King Saud University
WORKSHOP
1-4pm, 25th September

How to design a study that can be published in refereed journals

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Workshop Outline

1. Examples of studies – Discussion
2. Exercise to design a study – Presentation and Discussion
3. Questions
4. Finalising a proposal
5. Conduct the proposed study (hopefully)

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15th ECSS Congress
26/06 (Sat) Physiology 16

Effect of Static Stretching and PNF Training on Eccentric Exercise-Induced Muscle Damage

Nosaka K[1], Chen CH[2,3], Chen HL[2], Wu CJ[2], Tseng KW[4], Chen TC[2]

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INTRODUCTION

- Prevention or attenuation of muscle damage is important (Cheung et al. 2003)
- Stretching prior to exercise has no or little prophylactic effect (Johansson et at. 1999, Rodenburg et al. 1994)
- Flexible muscle is less susceptible to muscle damage (McHugh et at. 1999)
- A few studies examined static stretching training effect on muscle damage (Eston et at. 2007, LaRoche & Connoly 2006)
- No study has investigated effect of PNF training on muscle damage

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PURPOSE

- To investigate whether an 8-week flexibility training attenuates the magnitude of eccentric exercise-induced muscle damage
  Hypothesis: less muscle damage
- To compare between static stretching and PNF training on the muscle damage attenuation
  Hypothesis: SS<PNF

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METHODS - Study Design

3 Groups: Static stretching (n=10), PNF training (n=10), Control (n=10)

	Pre-Training			8-wk Flexibility Training	Pre-ECC		Exercise	Recovery				
Day	-3 FAM	-2	-1	•SS & PNF groups: 3 days/week •Control group: no training	-1	pre	ECC	post 1	2	3	4	5
MVC,OA	X				X	X		X	X	X	X	X
ROM	X				X	X		X	X	X	X	X
Soreness	X				X	X			X	X	X	X
CK/Mb						X			X	X	X	X

Reliability for MVC, OA, ROM, Soreness

MVC: ICC=0.96, CV=7.8% OA: ICC=0.88, CV=11.3%
ROM: ICC=0.93, CV=6.7% Soreness: ICC=0.99, CV=0.9%

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Subjects

30 untrained young men (students)
No flexibility, resistance, aerobic training (6 months)
Age: 20.8 ± 2.3 y
Height: 172.7 ± 6.2 cm
Body weight: 66.9 ± 7.0 kg

Maximal isokinetic knee flexor concentric strength

3 groups: Control, SS, PNF (n=10 / group)
No significant differences in physical characteristics
No anti-inflammatory drugs, nutritional supplements
No vigorous physical activities
~~Normal diet during the experimental period~~

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Flexibility Training

W-up (5-min jogging @ 6.4 km/h, 1% grade)

30-s stretch (30-s rest) x 30

3 times / week for 8 weeks
A minimum of 24-h interval

1. 30-s stretch (30-s rest) x 5
2. (contract:10s – relax:10s – agonist-contract:5s – stretch:10s) x 3
3. (stretch with knee extensors/flexors contraction:10s) x 3

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Cocentric Strength and ROM

Velocity: 60° ·s^{-1}
ROM: 0-120°
Average of 3 trials
Optimum angle

Leighton Flexometer
Brace and straps

A straight-leg-raise ROM test
Average of 3 trials (60-s rest)

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Effects of Flexibility Training

	CON	Pre SS	PNF	CON	Post SS	PNF
ROM (°)	97.6 ± 3.0	96.1 ± 3.6	95.5 ± 3.4	99.0 ± 3.1	120.1 ± 3.7*#	123.1 ± 3.5*#
MVC-Flx (Nm)	70.4 ± 3.9	72.7 ± 3.2	70.8 ± 3.7	71.0 ± 4.0	79.0 ± 3.0*#	81.8 ± 3.9*#
MVC-Ext (Nm)	117.1 ± 6.7	124.9 ± 7.8	121.9 ± 7.0	119.3 ± 6.8	128.7 ± 8.3	129.3 ± 6.6*#
OA-Flx (°)	35.6 ± 2.4	36.5 ± 2.2	34.1 ± 2.3	34.5 ± 2.8	27.9 ± 2.6*#	23.9 ± 2.7*#

* Significantly (P<0.05) different from pre, # significantly (P<0.05) different from CON

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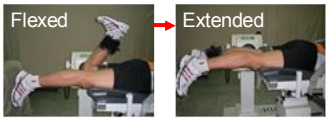
Eccentric Exercise

6 sets of 10 maximal eccentric contractions

ROM: 130 - 0°



Angular velocity: 30° /s
Passive recovery: 10° /s
13-s rest between contractions
60-s rest between sets

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Statistical Analyses

- Changes in muscle strength, optimum angle, ROM, muscle soreness, and plasma CK activity and myoglobin concentration following eccentric exercise
- Two-way repeated measures ANOVA to compare three groups (CON vs SS vs PNF) and between two groups (CON vs SS, CON vs PNF, SS vs PNF)
- Bonferroni post hoc test
- Pearson correlation coefficient (r)
- Statistical significance: $P < 0.05$
- Mean ± SEM

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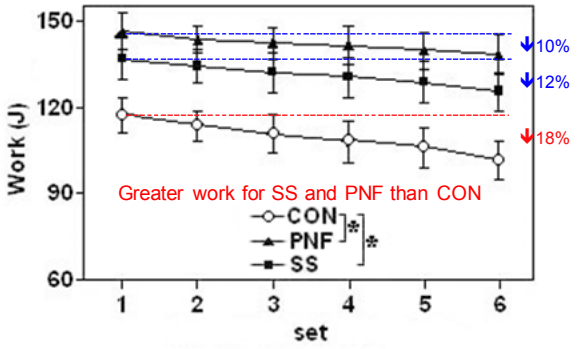
Work during Eccentric Exercise



Similar results for peak torque

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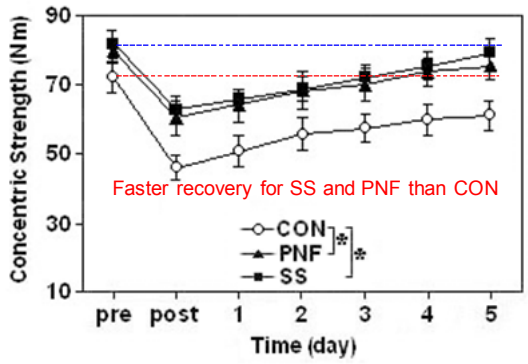
Concentric Strength



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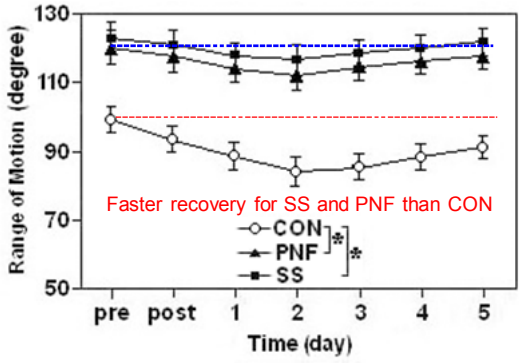
Range of Motion



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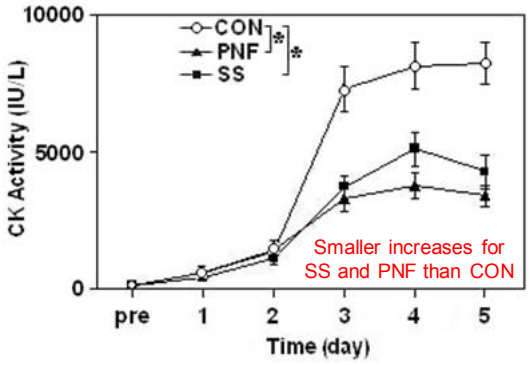
Plasma CK Activity



Similar results for myoglobin

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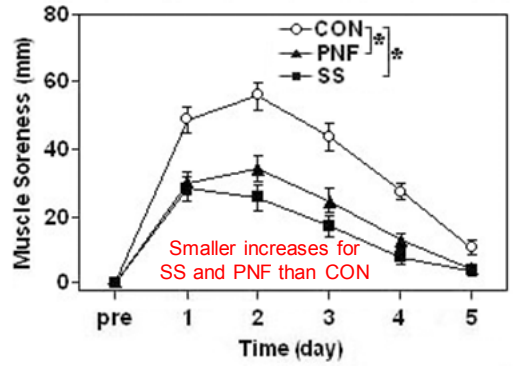
Muscle Soreness (VAS)



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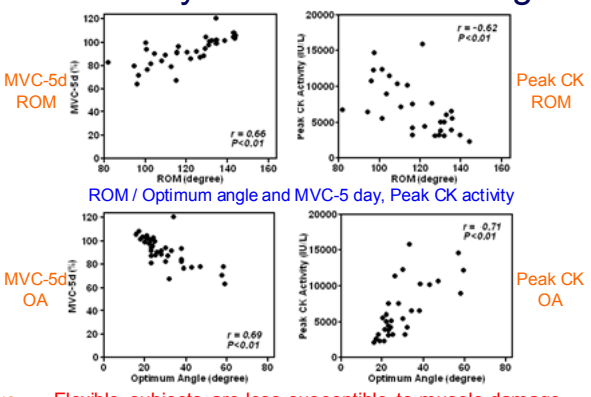
Flexibility and Muscle Damage



Flexible subjects are less susceptible to muscle damage

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CONCLUSION

The 8-week static stretching and PNF training shifted the optimum angle to a longer muscle length, increased the flexibility and strength of the knee flexors, and similarly attenuated muscle damage (~50%) induced by maximal eccentric exercise of the knee flexors

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CHEN, C-H., K. NOSAKA, H-L. CHEN, M-J. LIN, K-W. TSENG, and T. C. CHEN. Effects of Flexibility Training on Eccentric Exercise–Induced Muscle Damage. Medicine and Science in Sports Exercise. 43(3): 491–500, 2011.

Article

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16th ECSS Congress
08/07 (Fri) OP-PM42
Muscle Damage and Recovery

Two Maximal Isometric Contractions Attenuate Magnitude of Eccentric Exercise-Induced Muscle Damage

Nosaka K [1], Chen HL [2], Chen TC [2]
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[2] National Chiayi University (TAIWAN)

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INTRODUCTION

- The second eccentric exercise bout results in less muscle damage and faster recovery than the initial bout when the same exercise is repeated (Clarkson et al. 1992)
- Repeated bout effect: the adaptation whereby a single bout of eccentric exercise protects against muscle damage from subsequent eccentric exercise (McHugh 2003)
- Low-intensity "non-damaging" eccentric exercise confers protective effect against maximal eccentric exercise (Chen et al. 2007; Lavender & Nosaka 2008, Chen et al. 2011)

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- Animal studies showed that 75 isometric contractions conferred protective effect against muscle damage induced by 75 maximal eccentric contractions performed 2 weeks later (Koh & Brooks 2001; Pizza et al., 2002)
  another type of the repeated bout effect
- A familiarisation session in which includes maximal isometric contractions appears to attenuate the magnitude of muscle damage induced by maximal eccentric contractions performed a couple days later

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RATIONALE

- No previous human studies have examined the effect of maximal isometric contractions on eccentric exercise-induced muscle damage
- It may be that less muscle damage found in the studies with a familiarisation session was due to isometric contractions performed in the session, but this has not been systematically investigated

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PURPOSES

- To investigate whether maximal isometric contractions performed 2 days prior to maximal eccentric exercise could attenuate the magnitude of muscle damage
  Hypothesis: Yes
- To compare between 2 and 10 maximal isometric contractions on muscle damage induced by 30 maximal eccentric contractions
  Hypothesis: 2<10

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METHODS: Subjects

39 untrained young men (students)
No flexibility, resistance, aerobic training (>1 year)
Age: 22.5 ± 1.7 y
Height: 172.9 ± 5.7 cm
Body weight: 71.7 ± 9.0 kg

Maximal isokinetic elbow flexor concentric strength

Control, 2-MVC, 10-MVC (n=13 / group)
Sample size estimation based on a pilot study
No significant differences in physical characteristics
No anti-inflammatory drugs, nutritional supplements
No vigorous physical activities
Normal diet during the experimental period

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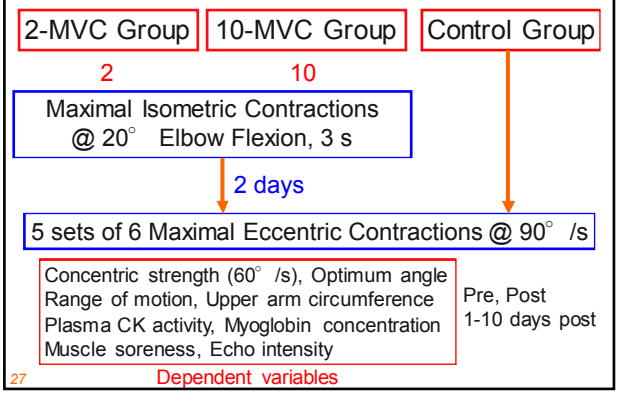
Study Design



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Isometric Contractions

2 or 10 maximal isometric contractions
20° flexion
3 s
45 s between contractions

Eccentric Exercise

5 sets of 6 maximal eccentric contractions
ROM: 90-0°
90° /s
10 s between contractions
2 min between sets

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Statistical Analyses

- Two-way repeated measures ANOVA
  - Comparison between 2-MVC and 10-MVC groups for the changes in dependent variables following isometric contractions
  - Comparison between Control, 2-MVC and 10-MVC groups for the changes in dependent variables following eccentric exercise
- Bonferroni post hoc test
- Statistical significance: $P < 0.05$
- Mean ± SEM

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RESULTS: Isometric Contractions

		pre	post	d1	d2
OA (°)	2-MVC	78.8 ± 2.0	77.7 ± 2.2	78.0 ± 2.0	78.2 ± 2.2
	10-MVC	77.6 ± 2.3	77.0 ± 2.4	76.1 ± 2.3	77.4 ± 2.4
MVC (Nm)	2-MVC	33.4 ± 1.6	32.6 ± 1.7	32.8 ± 1.7	33.4 ± 1.7
	10-MVC	32.5 ± 2.1	32.1 ± 2.0	32.5 ± 2.0	33.1 ± 1.9
ROM (°)	2-MVC	142.7 ± 1.3	142.6 ± 1.2	142.2 ± 1.2	143.0 ± 1.3
	10-MVC	142.8 ± 1.4	142.4 ± 1.4	142.5 ± 1.5	142.8 ± 1.6
CIR (mm)	2-MVC	275.1 ± 5.0	275.3 ± 4.9	275.2 ± 4.9	275.5 ± 5.0
	10-MVC	275.2 ± 5.4	275.4 ± 5.5	275.4 ± 5.5	275.3 ± 5.3
CK (IU/L)	2-MVC	114.9 ± 6.6	–	115.6 ± 7.6	118.4 ± 8.6
	10-MVC	113.4 ± 7.6	–	115.7 ± 7.8	116.2 ± 6.5
Mb (μg/L)	2-MVC	25.1 ± 0.9	–	25.5 ± 1.0	27.0 ± 1.2
	10-MVC	27.3 ± 1.4	–	26.5 ± 1.2	26.3 ± 1.1
SOR (mm)	2-MVC	0.0 ± 0.0	–	0.1 ± 0.1	0.3 ± 0.2
	10-MVC	0.0 ± 0.0	–	0.7 ± 0.3	3.8 ± 1.0
Echo-intensity (A.U.)	2-MVC	62.1 ± 2.0	–	63.8 ± 1.8	65.7 ± 1.9
	10-MVC	60.0 ± 1.2	–	60.3 ± 1.5	62.0 ± 1.0

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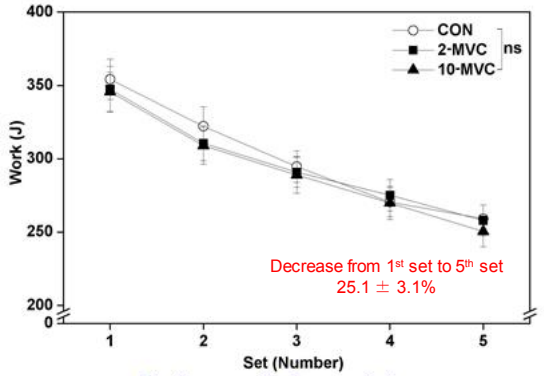
No significant changes =Control

Work during Eccentric Exercise



Similar results for peak torque

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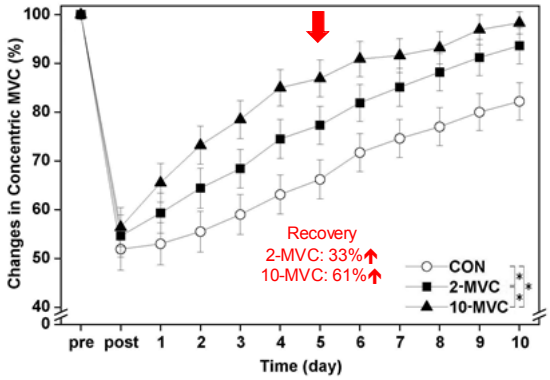
Concentric Strength



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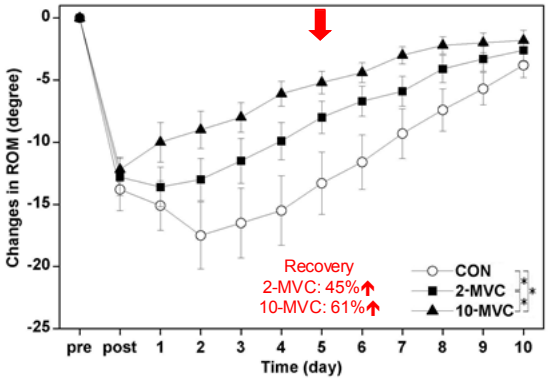
Range of Motion



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Upper Arm Circumference

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Increases
2-MVC: 44%
10-MVC: 58%

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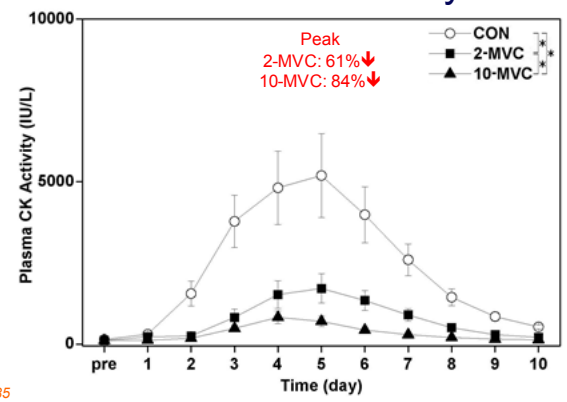
Plasma CK Activity



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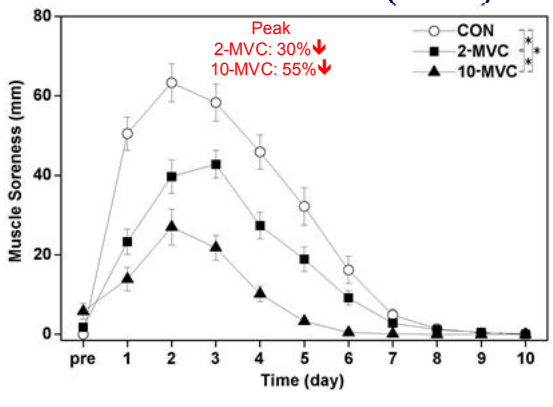
Muscle Soreness (VAS)



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CONCLUSION

- The magnitude of muscle damage induced by maximal eccentric contractions of the elbow flexors was attenuated by both 2 and 10 maximal isometric contractions performed 2 days prior to the eccentric exercise
- The magnitude of protective effect was greater for 10 than 2 maximal isometric contractions, but the difference was small
- ~~Every muscle contraction counts!~~

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CHEN, H-L., NOSAKA, K., PEARCE AJ., CHEN, TC.
Two maximal isometric contractions attenuate the magnitude of eccentric exercise-induced muscle damage.
Applied Physiology, Nutrition, and Metabolism.
37(4): 680-689, 2012.

Article

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17th ECSS Congress
06/07 (Fri) OP-PM37
Muscle Physiology

Protective Effect Conferred by Maximal Isometric Contractions at a Long Muscle Length

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[1] Edith Cowan University (AUSTRALIA)
[2] NCYU, [3] CCU, [4] NTU (TAIWAN)

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INTRODUCTION

- Magnitude of muscle damage is smaller and recovery is faster after the second than initial eccentric exercise bout: Repeated bout effect (Clarkson et al. 1992, McHugh 2003)
- Submaximal eccentric exercise including "low-intensity" (non-damaging) eccentric exercise confers protective effect against maximal eccentric exercise (Chen et al. 2007; Lavender & Nosaka 2008, Chen et al. 2011)

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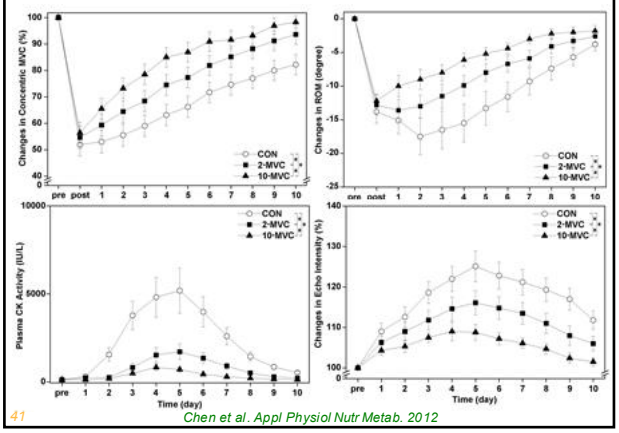
ECSS 2011: Protective Effect by Max Isometric Contractions



Chen et al. Appl Physiol Nutr Metab. 2012

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PURPOSE

To investigate the protective effect by 2 maximal voluntary isometric contractions at 20° elbow flexion (2MVCs) on changes in indirect muscle damage markers following maximal eccentric contractions (MaxECC) that were performed immediately after, or 2, 4 or 7 days later

Hypotheses: 1) immediately before: no effect; 2) 4 days: residual effect; 3) 7 days: no effect

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Study Design

2 Maximal Isometric Contractions @ 20° Elbow Flexion, 3 s

Untrained young men (n=13/group)
21.8 ± 2.3 y
173.6 ± 5.6 cm
69.2 ± 11.1 kg

15 min 0 day | 2 days | 4 days | 7 days | Control

5 sets of 6 Maximal Eccentric Contractions @ 90° /s

Concentric strength (60° /s), Optimum angle
Range of motion, Upper arm circumference
Plasma CK activity, Myoglobin concentration
Muscle soreness, Echo intensity

Pre, Post
1-10 days post

Dependent variables

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Isometric Contractions

2 maximal isometric contractions: 3 s
45 s between contractions
20° flexion

Eccentric Exercise

5 sets of 6 maximal eccentric contractions
10 s between contractions
2 min between sets
ROM: 90-0° , 90° /s

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Statistical Analyses

- Two-way repeated measures ANOVA
  - Comparison between Control, 0d, 2d, 4d, and 7d groups for the changes in dependent variables following eccentric exercise
- Bonferroni post hoc test
- Statistical significance: $P < 0.05$
- Mean ± SEM

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RESULTS: Changes after 2MVCs

	pre	post	d1	d2
MVC-CON (Nm)	32.7 ± 0.8	31.7 ± 0.7	32.1 ± 0.8	32.9 ± 0.7
OA (°)	77.2 ± 1.6	76.7 ± 1.6	77.2 ± 1.6	77.3 ± 1.5
ROM (°)	142.4 ± 0.9	142.8 ± 1.0	143.0 ± 1.0	142.7 ± 1.0
CIR (mm)	274.7 ± 3.7	274.9 ± 3.6	274.8 ± 3.6	274.9 ± 3.6
CK (IU/L)	116.8 ± 4.6	–	117.9 ± 5.1	118.9 ± 5.5
Mb (μg/L)	24.3 ± 0.8	–	25.4 ± 1.2	24.7 ± 0.8
VAS (mm)	0.0 ± 0.0	–	0.3 ± 0.1	0.1 ± 0.1

No significant changes

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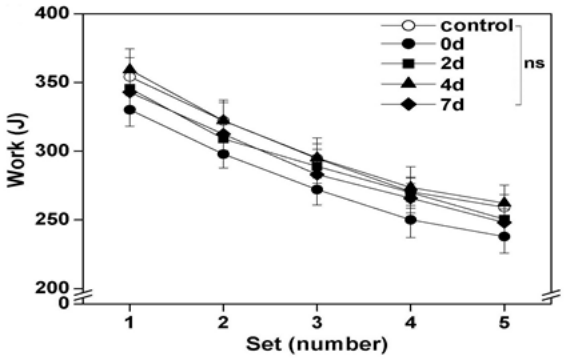
Work during Eccentric Exercise



Similar results for peak torque

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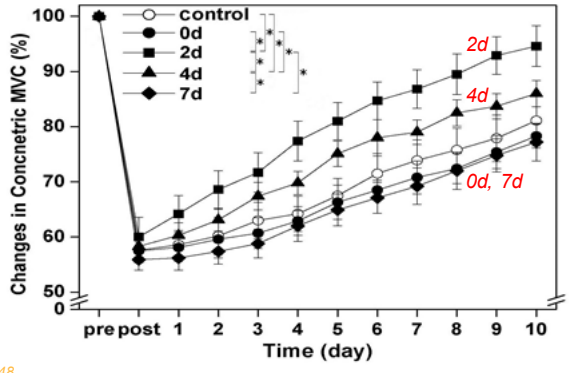
Concentric Strength



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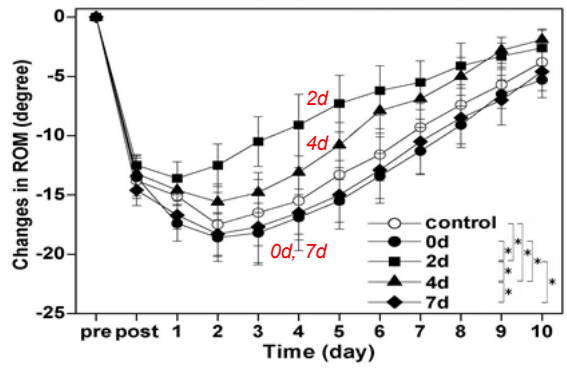
Range of Motion



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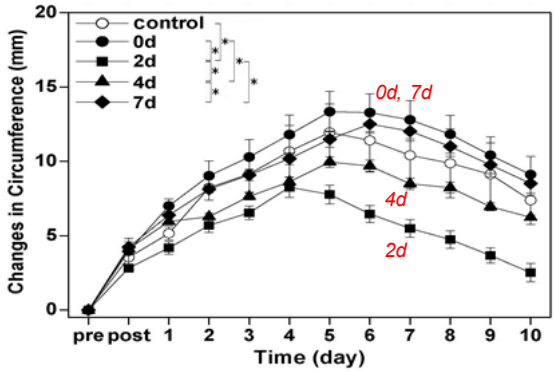
Upper Arm Circumference



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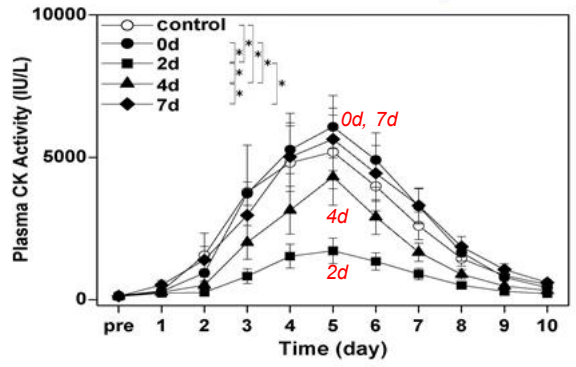
Plasma CK Activity



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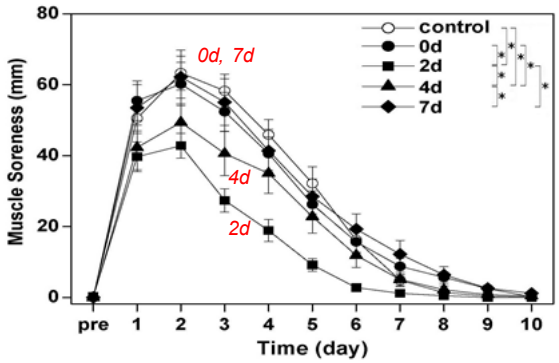
Similar results for plasma Mb concentration

Muscle Soreness (VAS)



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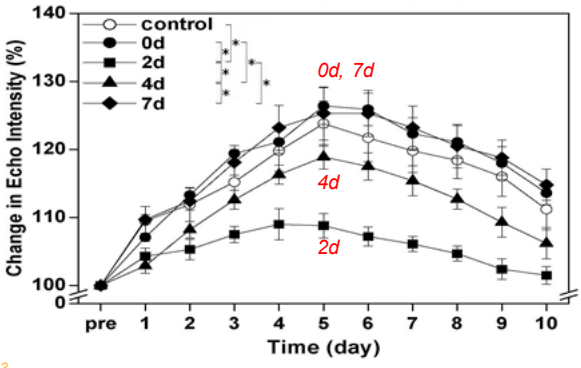
Echo Intensity



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CONCLUSION

- The magnitude of muscle damage induced by maximal eccentric contractions of the elbow flexors was attenuated by 2MVCs performed 2 or 4 days, but not immediately or 7 days prior to the eccentric exercise
- The protective effect is short-lived, and it requires at least one day for the effect to be produced

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PRACTICAL IMPLICATIONS

- MVC measures at a long muscle length (e.g., familiarisation session) should be scheduled more than a week before MaxECC
- A few MVCs can be used as a "pre-conditioning" exercise to attenuate potential muscle damage
- Every muscle contraction counts and a few MVCs is better than nothing

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Applied Physiology, Nutrition and Metabolism

Rejected

Revised

Submitted to

European Journal of Applied Physiology

Article

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Design a "Publishable" Study

- Find a good topic
- Know the background of the study (what is the originality of the study?)
- Set a clear research question and hypothesis
- Assume "comments" from reviewers when designing a study (e.g. sample size, reliability, validity, statistical analysis)

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Key Factors

- Clear research question
- Logical hypothesis
- Originality
- Rationale
- Significance
- Reasonable approach to the question
- Reliable methods
- Appropriate analysis and interpretation

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Exercise 1

What do you want to study?

- List three "questions" that you want to know from "research"
  - 1
  - 2
  - 3

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Exercise 2

Explain how important and exciting your research question is

- Why is it important?
- How is it exciting?

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Exercise 3

If you have an unlimited funding, how will you design a study to answer the research question?

- Aim(s)
- Methods
- Timeline

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Exercise 4

Explain the following in ONE sentence

- Background
- Aim(s)
- Methodology

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Brain Storming

- Diabetes
- Physical fitness tests for children
- Effects of pray on health
- Influence of fasting on performance

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Thank you very much

Questions?
Comments?

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