

(Appended Forms-2, Re: Article 9)

Report for Joint Research Project 2013-01

To: Director of Medical Center for Health Promotion and Sports Science,
Wakayama Medical University

Date Submitted (dd/mm/yyyy) : 16/01/2014
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I finished a study plan, I report it as follows; approval number [2013-01].

1. Project title						
The effect of hot water immersion on the immune response in tetraplegia						
2. Duration	(day)	(month)	(Year)	(day)	(month)	(Year)
2.5 weeks			From 03 December, 2013			until 19 December, 2013
3. Study status 2013 *Check the appropriate box.						
<input checked="" type="checkbox"/> We carried out the study as approved research plan.						
<input type="checkbox"/> We carried out the study with approval of changed/additional research plan						
Change point: none						
Reason: not applicable						
4. Outbreak of the disadvantage or hazard *Check the appropriate box.						
<input checked="" type="checkbox"/> No						
<input type="checkbox"/> Yes						
Occurrences:						
Cope:						

5. Usage of institute, material, samples

Defect of materials

No

Yes

Occurrences:

Cope:

6. Summary of research results

PURPOSE: Core temperature elevations can impact positively on immunity, potentially due to increases of catecholamines acting on immune cells' adrenergic receptors. The dysfunctional sympathetic nervous system in individuals with cervical spinal cord injury (CSCI) impairs adrenergic responses and may therefore contribute to depressed immunity and the occurrence of low grade systemic inflammation related disorders. However, some immune markers improve following exercise in CSCI, even though the positive effects are often blunted. Non-exercise induced body temperature manipulations have yet to be investigated in CSCI.

METHODS: Seven male participants with a motor complete CSCI and 8 male able-bodied controls were immersed for 60 min in water set at a temperature 2 °C above the individuals' resting oesophageal temperature. Blood and saliva were collected pre, post, and every hour up to 4 h post immersion. Blood was analysed for catecholamines, a range of cytokines and inflammatory markers. Salvia was analysed for immunoglobulin A and lysozyme.

RESULTS: Hot water immersion increased interleukin-6 (IL-6) by $133 \pm 112\%$ in both groups ($P < 0.001$), with a $63 \pm 37\%$ higher average IL-6 concentration in CSCI ($P = 0.07$). IL-1ra increased by $17 \pm 18\%$ in both groups ($P = 0.008$), with no difference between groups ($P = 0.30$). No changes over time or between groups were found in TNF- α , IL-8, sL-selectin or sICAM-1 ($P > 0.05$). Adrenaline and noradrenaline were significantly reduced in CSCI ($P < 0.05$). Salivary immunoglobulin A secretion rate and lysozyme secretion rate increased during immersion in both groups ($P < 0.002$), but both salivary markers returned to baseline values in the recovery period.

DISCUSSION: The increases in IL-6 and IL-1ra in CSCI following hot water immersion are in contrast to earlier exercise interventions, where no cytokine elevations in this participant group were found. Possibly, the reduced active muscle mass in CSCI does not allow for sufficient core temperature elevations during exercise to increase these cytokines. Together with the lower catecholamine levels found in CSCI, this may explain the blunted exercise response on some aspects of immunity. This seems especially concerning as higher average levels of IL-6 support the indication of chronic low grade systemic inflammation in CSCI.

CONCLUSION: Passive elevation of core temperature may help to improve the cytokine profile in CSCI, where the benefits of exercise on immune parameters can be blunted.

7. Publications and conference presentation

Mark with an asterisk listed 'Joint Research expense' in Funding section in the paper.

Publications:

Two research articles will be produced and submitted to a scientific journal (for the submission of the cytokine data, the Journal of Applied Physiology is a likely candidate). A second publication will likely contain an analysis of salivary markers.

Conference presentation:

Data will be presented at the 5th International State-of-the-Art Congress on Mobility, Exercise & Sports, held on April 23-25 2014 in Groningen (The Netherlands).

Conference attendance will be funded by the Peter Harrison Centre for Disability Sport.

8. Anything else should be reported

Project 2013-01 was part of a study where data was collected over a 2 month period (mid June – mid August 2013 in Wakayama and Nachi-Katsuura). The December data collection was conducted to complete the summer data set to achieve sufficient participant numbers for adequate statistical power.

No adverse events happened during the course of the study.