


Francqui
Foundation
INVITATION
2014-2015

FRANCQUI CHAIR

Awarded to Prof. dr. Luc van Loon,
Maastricht University Medical Center

Prof. dr. Eric Kerckhofs,
Dean of the Faculty of Physical Education and Physiotherapy
invites you to the




INAUGURAL LECTURE: 'THE HUMAN ENGINE'
Thursday 12th of February at 6 pm in room D0.07

Lecture series:

Monday 2nd of March: Exercise Metabolism

- 9.30 am - 11.30 am: Sports Nutrition to modulate fuel selection | Room L2.10
- 1 pm - 3 pm: Sports Nutrition to improve recovery after exercise | Room L2.10

INAUGURAL LECTURE: 'THE HUMAN ENGINE'
Thursday 12th of February at 6 pm in room D0.07



Lecture series:

Monday 2nd of March: Exercise Metabolism

- 9.30 am - 11.30 am: Sports Nutrition to modulate fuel selection | Room L2.10
- 1 pm - 3 pm: Sports Nutrition to improve recovery after exercise | Room L2.10

Monday 20th of April: Protein Metabolism

- 9.30 am - 11.30 am: Regulation of muscle mass maintenance | Room L2.10
- 1 pm - 3 pm: Muscle loss with ageing | Room L2.10

Monday 4th of May: Exercise and chronic metabolic disease

- 1 pm - 3 pm: Exercise in the prevention and treatment of type 2 diabetes | Room L2.10





Vrije Universiteit Brussel



Maastricht University

De menselijke motor

Prof. L.J.C. van Loon





M³ research unit

www.m3-research.nl





Betekenis 'onbezoldigd'

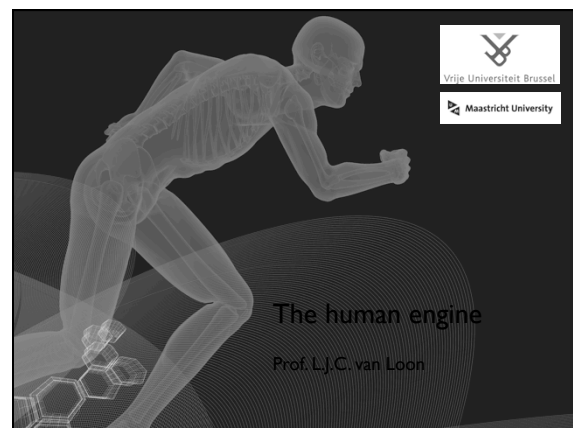
Je hebt gezocht op het woord: onbezoldigd.

on·be·zol·digd (bijvoeglijk naamwoord)

- 1 geen loon ontvangend
- 2 geen loon opleverend



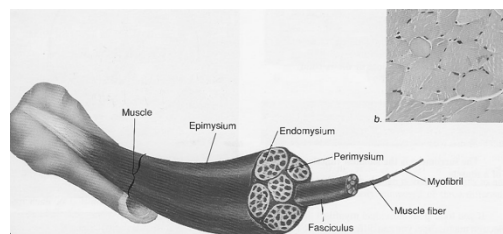
Francqui leerstoel VUB



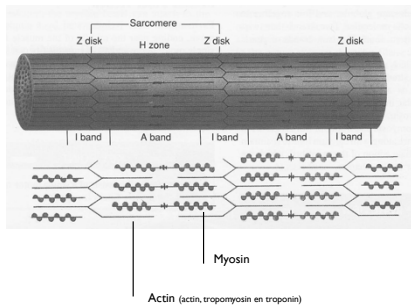
The human engine



Muscle anatomy



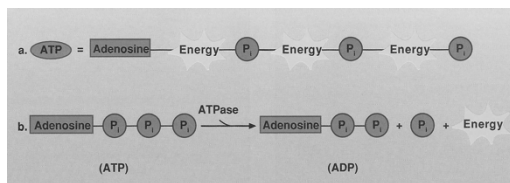
Muscle contraction



Adenosine tri-phosphate



ATP as a universal energy-donor



Muscle energetics

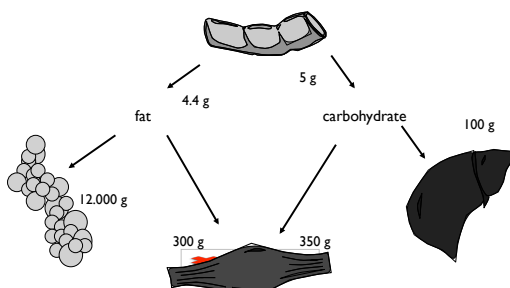


carbohydrate

fat

protein

Endogenous energy stores



Endogenous energy stores

▲ fat

- 38 kJ g⁻¹
- large storage capacity (500 MJ)
- 7 days running
- energy turnover low

▲ carbohydrate

- 17 kJ g⁻¹
- limited storage (8 MJ)
- 60-90 min running
- energy turnover high

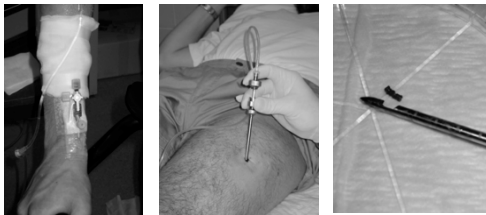
The human engine



Exercise metabolism



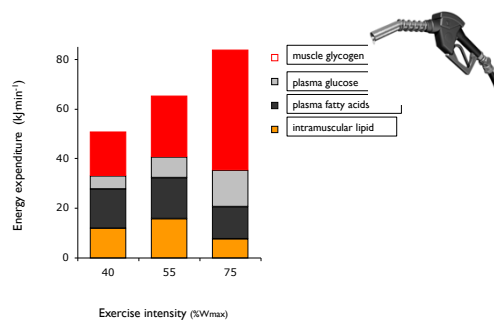
Muscle metabolism



The human engine



Endogenous fuel selection



Dietary intervention targets

- *Before competition:* optimize muscle glycogen stores
- *During competition:* exogenous carbohydrate administration
- *After competition:* replenish muscle glycogen stores



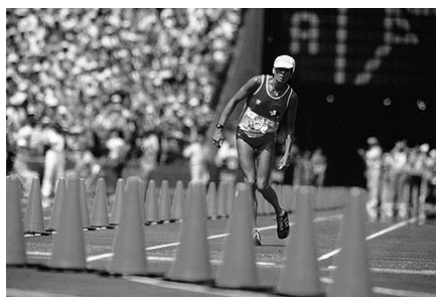
Nutritional needs of the athlete



Sportsdrinks



Reasons to use sportsdrinks



Exercise and gastro-intestinal function



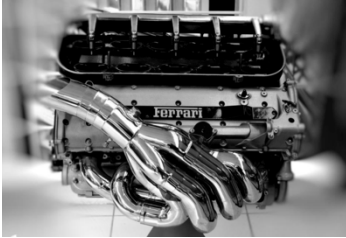
Optimizing performance



Improve recovery



The human engine

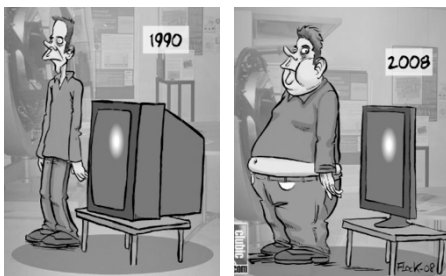


Lecture series:

Monday 2nd of March: Exercise Metabolism

- 9.30 am - 11.30 am: Sports Nutrition to modulate fuel selection | Room L2.10
- 1 pm - 3 pm: Sports Nutrition to improve recovery after exercise | Room L2.10

Lifestyle



The compromised human engine

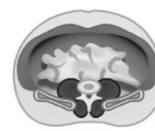


Overfeeding

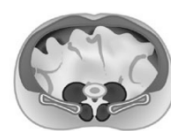
- High fat diet
- High energy intake
- Low physical activity level



Obesity



Little visceral fat



Lots of visceral fat

Flooding the human engine



Type 2 diabetes



- skeletal muscle insulin resistance

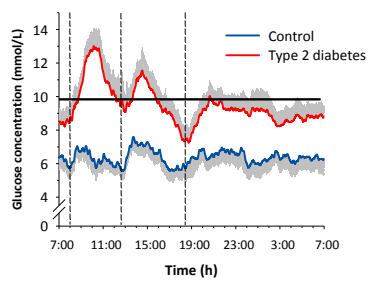


- impaired heart function



- liver dysfunction / impaired glucoregulation

Glycemic control



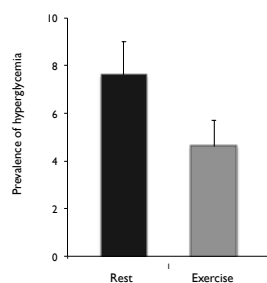
van Dijk et al., Diabetes Res Clin Pract, 2011

Type 2 diabetes

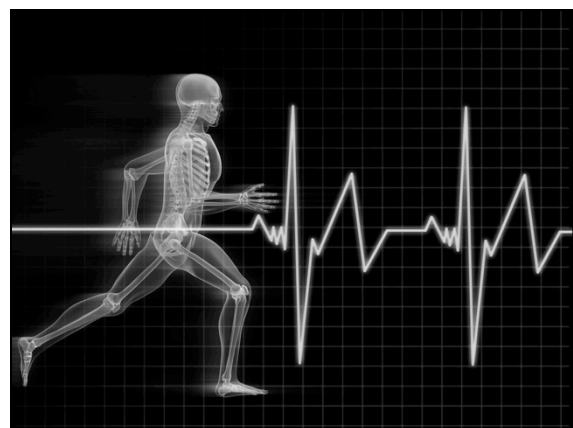
Skeletal muscle tissue is responsible for up to 80% of all the glucose taken up from the circulation.



Exercise and type 2 diabetes



Praet et al., Med Sci Sports Exerc, 2006



Lecture series:

Monday 4th of May: Exercise and chronic metabolic disease

- 1 pm - 3 pm: Exercise in the prevention and treatment of type 2 diabetes | Room L2.10

The human engine



Muscle reconditioning

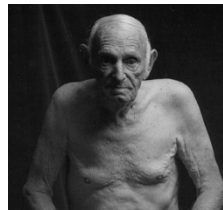


Lance Armstrong



Jay Cutler

Muscle deconditioning

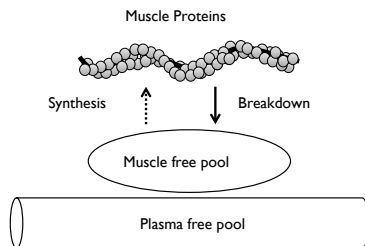


- immobilisation
- sarcopenia
- cancer cachexia
- COPD
- type 2 diabetes
- cardiovascular disease

What regulates muscle conditioning?



Muscle protein synthesis



Burd et al., Exerc Sport Sci Rev, 2013

Fractional muscle protein synthesis

1-2 % per day

(0.04 – 0.14 %h⁻¹)

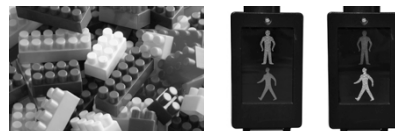


Main anabolic stimuli

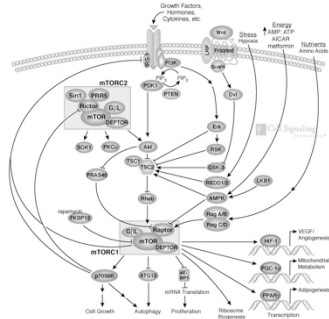
Nutrition is an anabolic stimulus



Amino acids



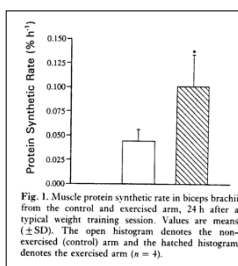
Amino acids stimulate protein synthesis



Muscle contraction is an anabolic stimulus



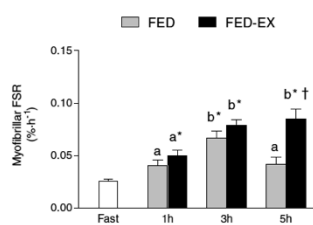
Muscle contraction



Chesley et al., 1992

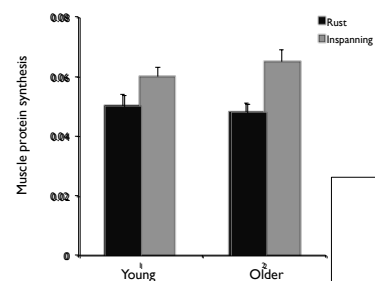
Interaction between physical activity and food intake

Exercise and nutrition



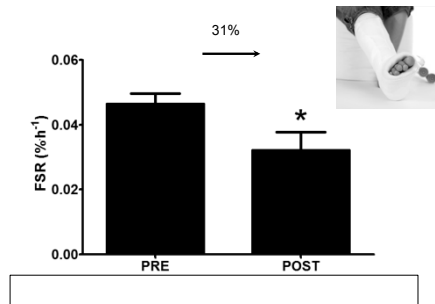
Moore et al., J. Physiol., 2009.

Post-prandial muscle protein synthesis



Reijnen et al., Am J Clin Nutr, 2010

Anabolic resistance to protein intake



Wall et al. J Clin Endocrinol Metab, 2013

Lecture series:

Monday 20th of April: Protein Metabolism

- 9.30 am - 11.30 am: Regulation of muscle mass maintenance | Room L2.10

Sarcopenia

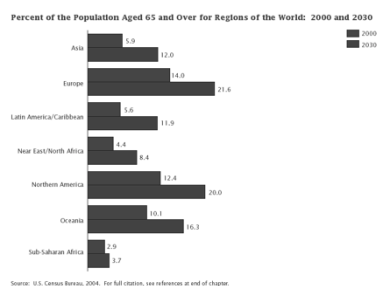


Population demographics

In Europe, the number of people aged 65 years and over are projected to rise by almost 80% over the next 50 years, from 85 million in 2008 to up to 152 million by 2060.

By the year 2060, people with an age of 65 and over will comprise more than 30% of the total EU population.

Global aging

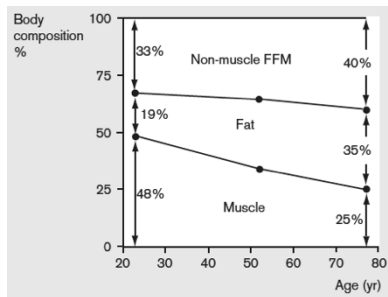


Functional capacity in the elderly



Leenders et al. Med Sci Sports Exerc., 2013.

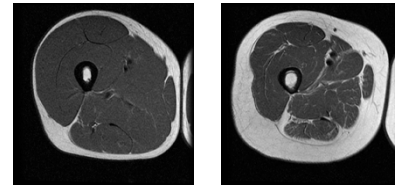
Muscle mass maintenance



Short and Nair, 2000

Loss of muscle mass with aging

Height and weight matched



Young Male, age 25

Older Male, age 63

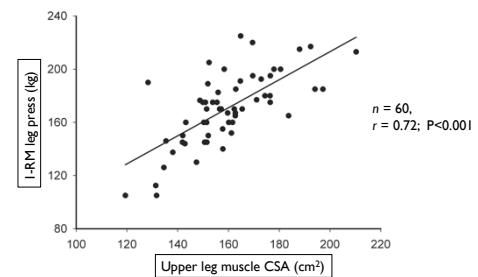
Sarcopenia

- type II muscle fiber atrophy
- muscle fiber type grouping
- muscle fiber loss



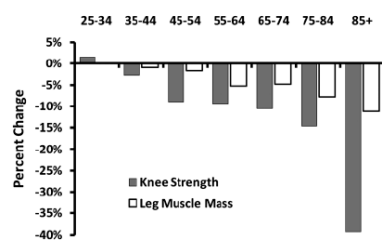
Nilwik et al., 2013

Muscle mass versus muscle strength



Verdijk et al., unpublished

Muscle loss versus strength loss



Ferrucci et al., J Gerontology, 2012

Age related decline in muscle strength



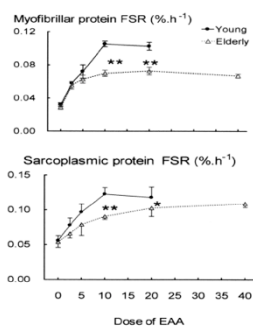
- functional capacity
- metabolic disease
- quality of life

Prevention and treatment of sarcopenia

Nutrition is an anabolic stimulus



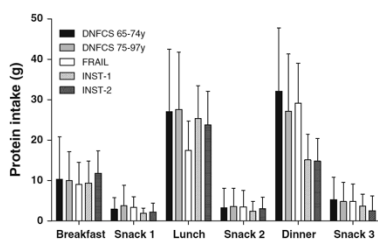
Anabolic resistance



Cuthbertson et al, FASEB J, 2005

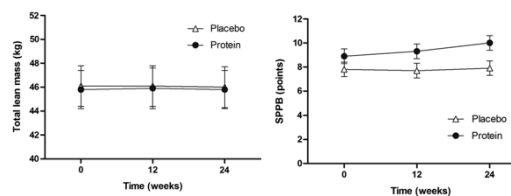


Protein intake in the elderly populations



Tieland et al, Eur J Nutr, 2011

Protein supplementation in frail elderly



Tieland et al, JAMDA, 2012A



Functional capacity



Exercise training and protein supplementation

Young

Antonio, 2000 (62)
 Ballard, 2008 (63)
 Bird, 2006a (4)
 Bird, 2006b (4)
 Coles, 2007 (64)
 Hartman, 2007 (5)
 Hoffman, 2007 (65)
 Hoffman, 2009 (51)
 Knapik, 2006 (17)
 Knapik, 2009 (17)
 Knapik, 2010 (18)
 Rozek, 2002 (19)
 Walker, 2004 (18)
 White, 2009 (20)
 Wiloughby, 2007 (9)
 Sub-total

Older

Bemben, 2010 (26)
 Campbell, 1995 (56)
 Holm, 2006 (57)
 Ilay, 2009 (58)
 Kukuljan, 2009 (59)
 Verdij, 2009 (41)
 Sub-total

Total

Favors placebo (kg) Favors protein (kg)

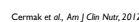
Cermak et al., *Am J Clin Nutr*, 2012.



Exercise training and protein supplementation

Group	Study	n	Effect Size (kg)	95% CI (kg)
Young	Bird, 2006a	(4)	~65	~35 - 95
	Bird, 2006b	(4)	~60	~30 - 90
	Hartman, 2007	(5)	~10	~-10 - 30
	Hulmi, 2009	(16)	~15	~-5 - 35
	Jossie, 2010	(6)	~10	~-10 - 30
	Kerksick, 2006	(7)	~25	~5 - 45
	Rozemek, 2002	(19)	~35	~15 - 55
	Walberg, 2004	(18)	~45	~25 - 65
	White, 2009	(20)	~85	~65 - 105
	Willoughby, 2007	(9)	~10	~-10 - 30
Young Sub-total			~25	~5 - 45
Older	Bemben, 2010	(35)	~35	~15 - 55
	Iglay, 2009	(38)	~25	~5 - 45
	Verdijk, 2009	(41)	~15	~-5 - 35
	Older Sub-total			~15
Total			~10	~-10 - 30

Cermak et al., *Am J Clin Nutr*, 2012.



Protein supplementation in frail elderly

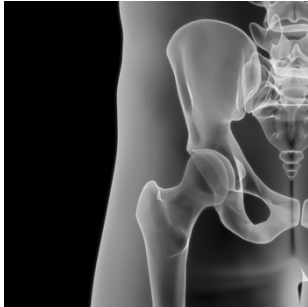
A bar chart titled 'Protein supplementation in frail elderly' showing 'Total lean mass (kg)' on the y-axis (ranging from -1.0 to 1.5) against 'Time (wk)' on the x-axis (0, 12, and 24 weeks). The chart compares two groups: Placebo (grey bars) and Protein (black bars). Error bars represent standard deviation. The Protein group shows a significant increase in lean mass over time, while the Placebo group shows a slight decrease.

Time (wk)	Placebo (kg)	Protein (kg)
0	0.0	0.0
12	0.05	1.2
24	-0.2	1.05

Tieland et al., JAMDA, 2012/3-8



Falls and fractures



Wall et al. *Acta Physiol. Scand.*, 2013

Muscle disuse atrophy



Wall et al. *Acta Physiol. Scand.*, 2013

Muscle disuse atrophy



Wall et al. *Acta Physiol. Scand.*, 2013



Prevention of disuse atrophy

Dietary protein consumption

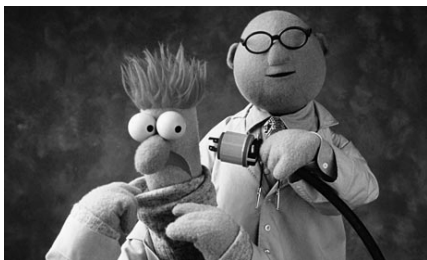


Bed rest and physical activity



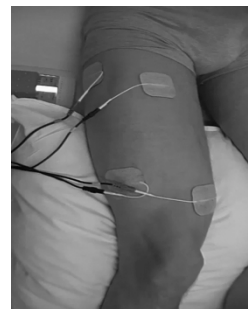
Alkima, *Acta Physiol Scand*, 2001
Oates et al. *Muscle Nerve*, 2010

Neuromuscular electrical stimulation



Wali et al. *Am J Physiol*, 2012

Neuromuscular electrical stimulation



Wali et al. *Nutr Rev*, 2013

NMES to prevent disuse atrophy



Dinks et al. *Acta Physiol*, 2013

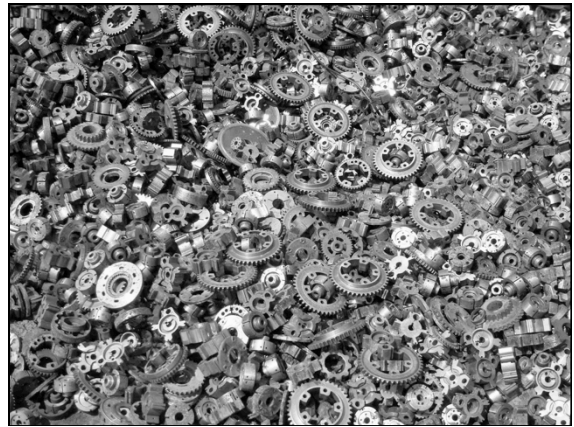
Comatose patients



Lecture series:

Monday 20th of April: Protein Metabolism

- 1 pm - 3 pm: Muscle loss with ageing | Room L2.10



Collaborators and sponsors



http://www.kenniscentrumsuiker.nl/images/pdf/brochures/De_menselijke_motor_2012_online_03.pdf

