

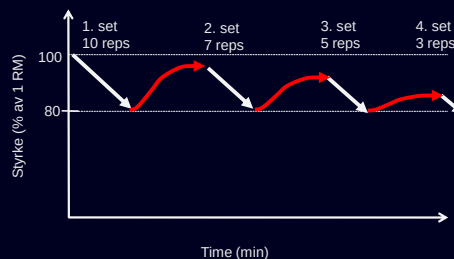
Styrketrening og restitusjon



Truls Raastad

Seksjon for Fysisk Prestasjonsevne

Tretthet utvikles gradvis - serier til utmattelse 80% of 1 RM



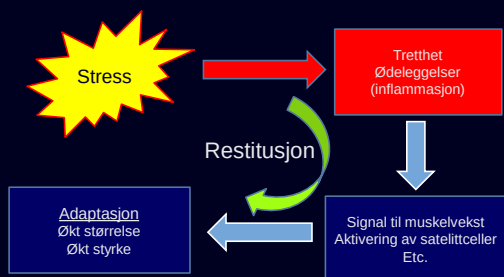
Årsaker til muskeltretthet

- Forstyrrelser i elektrolyttbalansen over cellemembranen (sek - min)
- Redusert CrP, pH/Økt P_i (min)
- Oksidativ stress, ROS produksjon (min)
- Svikt i eksitasjons-kontraksjonskoblingen (timer - dager)
- Endret struktur på proteiner (timer - dager)
- Strukturelle ødeleggelser
 - Små (1- 4 dager)
 - Moderate (5 -10 dager)
 - Store (uker)

Ulike typer stress som vi utsetter muskulaturen for

- Mekanisk stress
 - Motstand Høyt ----- Lavt
 - Utførelse
- Metabolsk stress Høyt ----- Lavt
 - Reps og pauselengde
 - Okklusjon av blodstrøm
- Totalt treningsvolum Høyt ----- Lavt
 - Serier og øvelser

Hvorfor er det viktig å «stresse» muskulaturen?

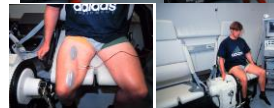


Hvordan måle tretthet og restitusjon?

Isokinetisk kneekstensjon



Elektrisk stimulering



Spenst og hurtighet

Spørreskjema: «Hvordan føler du deg?»

Restitusjon etter styrketrening

- Styrkeløftere, nasjonalt nivå

3 x 3 RM i knebøy (169±7 kg)

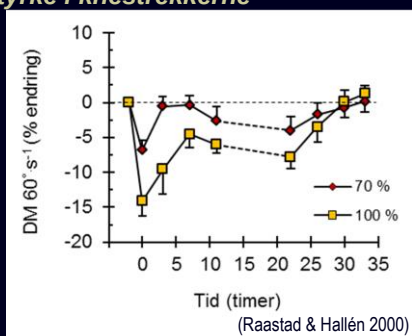
3 x 3 RM i frontbøy (121±5 kg)

6 x 6 RM i knee-ekstensjon (68±4 kg)

(Raastad & Hallén 2000)



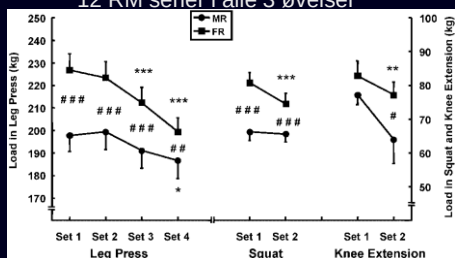
Restitusjon etter styrketrening - Styrke i knestrekkerne



(Raastad & Hallén 2000)

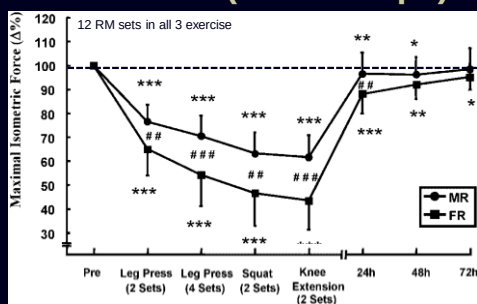
Økt motstand (Forced reps)

12 RM serier i alle 3 øvelser



(Ahtiainen et al. 2003)

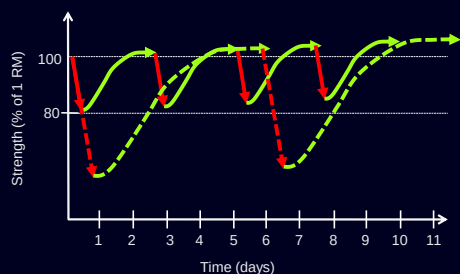
Økt motstand (Forced reps)



(Ahtiainen et al. 2003)

Treningsfrekvens

- 12 RM protokol vs forced rep protokol



Hva er best?

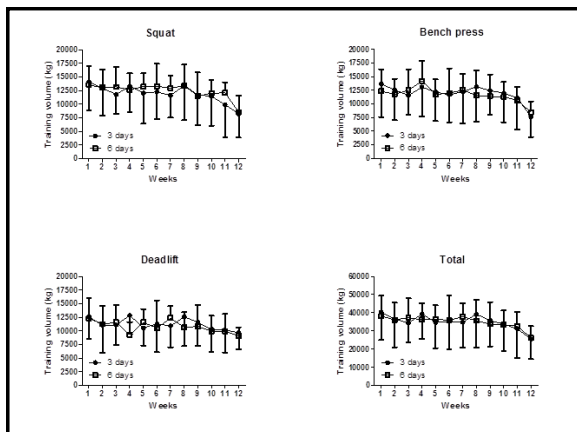
- Å trene ofte med lav/moderat belastning?
 - Moderat treningsvolum per økt
- Eller...
- Å trene sjelden med stor belastning?
 - Stort treningsvolum per økt

3 økter per uke

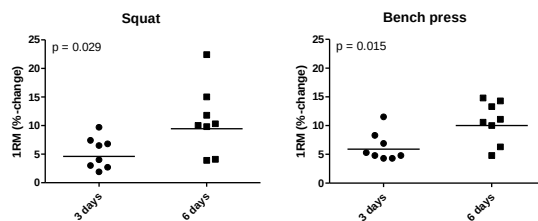
3 økter per uke									
Øvelser	Mandag								
1 Magen med vekt	Reps	10	10	10	10				
2 Rygghev m.vekt	Reps	10	10	10	10				
3 Styrkeløftknebøy	Reps	6	6	4	4	4	3	3	3
4 Knebøy med stopp	Reps	6	5	4	3	3	3		
5 Benkpress middels g	Reps	6	5	4	3	3	3	3	
6 Benkpress smalt grep	Reps	6	6	5	5	3	3	3	
7 Markløft fra heng	Reps	6	5	4	4	4	4		
8 Stillelegmarkløft	Reps	6	5	4	3	3	3		
9 Lattrowing stang	Reps	10	10	10					
10 Lårcurl	Reps	10	10	10					

6 økter per uke

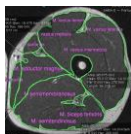
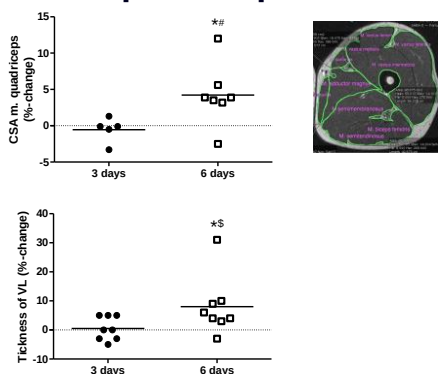
6 økter per uke									
Øvelser	Mandag	Tirsdag							
1 Magen med vekt	Reps	10	10	10	10				
2 Rygghev m.vekt	Reps	10	10	10	10				
3 Styrkeløftknebøy	Reps	6	6	4	4	4	3	3	3
4 Knebøy med stopp	Reps	6	5	4	3	3	3		
5 Benkpress middels g	Reps	6	5	4	3	3	3	3	
6 Benkpress smalt grep	Reps	6	6	5	5	3	3	3	
7 Markløft fra heng	Reps	6	5	4	4	4	4		
8 Stillelegmarkløft	Reps	6	5	4	3	3	3		
9 Lattrowing stang	Reps	10	10	10					
10 Lårcurl	Reps	10	10	10					



Endring i 1 RM knebøy og benk



Muskelvekst quadriceps

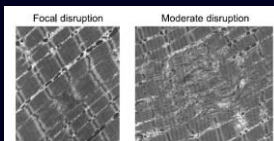


Årsaker til muskeltretthet

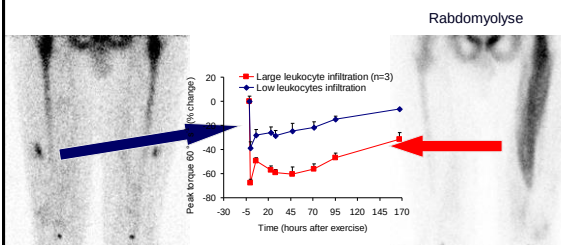
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- Redusert CrP, pH/Økt P_i (min)
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- Svikt i eksitasjons-kontraksjonskoblingen (timer - dager)
- Endret struktur på proteiner (timer - dager)
- Små strukturelle ødeleggelser (1- 4 dager)
- Moderate strukturelle ødeleggelse (5 -10 dager)
- Store strukturelle ødeleggelse (uker – måneder (nekrose))

Strukturelle endringer

- Membranødeleggelser
- Endringer i bindevevet rundt muskelfibre
- Myofibrillære endringer
- Fiber nekrose



Ekstreme protokoller Leukocytt infiltrasjon og restitusjon



(Paulsen et al, 2010)

Restitusjonsstrategier

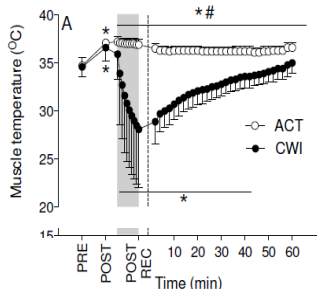
- Active recovery - recovery exercise?
- Hot and cold baths?
 - «Cold water immersion» (CWI)
 - «Contrast water therapy» (CWT)
- Cryotherapy (-110°C)
- Recovery enhancing substances?
- Massage?
- Hyperbaric chambers?
- Compression garments?

Kalde bad Cold water immersion



10°C i 10 minutter

Kalde bad reduserer muskeltemperatur



10°C i 10 minutter -> 4-6°C reduksjon i muskel

Meta-analyse CWI

Cold water immersion and recovery from strenuous exercise: a meta-analysis

Jonathan Leeder,^{1,2} Conor Gissane,³ Ken van Someren,⁴ Warren Gregson,⁴ Glyn Howatson^{1,5}

¹School of Life Sciences, Northumbria University, Newcastle, UK
²Physiology, English Institute of Sport, UK
³Sports Rehabilitation, St Mary's University College, Twickenham, UK
⁴Sport and Exercise Sciences, Liverpool John Moores, Liverpool, UK
⁵Partner for Exercise Research

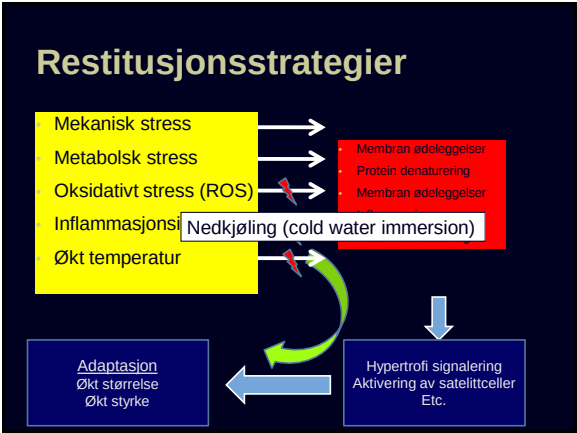
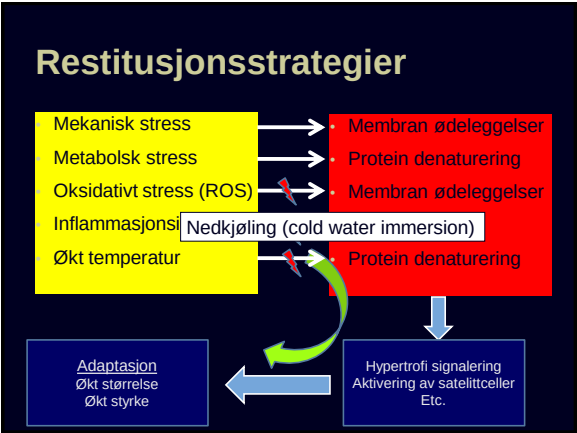
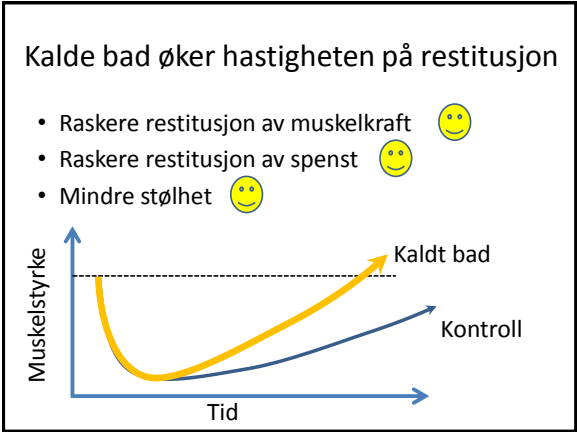
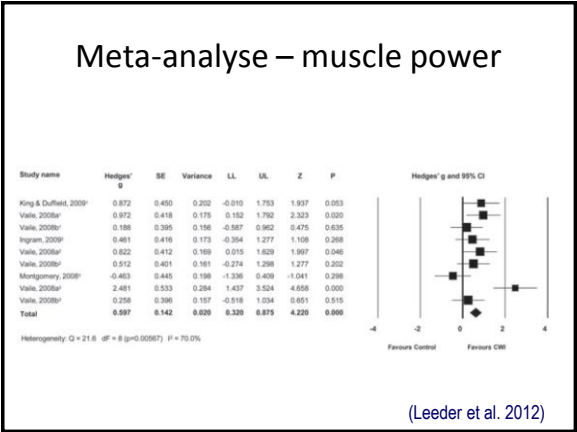
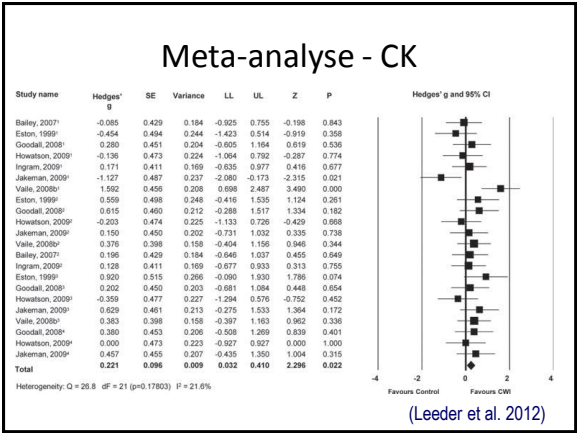
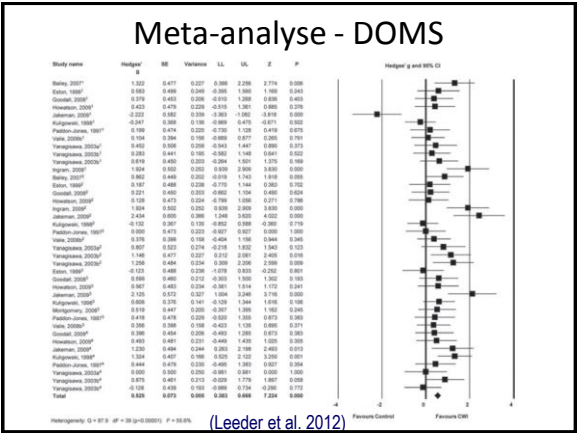
INTRODUCTION

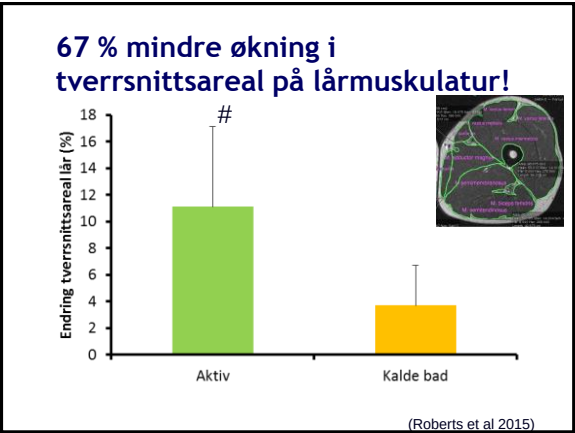
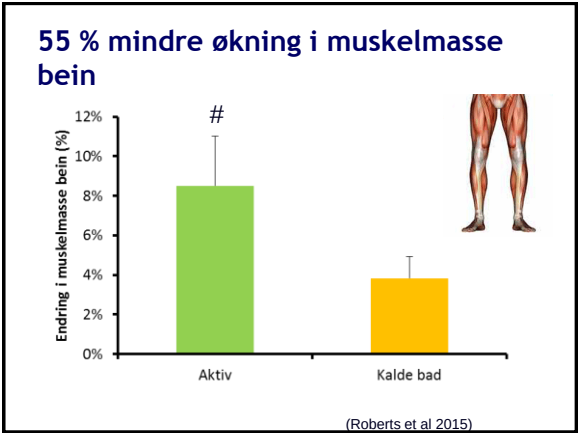
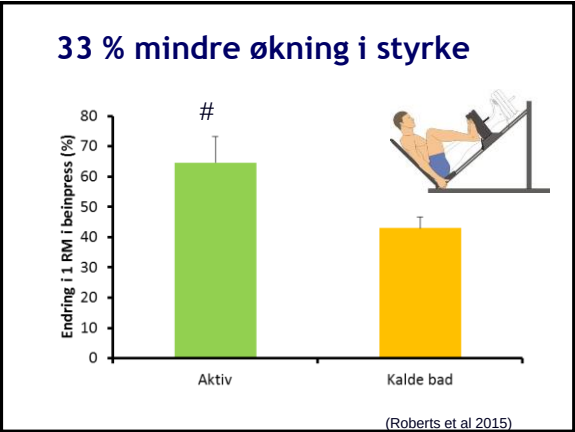
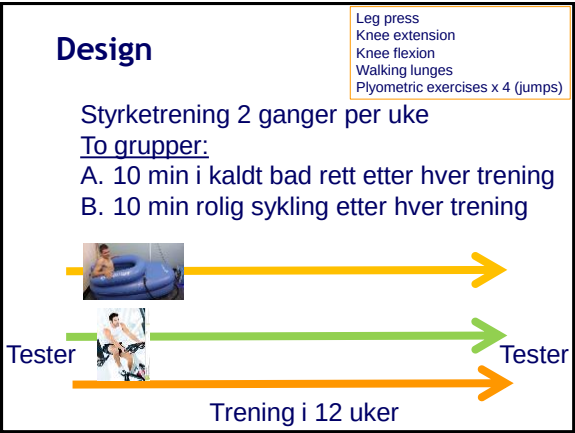
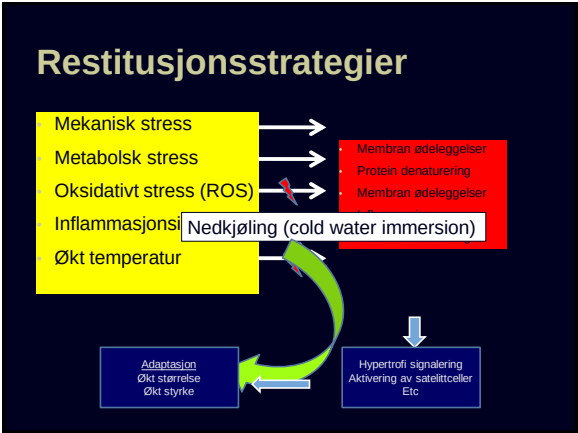
Elite-level athletic training and competition is accompanied by the recovery of a series of physiological stressors. The physiological stress will vary considerably depending upon the specific exercise type, duration and intensity and also on the athletes' familiarisation to the exercise insult. It is well documented that when the exercise stress incorporates a novel eccentric component or the intensity is at considerable increases no duration 1

This proposed reduction in inflammation might be related to attenuated delayed-onset muscle soreness (DOMS) and enhanced recovery of muscle function.¹⁴

Attempting to increase rate of recovery may be beneficial to the elite athlete. For example, following high-intensity intermittent sprint sports, it is common for athletes to experience elevated muscle soreness and reductions in muscle function of up to 70% for several days after the cessation of use.

(Leeder et al. 2012)





Bør vi bruke kalde bad for å påskynde restitusjon?

■ NEI!

Ikke regelmessig ved normal trening!

■ JA!

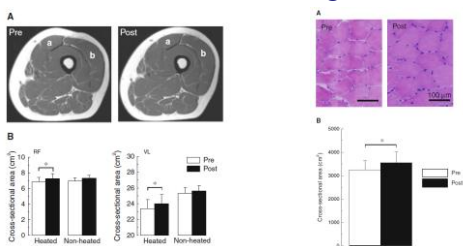
Når vi må restituere raskt mellom konkurranser

Kan varme bad øke effekten av styrketrening?



Hot water immersion, 45° for 10 min

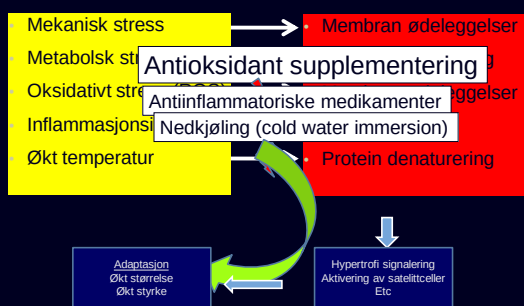
Positive effect of muscle heating on muscle mass and strength



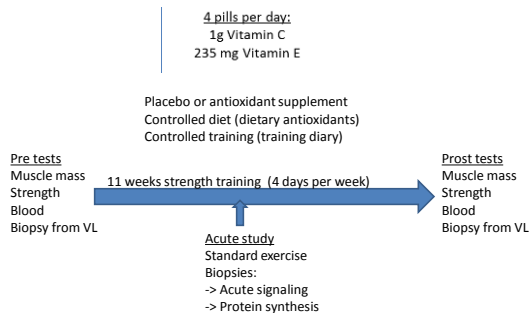
8 hrs heating of one leg 4 days/week for 10 weeks
34.8 → 38.3 °C

(Goto et al 2011)

Restitusjonsstrategier

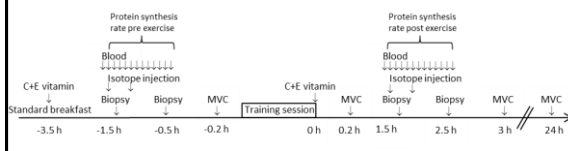


Styrketrening og antioksidanttilskudd



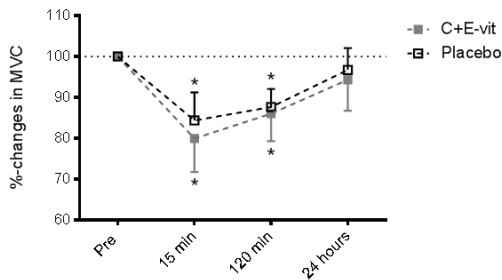
(Paulsen et al. 2014)

Akutt studie



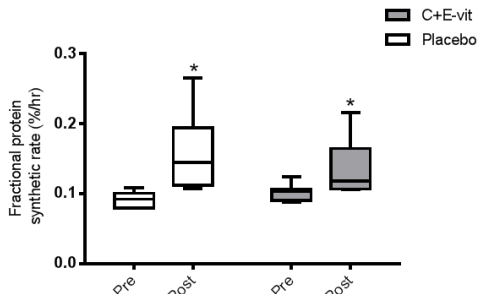
(Paulsen et al. 2014)

Restitusjon av muskelstyrke

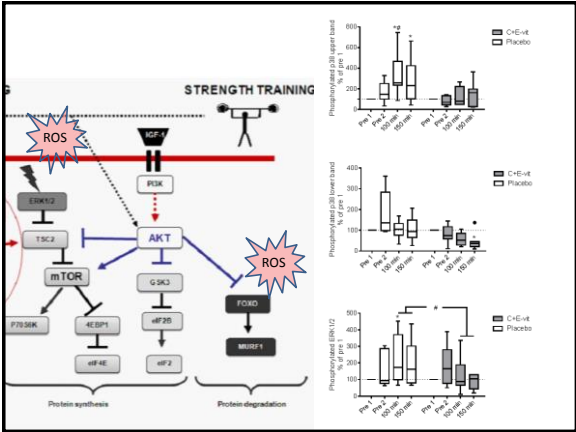


(Paulsen et al. 2014)

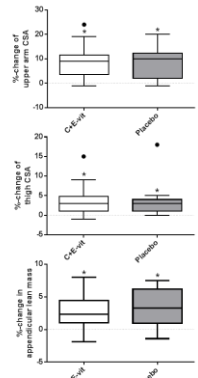
Hastighet på muskelproteinsyntese



(Paulsen et al. 2014)

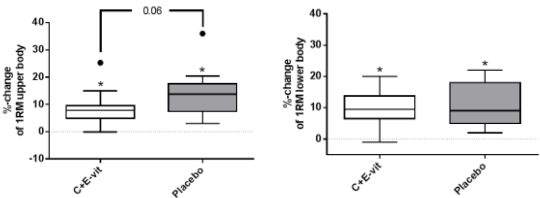


Muskelvekst



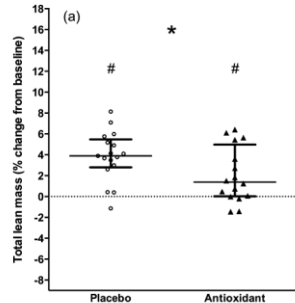
(Paulsen et al. 2014)

Endring i muskelstyrke



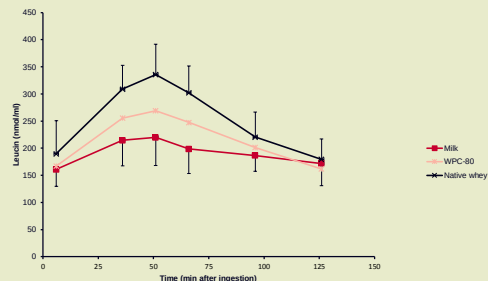
(Paulsen et al. 2014)

Effekt av vitamin C og E supplementering på muskelvekst hos eldre menn



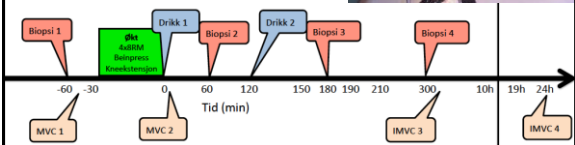
(Bjørnsen et al. 2015)

Kan "hurtige proteiner" bedre restitusjonen?

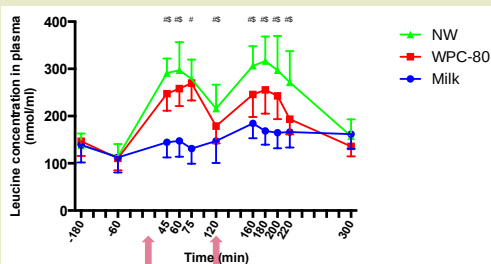


Design

Melk: 12
WPC-80 } 10
Nativ myse }

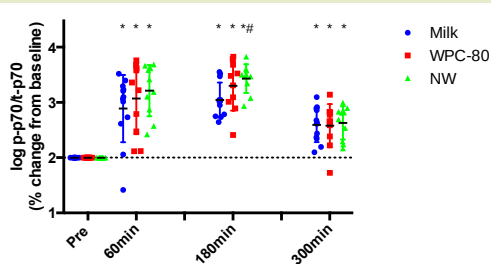


Leucinkonsentrasjon i blod



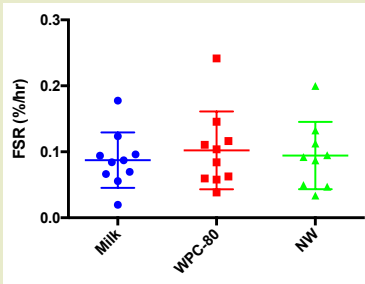
(Hamarsland m.fl.)

Anabol signalering



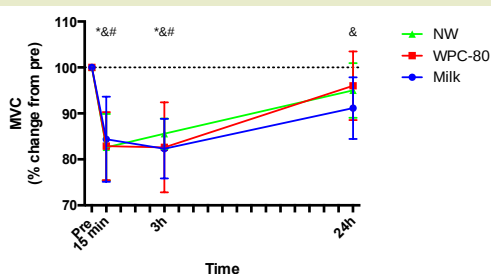
(Hamarsland m.fl.)

Proteinsyntese

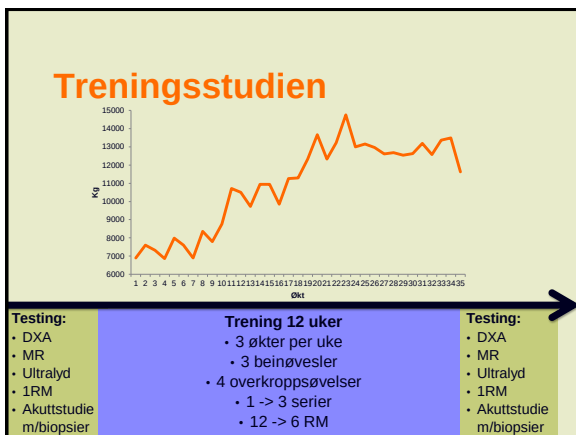


(Hamarsland m.fl.)

Restitusjon



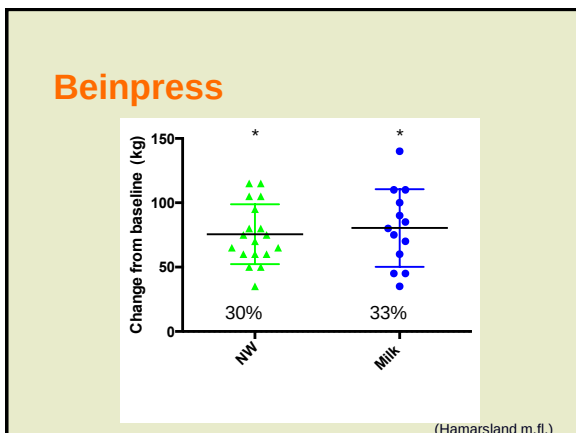
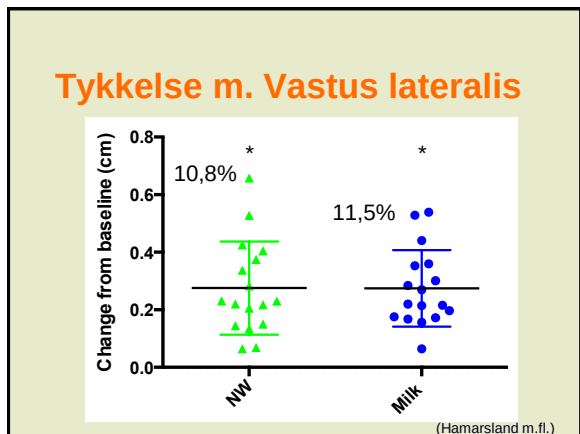
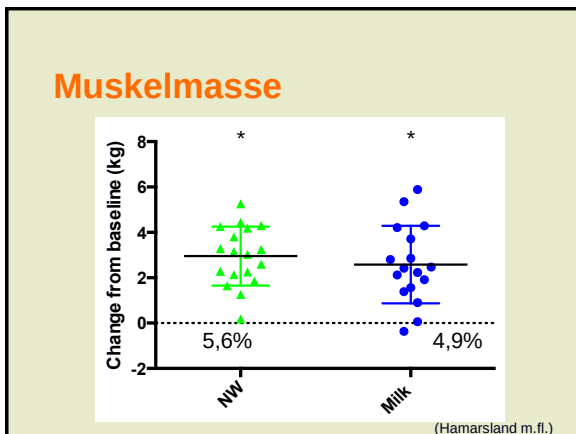
(Hamarsland m.fl.)



Treningsstudien

- 2 grupper
 - Melk
 - Nativ myse
- 2x20g/dag
 - Proteininntak med tilskudd: 2g/kg/dag

(Hamarsland m.fl.)



Oppsummering

- Planlegg for en optimal balanse mellom treningsbelastning og restitusjon
 - Tilpass treningsfrekvens til den belastningen som er i hver enkelt treningsøkt
 - "Lettere økter" ofte gir bedre kontroll enn få "tunge økter"
 - Ikke belast muskulaturen for hardt i enkelte treningsøkter!!
- Ikke legg mye vekt på sofistikerte restitusjonsstrategier i det daglige treningsarbeidet!
 - Kan brukes ved tett konkurranseprogram!
- Tren godt – spis godt – sov godt!