The effect of the Gravity-Loading Countermeasure Skinsuit (GLCS) upon aerobic exercise performance

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Chicago - 2013
Disclosure Information
84th Annual AsMA Scientific Meeting
Julia Attias

I acknowledge the support of Wyle in conducting the study on behalf of the CMSO of ESA

I am currently working as a health mentor for Nuffield Health and as a research associate for King’s College London

I will not discuss off-label use and/or investigational use in my presentation
Introduction

- Microgravity-induced aerobic de-conditioning (VO$_{2\text{max}}$)
- Countermeasures are time/resource consuming
- GLCS $\rightarrow$ Earth’s Gz loading (Waldie & Newman, 2010)

- Mk III $\sim$0.8Gz - integration with ergometry countermeasure?
- VO$_{2\text{max}}$ ‘prediction’ based on HR-VO$_{2}$ 1Gz response
Aims

- To investigate the effect and tolerability of donning the GLCS’s during UPRIGHT and RECUMBENT ergometry (aerobic exercise) vs. loose fitting gym (GYM) clothing

- To investigate the effect of the GLCS on VO\textsubscript{2max} predictions based on the HR-VO\textsubscript{2} relationship
Methods

- **Participants:** ♂=5; ♀=3; 28±6yrs; 183±10cm; and 77±8kg
- **Astrand Rhyming:** sub-max exercise test $\rightarrow$ 75% VO$_{2\text{max}}$
- **Protocol:** 20 mins at 75% VO$_{2\text{max}}$ when Upright & Recumbent
- **Physiological recordings:** Heart rate, core temperature, lactate & breath-by-breath respiratory parameters
- **Subjective ratings:** Rating of perceived exertion, thermal comfort, movement discomfort and body control
Results: Delta Minute Ventilation ($V_E$)
Results: Delta Oxygen Consumption (VO$_2$)
Results: Delta Heart rate (HR)
Results: HR-VO$_2$ relationship
Results: Delta Lactate & core temperature at 20 mins

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<th>UPRIGHT</th>
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<th>RECUMBENT</th>
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<tbody>
<tr>
<td></td>
<td>GYM</td>
<td>GLCS</td>
<td>GYM</td>
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<td>GYM</td>
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<td>Δ Lactate from baseline (mmol/L)</td>
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<tr>
<td>Mean ± SEM</td>
<td>1.57 ±0.3</td>
<td>2.81 ±0.6</td>
<td>1.81 ±0.4</td>
<td>3.59 ±0.9</td>
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<td>Δ Temperature from baseline (°C)</td>
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<tr>
<td>Mean ± SEM</td>
<td>0.56 ±0.1</td>
<td>0.64 ±0.1</td>
<td>0.55 ±0.1</td>
<td>0.51 ±0.1</td>
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### Results: Subjective reports at 20 mins

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<tr>
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<th>UPRIGHT</th>
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<td><strong>Thermal Comfort</strong></td>
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<td>GYM</td>
<td>GLCS</td>
<td>GYM</td>
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<tr>
<td>Mean (± 95% CI)</td>
<td>2 (1.3-2.5)</td>
<td>3 (2.3-3)*</td>
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<td><strong>Movement Discomfort</strong></td>
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<tr>
<td>GYM</td>
<td>GLCS</td>
<td>GYM</td>
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<tr>
<td>Mean (± 95% CI)</td>
<td>3 (1.9-4.8)</td>
<td>7 (5.9-8.6)*</td>
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<td><strong>RPE</strong></td>
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<tr>
<td>GYM</td>
<td>GLCS</td>
<td>GYM</td>
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<tr>
<td>Mean (± 95% CI)</td>
<td>13 (13.5-12.5)</td>
<td>16 (14.3-16.7)*</td>
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<tr>
<td><strong>Body Control</strong></td>
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<tr>
<td>GYM</td>
<td>GLCS</td>
<td>GYM</td>
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<tr>
<td>Mean (± 95% CI)</td>
<td>3 (1.5-3.6)</td>
<td>6 (4.7-6.8)*</td>
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Discussion

- No difference in HR, core temp, lactate and VO₂
- Vₑ – greater in the recumbent orientation (at 20 minutes) and in the GLCS (but only up to 3 minutes)
- Subjective ratings – worsened – but did not impede on exercise
- GLCS an exercise enhancer - HR-VO₂ affected by GLCS
- However, in RECUMBENT (↑HR) vs. UPRIGHT (↓HR)
Conclusion

- GLCS did not significantly alter physiological responses to ergometry when upright or recumbent.
- Mechanism of GLCS HR-VO$_2$ dissociation is unclear and warrants further study.
- ‘Real’ VO$_{2\text{max}}$ testing.
- Biomechanical/metabolic efficiency.
- Integration with ergometry and/or treadmill countermeasures.
- Terrestrial application → Athletic or disuse/unloading rehab.
Acknowledgements

@ Dr James Waldie
@ Liz Pearlman & Costumeworks
@ Dr Simon Evetts & CMSO (EAC, ESA)
@ Wyle
@ Lindsey, Tony & Helen
@ Dr David A Green
@ Phil Carvil