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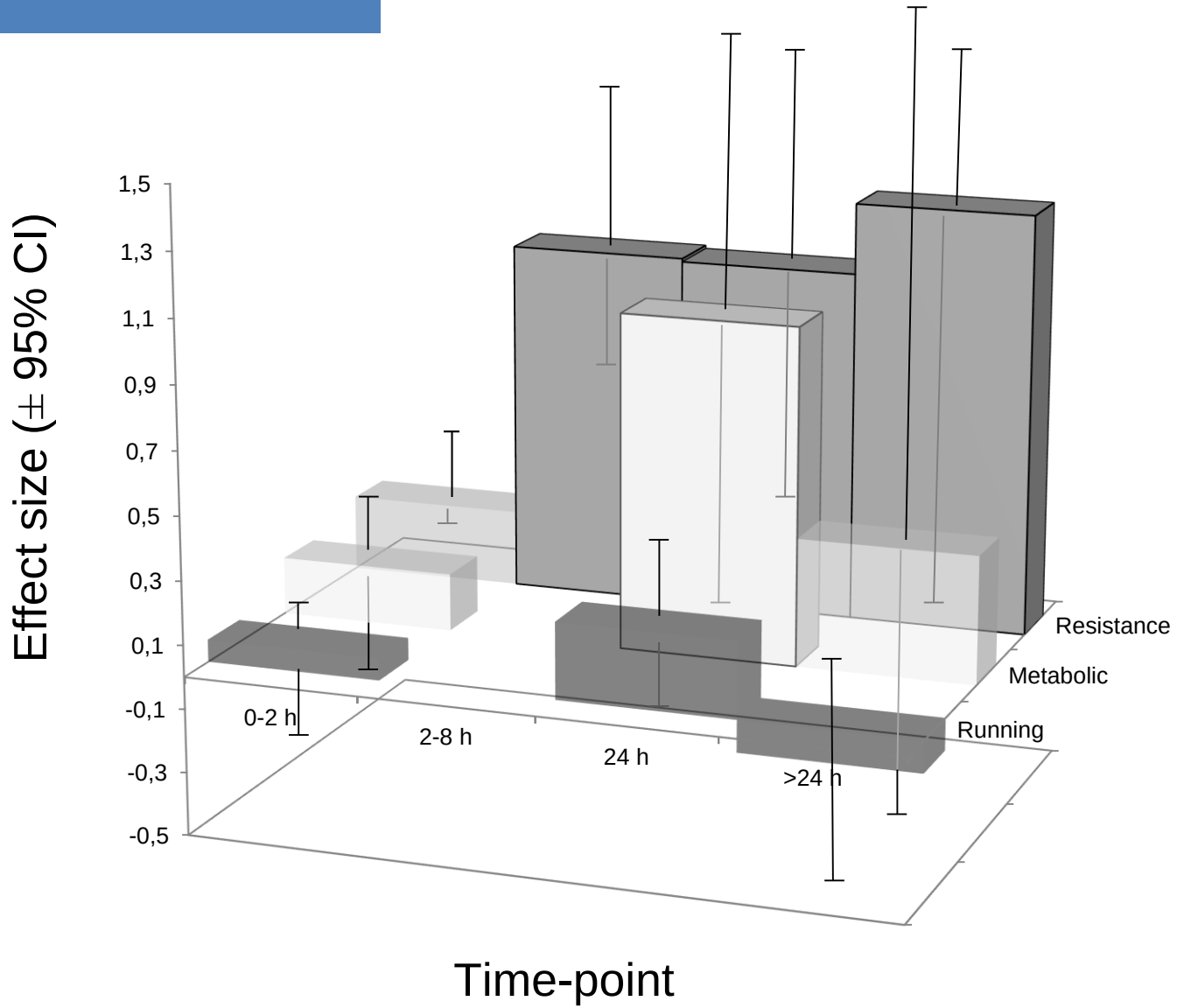
Sports specific applications of compression:

Inflammatory implications and recommendations for future research

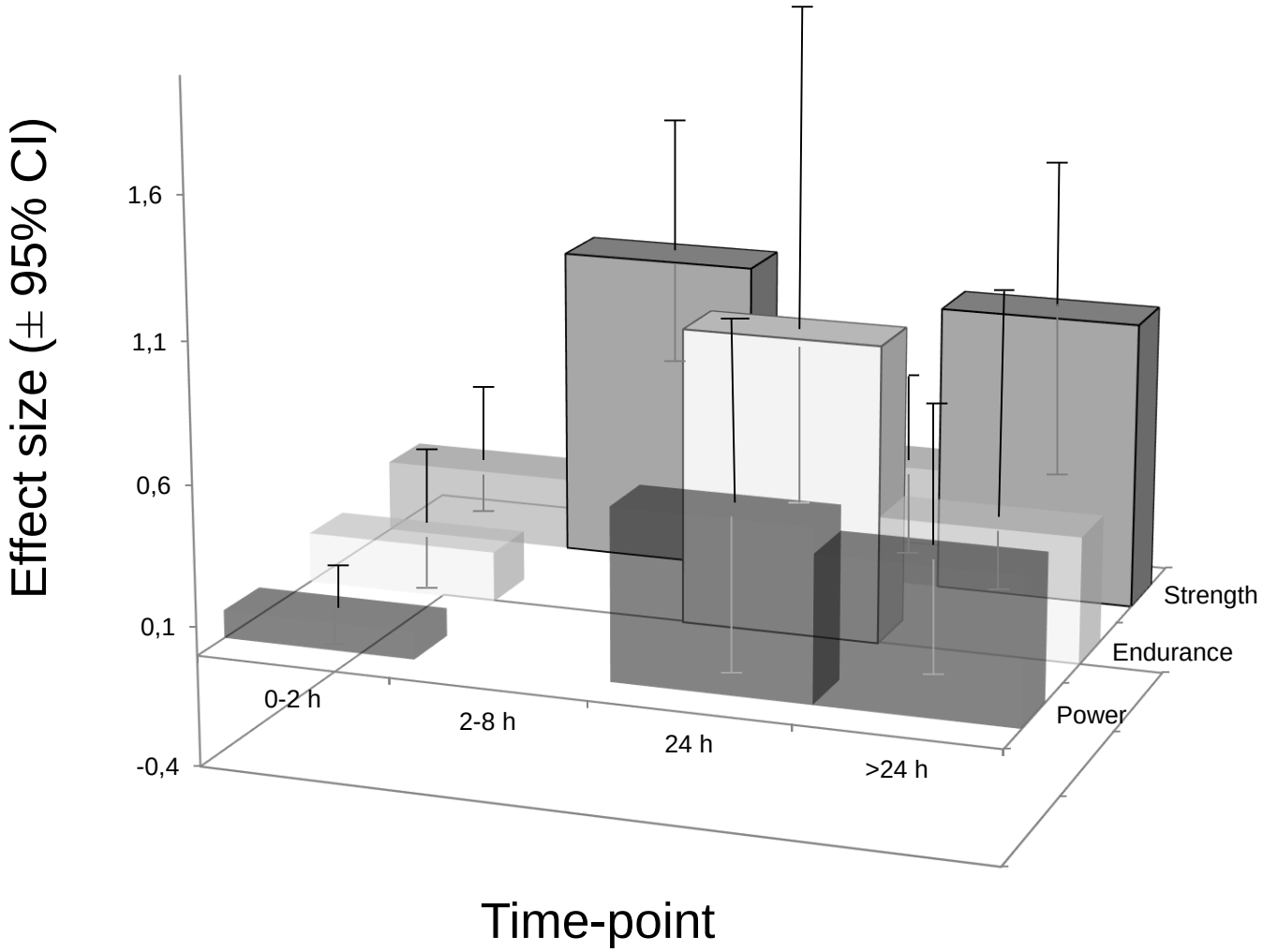
Coventry University

Exercise Challenge



Overall effect: $p <$ 0.00001, Z = 5.46, ES = 0.38 [0.25, 0.51]

Performance Outcome



Rugby - Performance

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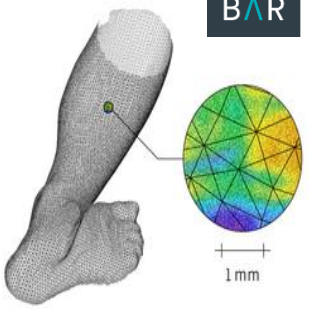
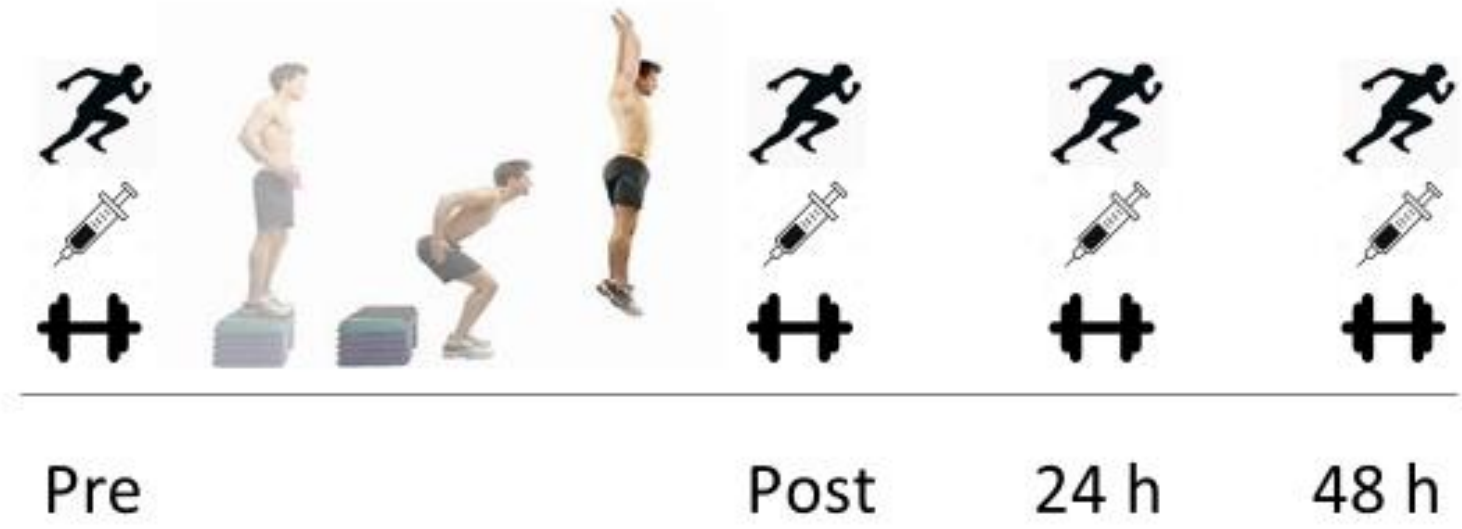
ISO BAR CUSTOM FIT COMPRESSION GARMENTS





= Physiological tests (NIRS, mid-thigh girth, soreness, creatine kinase activity)

= Performance tests (peak knee-extension force, 30 m sprint, CMJ)

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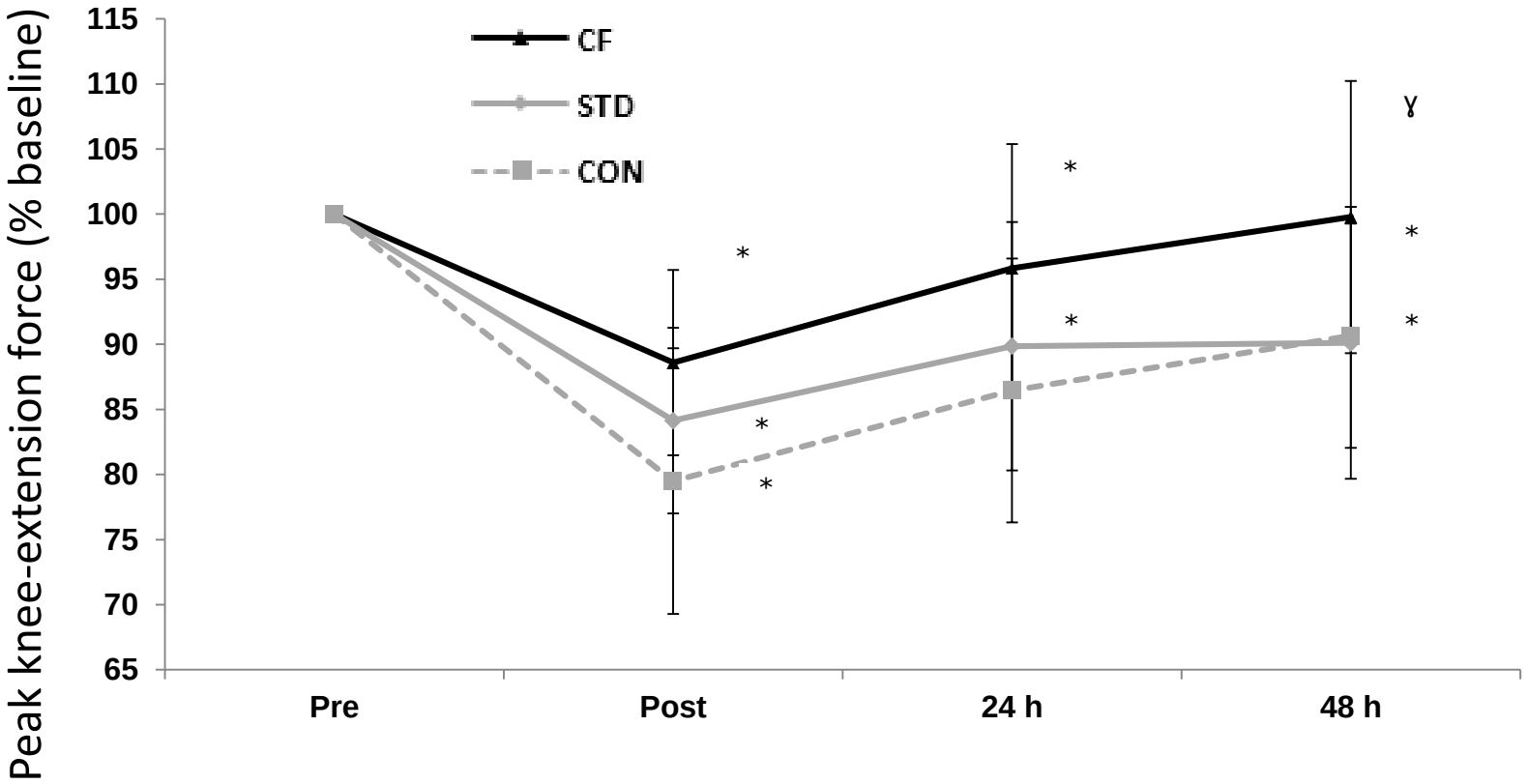
Rugby - Performance

The effect of CG on strength recovery in rugby players



ɣ = significant time x group effect ($p < 0.001$).

Asterisks indicate a significant difference from baseline values ($p < 0.001$)

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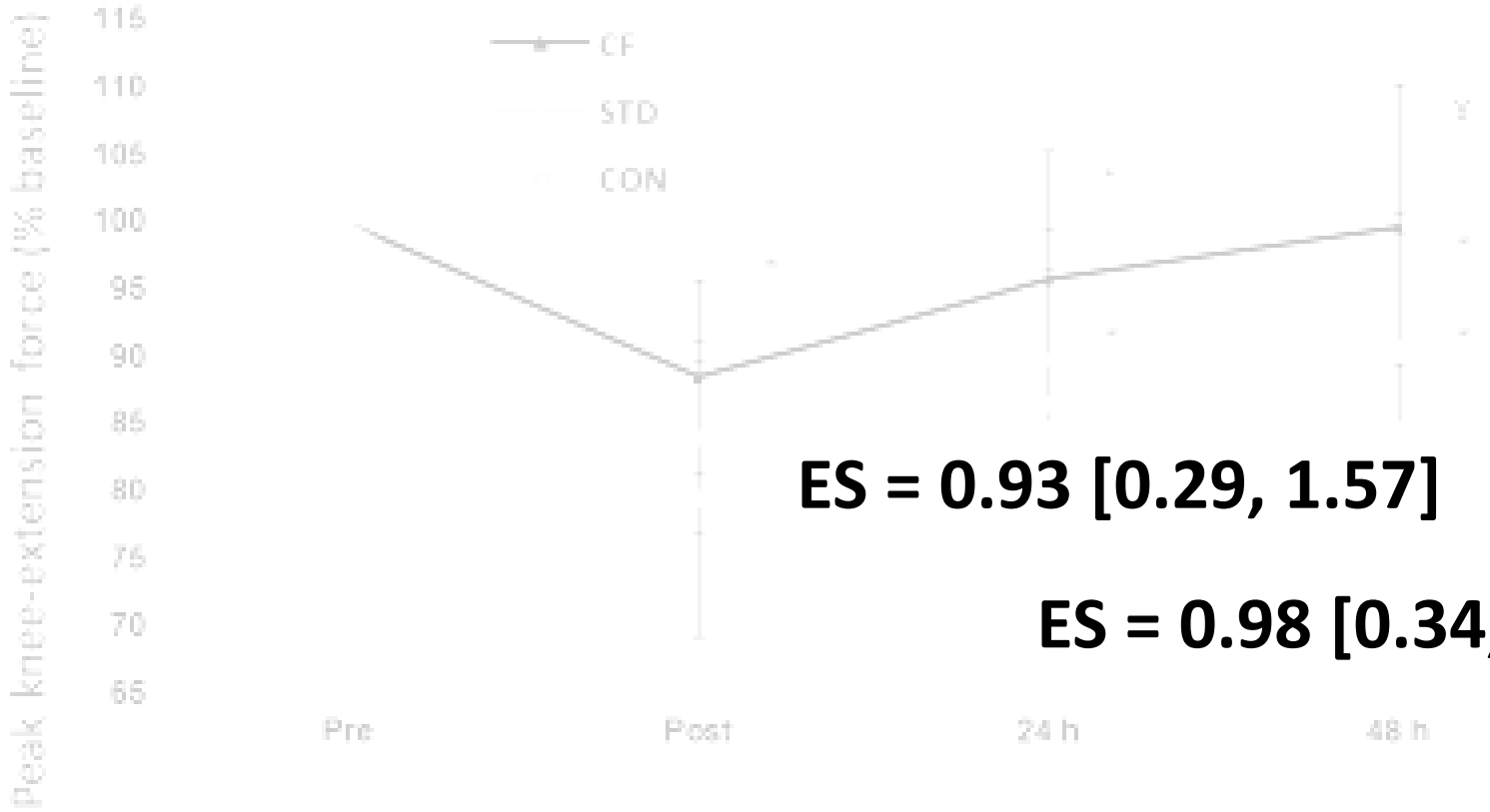
Rugby - Performance

The effect of CG on strength recovery in rugby players



ES = 0.93 [0.29, 1.57]

ES = 0.98 [0.34, 1.63]

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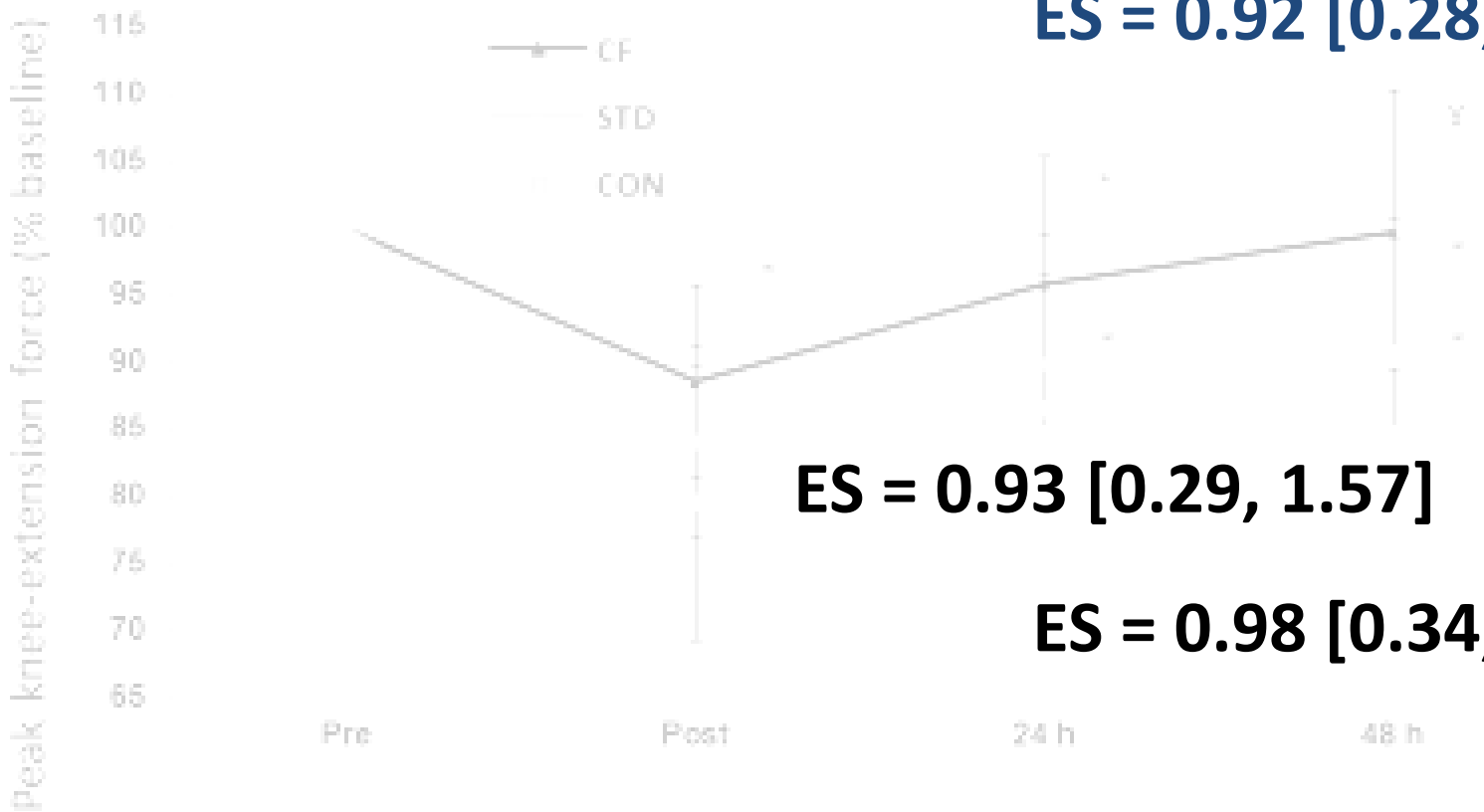
Rugby - Performance

The effect of CG on strength recovery in rugby players



ES = 0.92 [0.28, 1.56]

ES = 0.93 [0.29, 1.57]

ES = 0.98 [0.34, 1.63]

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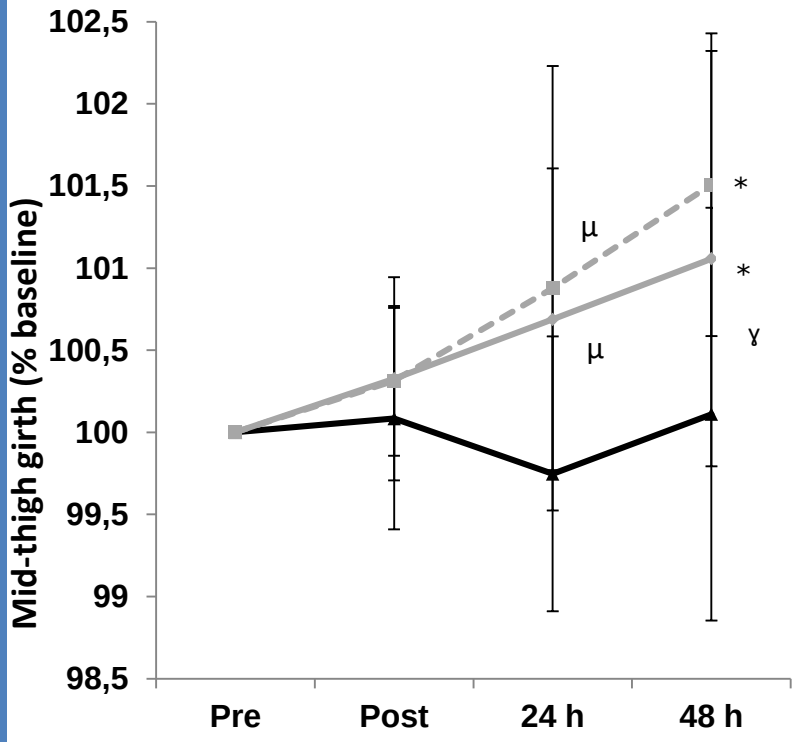
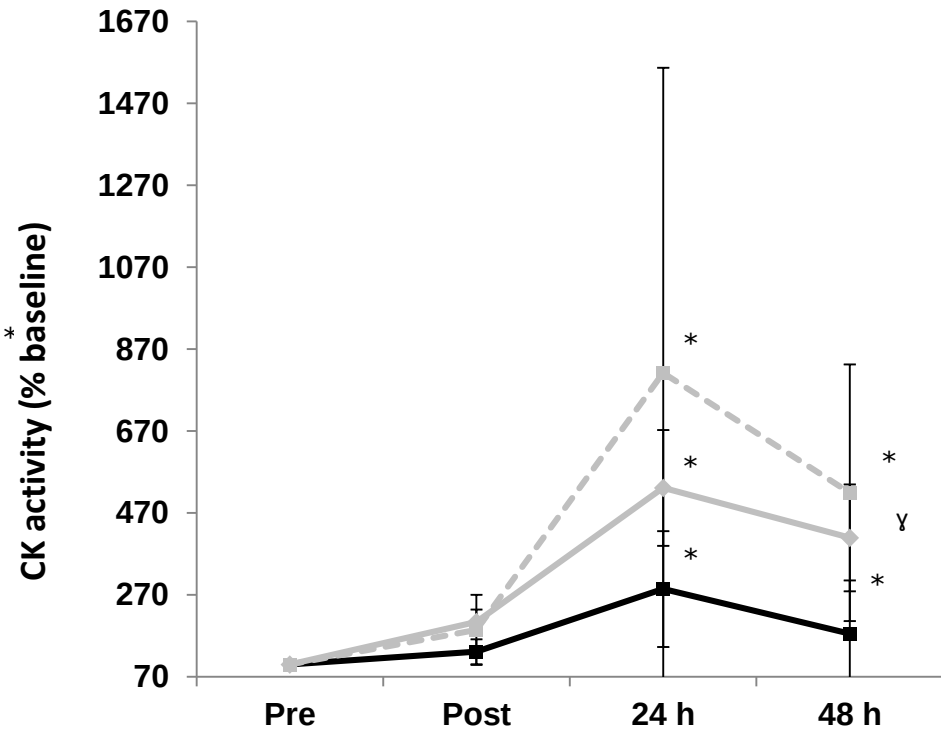
Rugby - Performance

The effect of CG on swelling and [CK] in rugby players





ɣ = significant time x group effect ($p < 0.001$); μ = significant difference from baseline ($p < 0.05$)

* = significant difference from baseline ($p < 0.001$)

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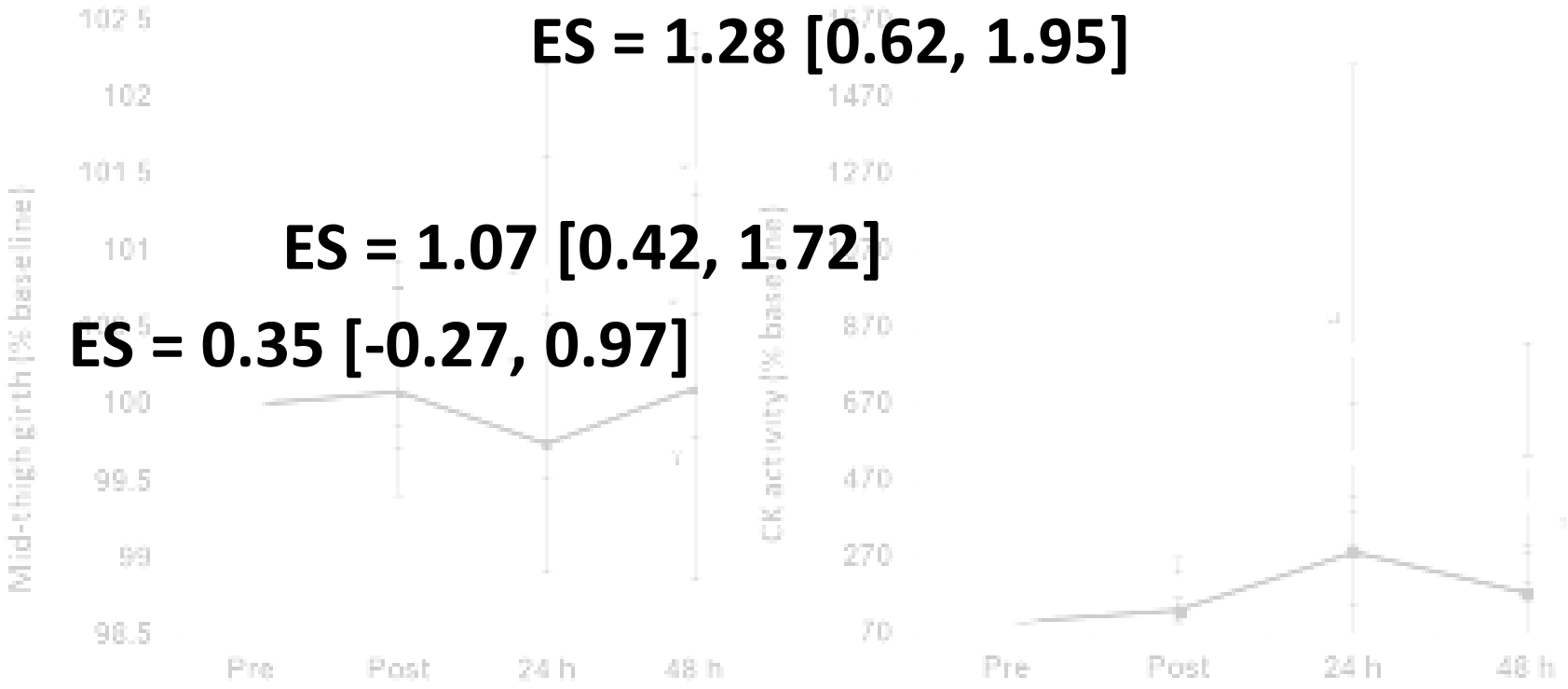
Rugby - Performance

The effect of CG on swelling and [CK] in rugby players

ES = 1.28 [0.62, 1.95]

ES = 1.07 [0.42, 1.72]

ES = 0.35 [-0.27, 0.97]



γ = significant time x group effect ($p < 0.001$) μ = significant difference from baseline ($p < 0.05$)

※ = significant difference from baseline ($p < 0.001$)

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Rugby - Performance

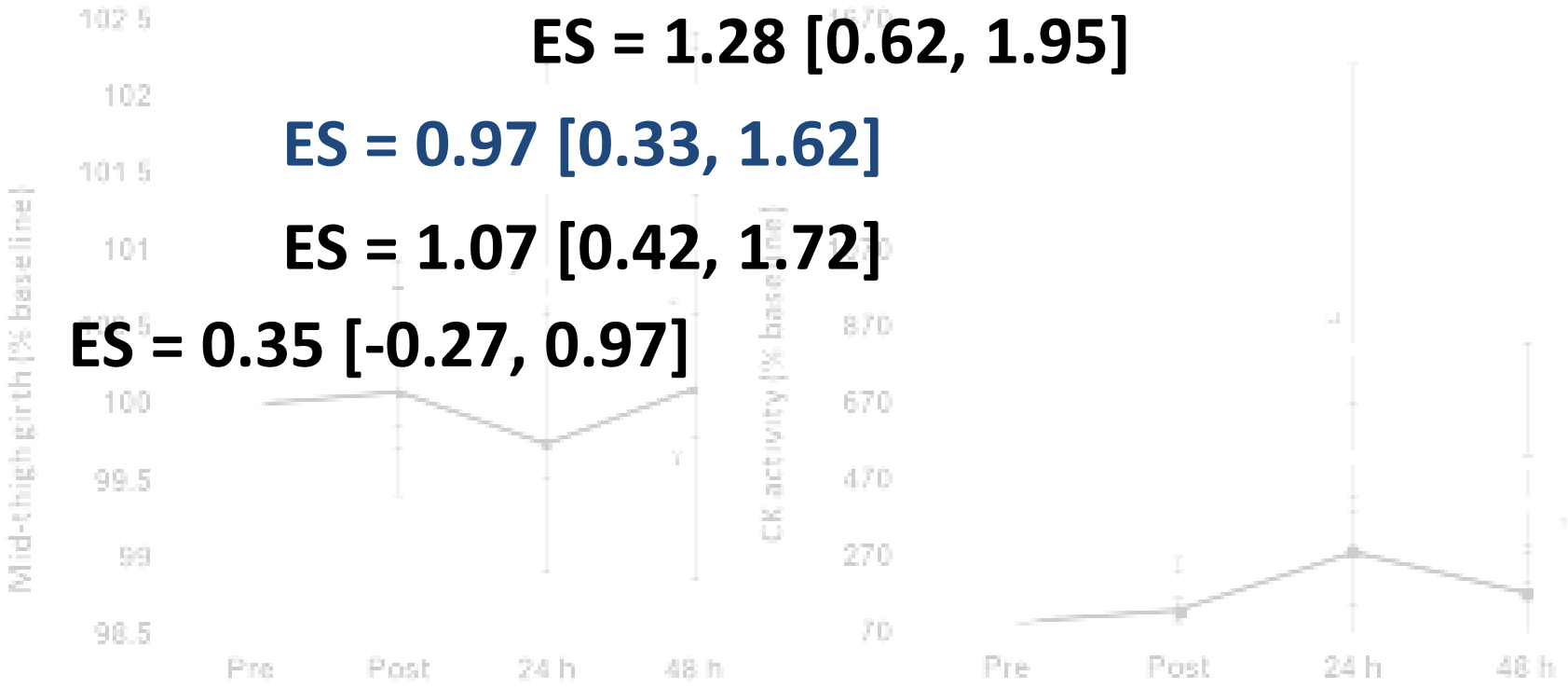
The effect of CG on swelling and [CK] in rugby players

ES = 1.28 [0.62, 1.95]

ES = 0.97 [0.33, 1.62]

ES = 1.07 [0.42, 1.72]

ES = 0.35 [-0.27, 0.97]



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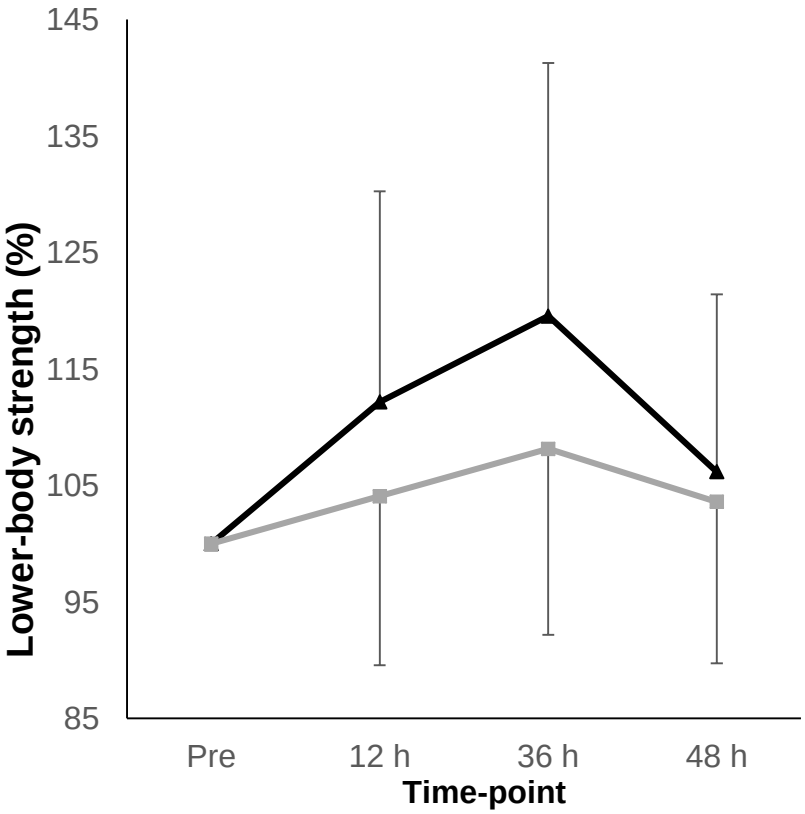
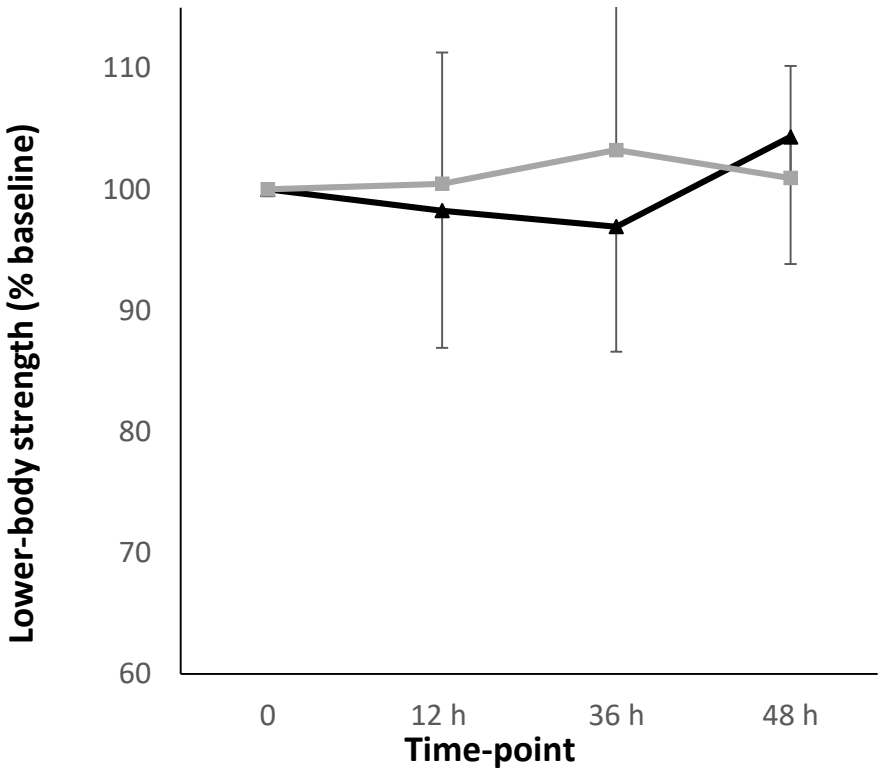
※ = significant difference from baseline ($p < 0.001$)

Elite athlete studies

Elite athlete studies





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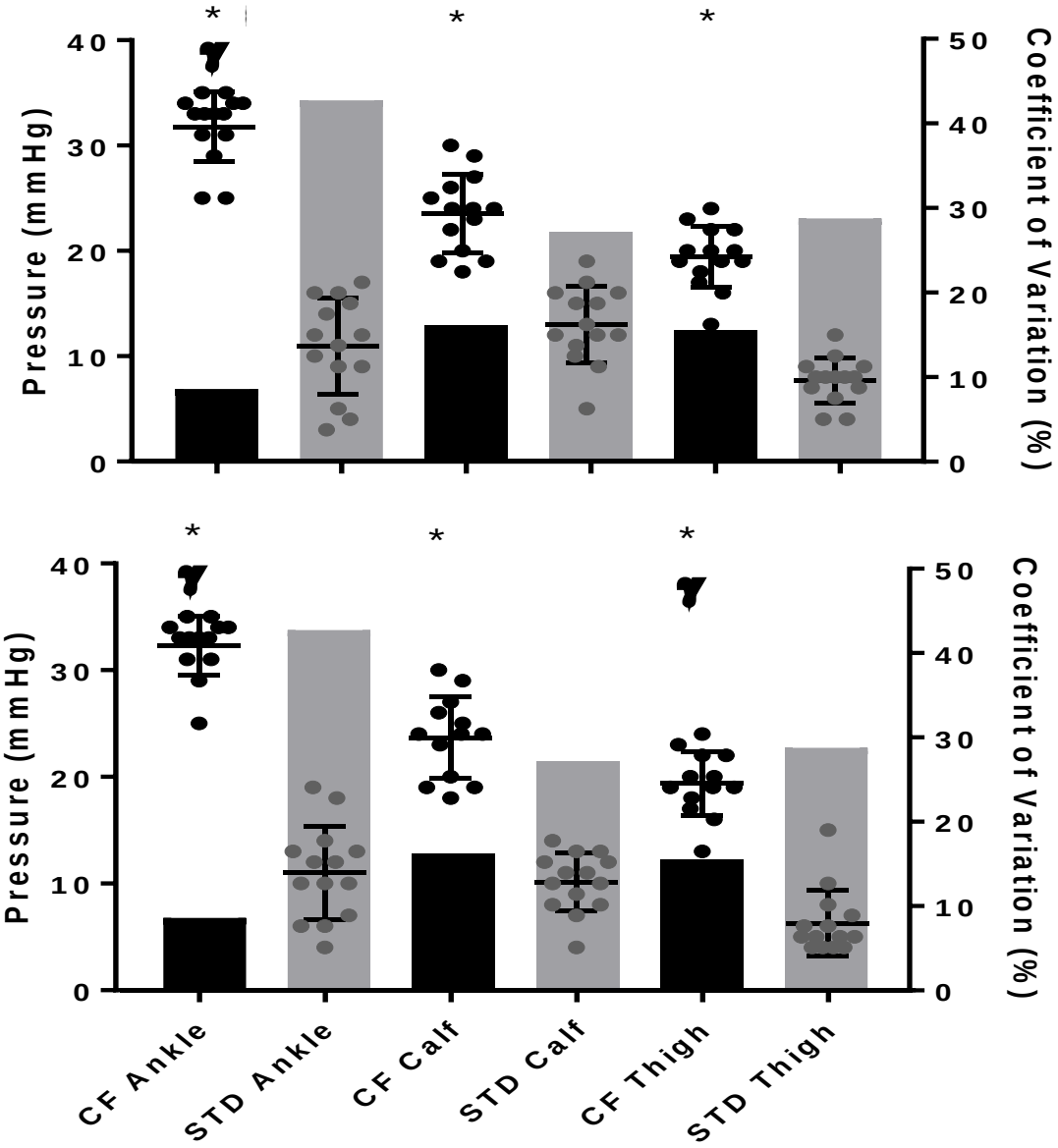
Pressure



a = Crossover trial

b = Parallel group trial

* = Significant difference in pressure

γ = Significant difference in COV ($p \leq 0.05$)

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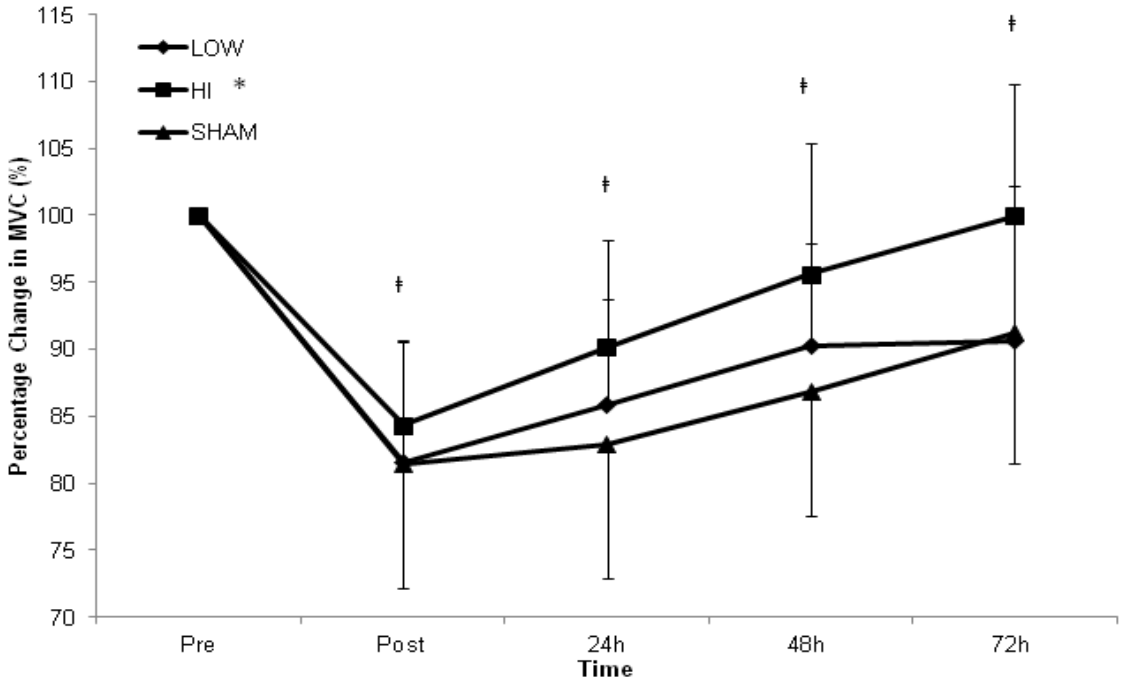
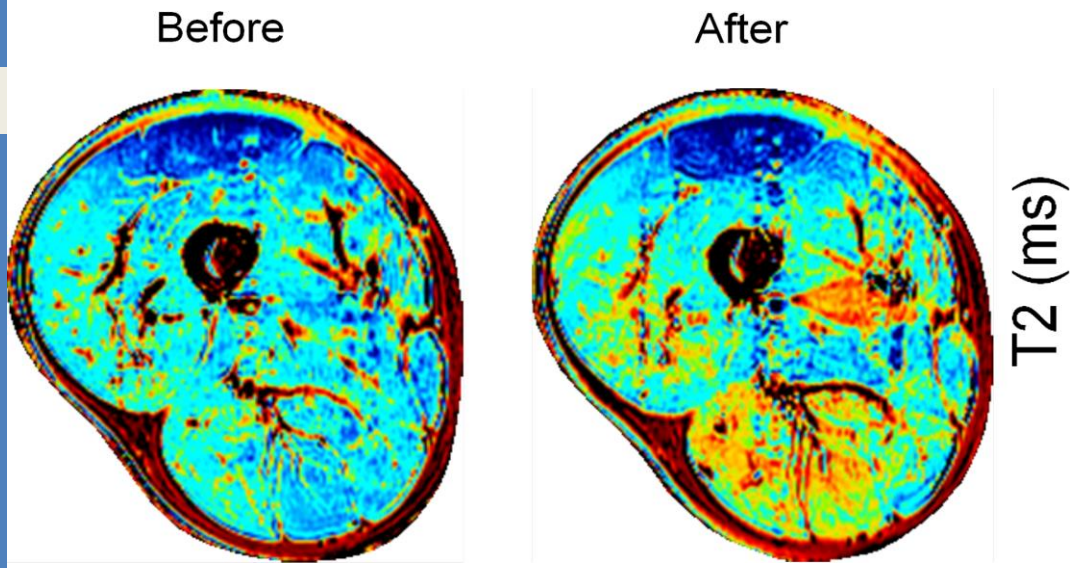
Effects of Pressure???

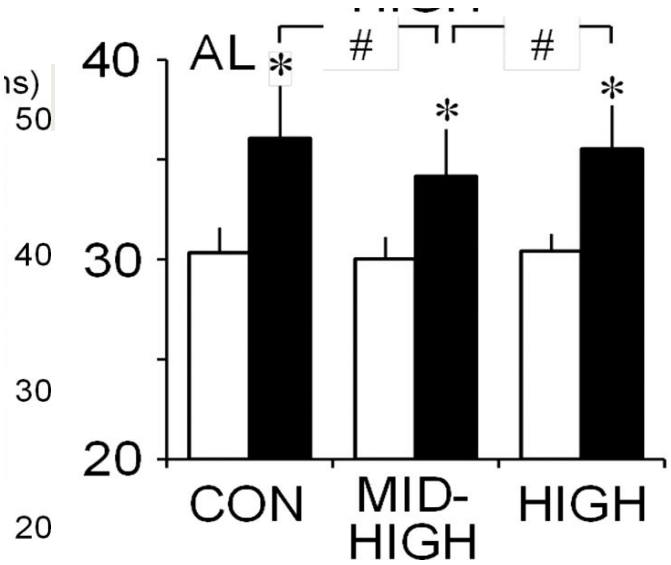
- Meta-analysis showed no effect of pressure
  - Limited by number of trials taking direct measurements and distribution of trials eliciting EIMD vs other exercise modalities
  - Beliard et al., (2015)
    - Running
- Hill et al., (2017)



Swelling

Changes in T2 relaxation time of the VL with compression (Miyamoto et al., 2014)





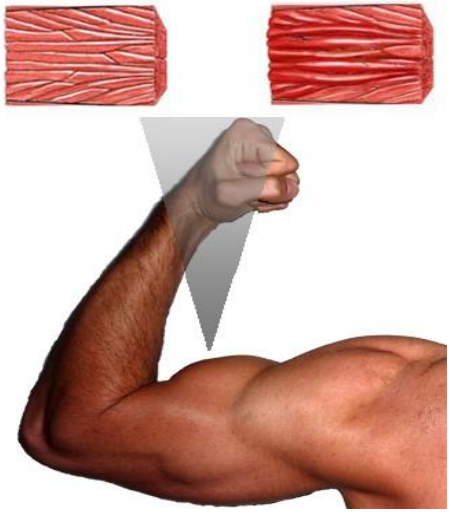
- Unknown whether improved exercise recovery is related to observed reductions in limb circumference
- Pressure optima?
  - Watanuki et al., (1994)
  - Lee et al., (2018)
  - Hargens et al., (1981); Levick, 1987, 1991)

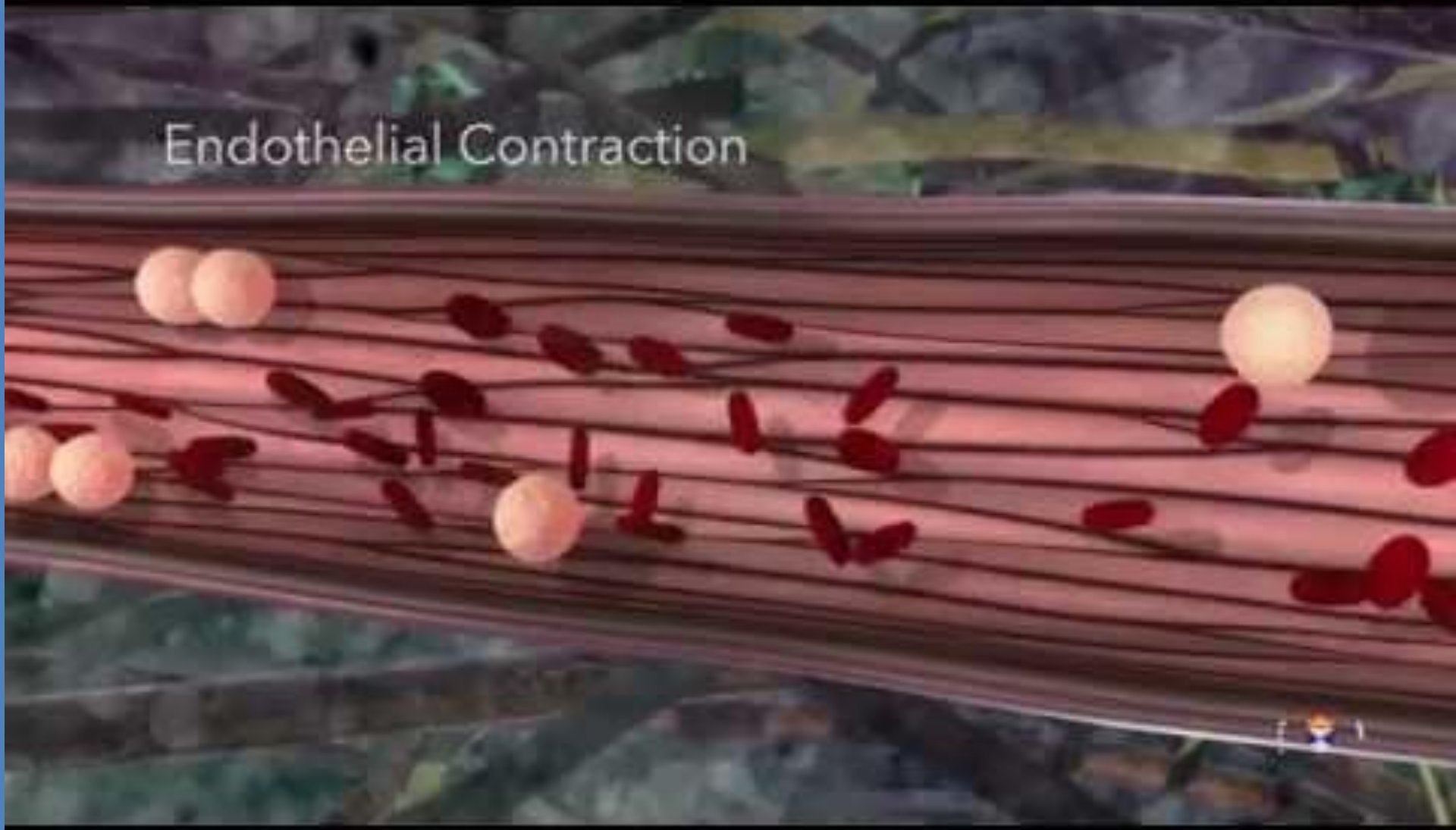
Swelling

- Mechanistic insight will help to guide future research
  - Benefits to performance observed alongside reductions in swelling
    - Goto & Morishima (2014)
    - Kraemer et al., (1996)
    - Kraemer et al., (2001)
    - Fragala (2010)
    - Arabi (2015)
    - Driller & Halson, (2013)
  - Only study to report a benefit from CG on recovery from damaging exercise without a concomitant improvement in swelling
    - Mizuno et al., (2016)

What's Happening?

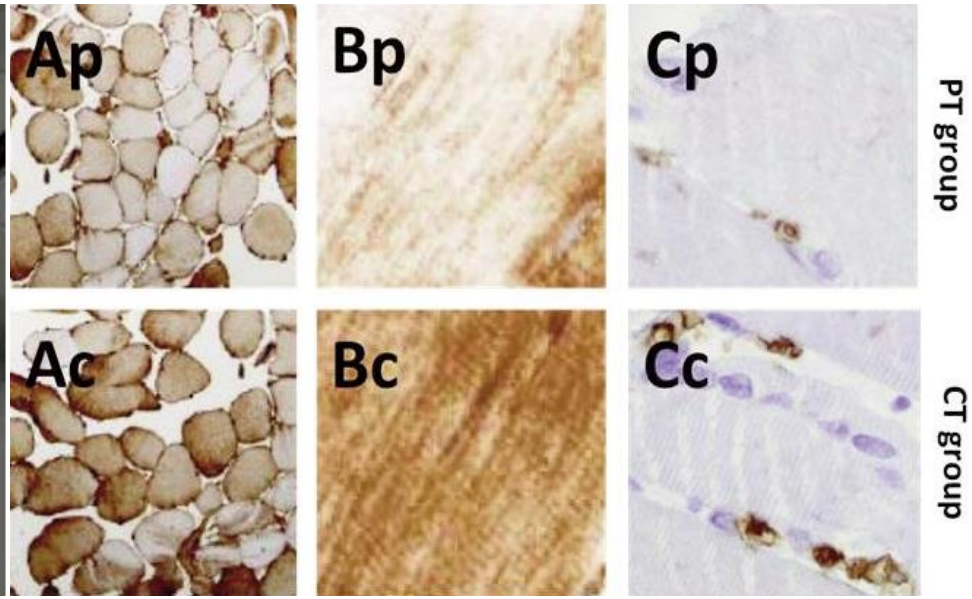
- Anti-inflammatory mechanism would explain post-exercise benefits from CG following EIMD
  - CG reduce tissue inflammation in a clinical setting (Beidler et al., 2009; Gohel et al., 2008)
    - Oedema playing a mechanistic role?
  - Leukocyte adhesion ↑x 100 with vascular stasis (Lawrence, Smith, Eskin, & McIntire, 1990; Lawrence, McIntire, & Eskin, 1987).
  - Associated with reduced circulating ROS following prolonged standing in healthy participants (Flore et al., 2007; Okamoto et al., 2013).




Endothelial Contraction

Potential mechanisms

- Anti-inflammatory mechanism would explain post-exercise benefits from CG following EIMD

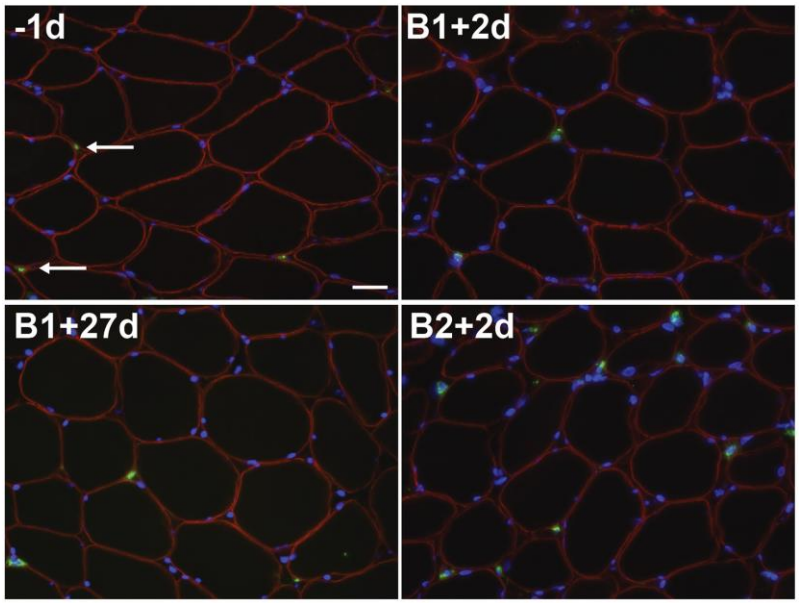


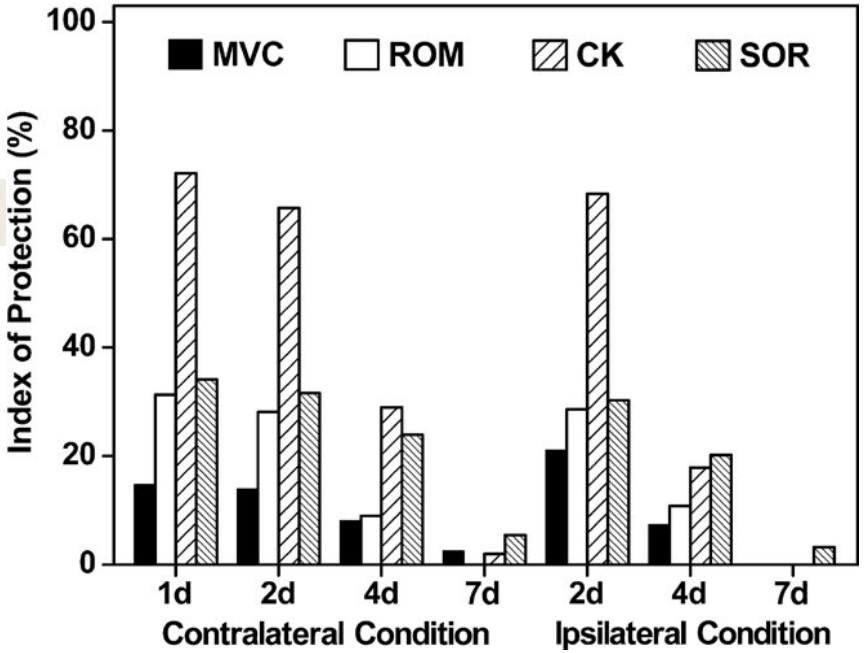
- Infiltration of albumin, CD3+ (T-cells) and MPO (neutrophils)

Valle, X., Til, L., Drobnic, F., Turmo, A., Montoro, J. B., Valero, O., & Artells, R. (2013). Compression garments to prevent delayed onset muscle soreness in soccer players. *Muscles, ligaments and tendons journal*, 3(4), 295.

- Pressure not measured
- Garments worn only throughout exercise
  - 40 min downhill running
  - - 10 % slope
  - 73 % VO2max
- No detail on how long afterwards athletes were permitted to keep wearing the garments
- Muscle oscillation?
  - Anti-inflammatory effects?

Repeated Bout Effect (RBE)





- Inflammatory aspect to RBE (a - Dehyle et al., 2016)
- Neural component (b - Chen et al., 2018)
- Compression has been shown to reduce circulating markers of EIMD (Kraemer et al., 2001, 2010), local inflammatory activity (Beidler et al., 2009)

<u>Studying the effects of CG on RBE could help guide the appropriate use of CG to optimise adaptation</u>

Analysis of RBE

-7 -2 -1 Pre-test/EIMD/post-test 1 2 3 4 5 6 7 Pre-test/EIMD/post-test 1 2 3


FUTURE

Compressing adaptation?

Mechanistic study…

Muscle damage

Compression
(> 20 mmHg at the medial calf and > 15 mmHg at the mid-thigh)

Control

Muscle biopsies taken

Flow cytometry to identify specific leukocytes from specific integrins

- T-cells (CD3, CD4, CD8, CD45RA, CD27)
- Monocytes/macrophages (CD14, CD16, CD45, CD163)
- Neutrophils (CD16, CD15, CD11b, CD66b)

Alterations in redox homeostasis

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Conclusions

- Custom fitted CG enhance recovery from exercise-induced muscle damage
  - Strength performance
  - Swelling
    - Muscular trauma?
    - Haemodynamic effects?
- Custom fitted CG can be made to apply higher, more precise pressures
- Future research should explore:
  - The effect of training status
  - Optimal pressures
  - Mechanisms
  - Adaptation

…to guide best practise

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