metadata page. The content must not be changed in any way. Full items must not be sold commercially in any format or medium without formal permission of the copyright holder. The full policy is available online: <http://nrl.northumbria.ac.uk/policies.html>

This document may differ from the final, published version of the research and has been made available online in accordance with publisher policies. To read and/or cite from the published version of the research, please visit the publisher's website (a subscription may be required.)

MEETING ABSTRACT

Open Access

Brain blood flow and hyperventilation on cold water immersion: can treading water help control these symptoms of cold shock?

Martin Barwood^{1*}, Holly Burrows², Jess Cessford¹, Liz Fraser¹, Stuart Goodall¹, Scott Griffiths¹

From 15th International Conference on Environmental Ergonomics (ICEE XV)
Portsmouth, UK. 28 June - 3 July 2015

Introduction

Cold-water immersion (CWI) elicits the cold shock response (CSR). The hyperventilatory component of the CSR causes a decrease in cerebral blood flow velocity (CBFv) potentially causing sensations of dizziness and increasing the risk of becoming unconscious and consequently drowning [1]. In these early minutes of CWI the current advice is to 'float first' and remain stationary [2] yet this strategy may not have any effect on ventilation and therefore brain CBFv. We tested the hypothesis that leg only exercise could offset the reduction in CBFv in a resting CWI (H₁) and be absent in warm water immersion.

Methods

Seventeen participants consented and visited the laboratory 3 times; mean [SD]: age 21 [3]yrs; height 1.71 [.01] m; mass 70.9 [10.1]kg. All immersions were standardised

by depth, duration, clothing (bathing suit) and time of day. Test conditions were a) a resting warm water immersion (WWI; 34.7 [2.6] °C), b) a resting CWI (CWI-R; 12.2 [0.5] °C), c) a CWI (12.1 [0.5] °C) where light exercise (leg kicking/treading water; 80 bpm⁻¹) commenced 30-seconds after water entry (CWI-K). CBFv was measured using a transcranial Doppler at a fixed depth (61 [1] mm) over the middle cerebral artery. Oxygen uptake and ventilation were measured using an online gas analysis system. Perceptions of breathlessness were measured after 1, 3 and 5 minutes using an 11-point categorical scale (0-not at all breathless, 10-extremely breathless). ANOVA was used to analyse the data to an alpha level of 0.05.

Results

CWI induced significant changes in contrast to WWI (see Table 1).

Table 1 Mean [SD] perceived breathlessness, CBFv, oxygen uptake, and carbon dioxide production in WWI (condition a), CWI-R (b) and CWI-K (c); letters denote differences between the corresponding condition.

	CBFv (Δ%)			VO ₂ (mL.kg ⁻¹ .min ⁻¹)			VCO ₂ (mL.kg ⁻¹ .min ⁻¹)		
	WWI ^a	CWI-R ^b	CWI-K ^c	WWI ^a	CWI-R ^b	CWI-K ^c	WWI ^a	CWI-R ^b	CWI-K ^c
PRE	-	-	-	387[96]	407[58]	405[90]	335[80]	377[75]	365[87]
1 MIN	5[4] ^b	-6[9] ^a	-3[16]	633[117] ^c	671[129]	692[137] ^a	518[97] ^{b,c}	837[253] ^a	880[343] ^a
2 MIN	3[6] ^b	-6[9] ^a	2[20]	424[84] ^c	437[94] ^c	534[89] ^{a,b}	375 [79] ^c	482[212] ^c	623[216] ^{ab}
3 MIN	3[4]	1[10]	3[16]	390[76] ^{bc}	432[84] ^{ac}	537[79] ^{a,b}	347 [76] ^c	405[173] ^c	497[133] ^{ab}
4 MIN	3[4]	7[11]	8 [21]	359[66] ^{bc}	436[101] ^{ac}	543[84] ^{a,b}	321[60] ^c	368[135] ^c	460[120] ^{ab}
5 MIN	5[6]	7[10]	4[17]	362[72] ^{bc}	454 [85] ^{ac}	570[99] ^{ab}	322[66] ^c	372[108] ^c	455[99] ^{ab}

* Correspondence: martin.barwood@northumbria.ac.uk

¹Dept. Sport, Exercise & Rehabilitation, Northumbria University, UK
Full list of author information is available at the end of the article

Discussion

Leg kicking on CWI partially offset the reduction in CBFv that normally occurs on CWI; in contrast to a warm water control. WWI CBFv was only different to the CWI-R condition. This did not alleviate symptoms of breathlessness despite increased oxygen uptake and carbon dioxide production in the CWI-K condition; the hypothesis is only partially supported.

Authors' details

¹Dept. Sport, Exercise & Rehabilitation, Northumbria University, UK. ²Royal Victoria Infirmary, Emergency Medicine Unit, Newcastle-Upon-Tyne, UK.

Published: 14 September 2015

References

1. Mantoni T, Rasmussen JH, Belhage JH, Pott FC: **Voluntary respiratory control and cerebral blood flow velocity upon ice-water immersion. Aviation. *Space and Environmental Medicine* 2008, **79**(8):765-768.**
2. Barwood MJ, Bates V, Long GM, Tipton MJ: *Int J Aq Res Edu* 2011, **5**:147-163.

doi:10.1186/2046-7648-4-S1-A40

Cite this article as: Barwood *et al.*: Brain blood flow and hyperventilation on cold water immersion: can treading water help control these symptoms of cold shock? *Extreme Physiology & Medicine* 2015 **4**(Suppl 1):A40.

**Submit your next manuscript to BioMed Central
and take full advantage of:**

- Convenient online submission
- Thorough peer review
- No space constraints or color figure charges
- Immediate publication on acceptance
- Inclusion in PubMed, CAS, Scopus and Google Scholar
- Research which is freely available for redistribution

Submit your manuscript at
www.biomedcentral.com/submit

