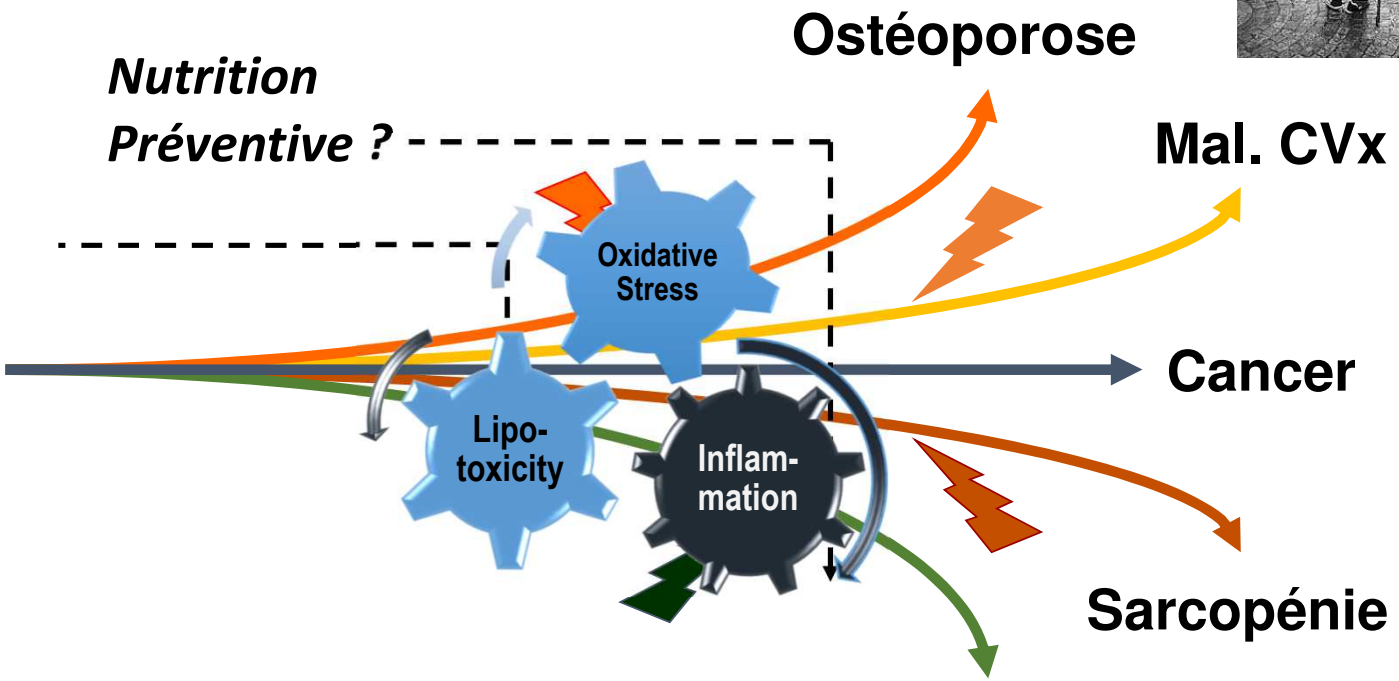
12ème journée inter-CLAN du Limousin
Limoges
24 novembre 2017

Répartition et choix des protéines sur les repas de la journée

Pr. Yves Boirie
Service de Nutrition Clinique, CHU de Clermont-Ferrand
Centre de Recherche en Nutrition Humaine

Nutrition préventive pour un vieillissement réussi



Désordres métaboliques liés à l'âge

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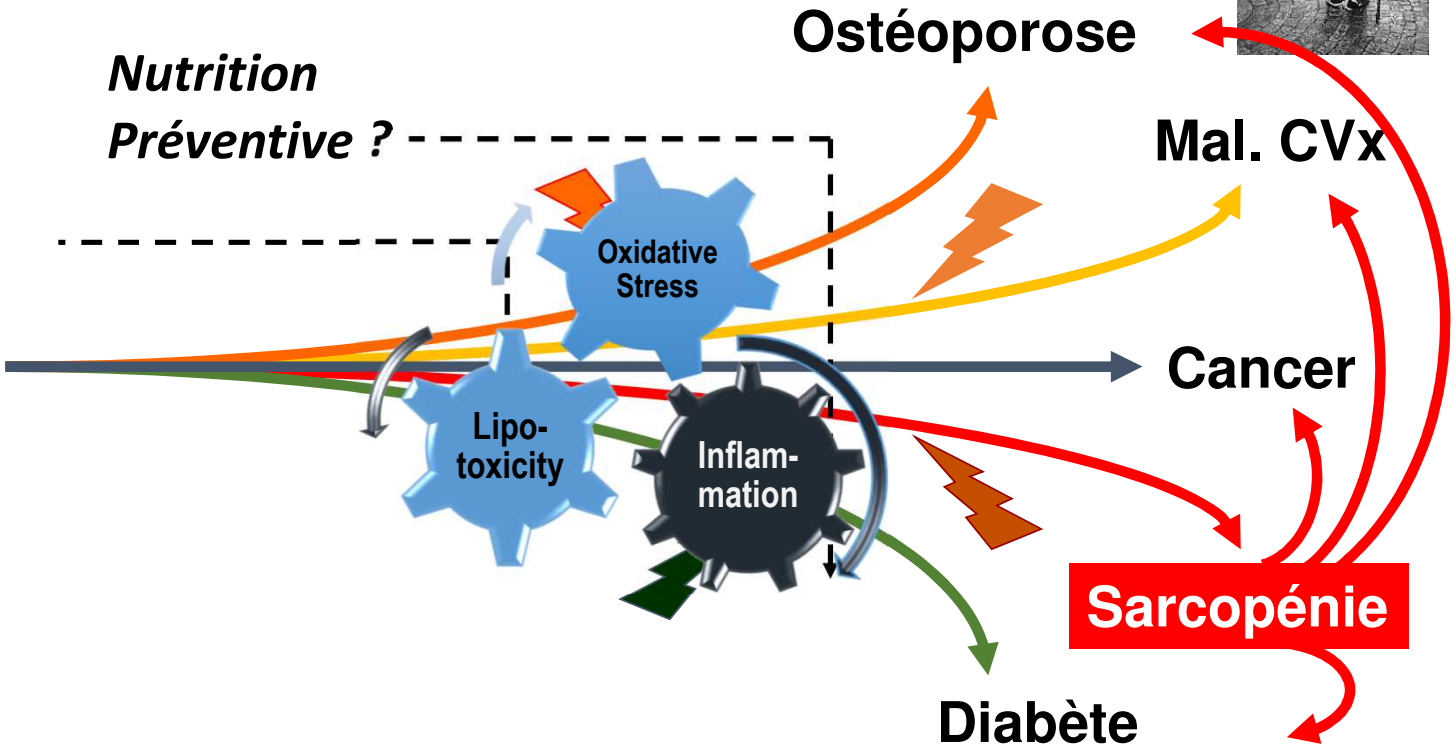
Nutrition préventive pour un vieillissement réussi



Désordres métaboliques liés à l'âge

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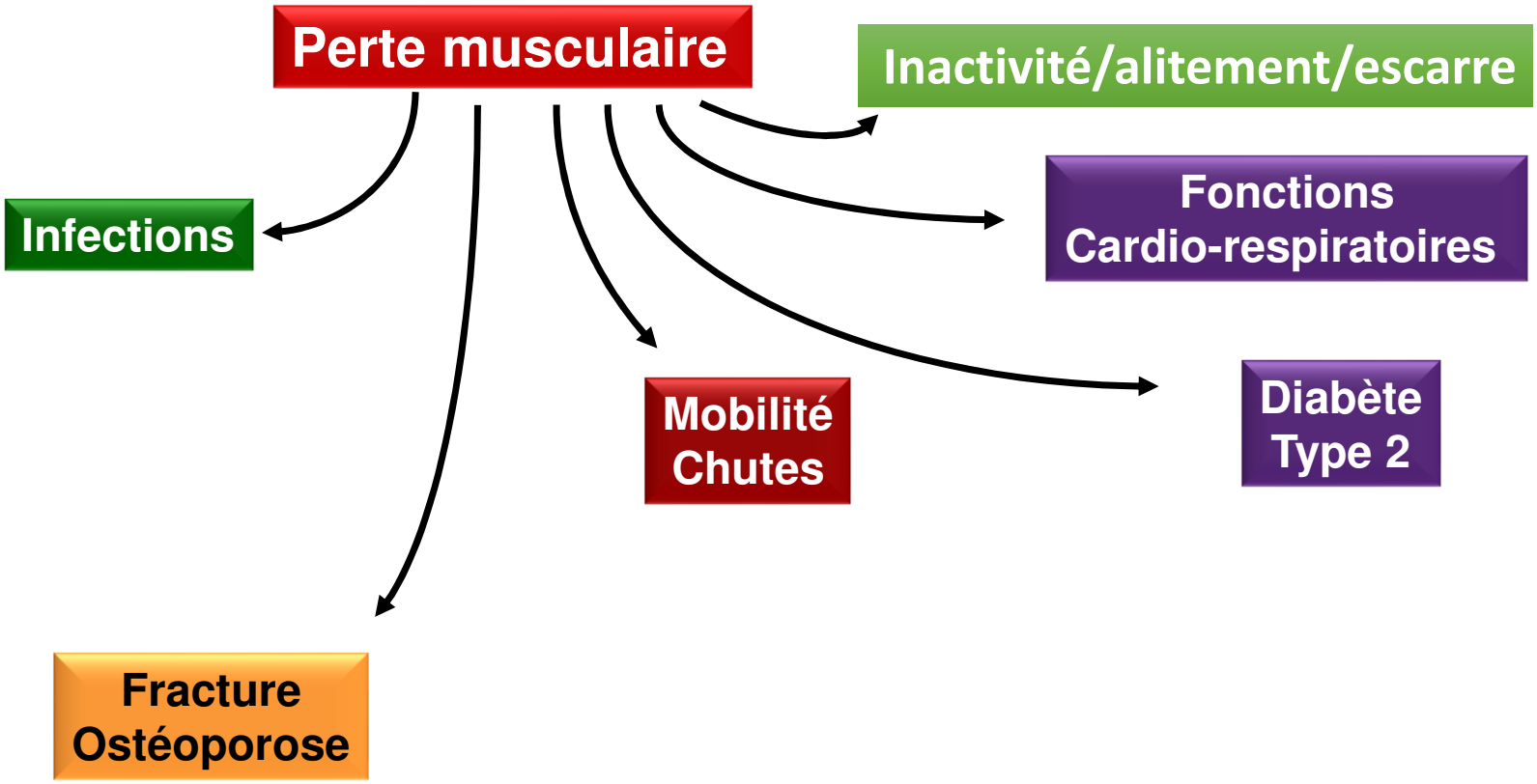
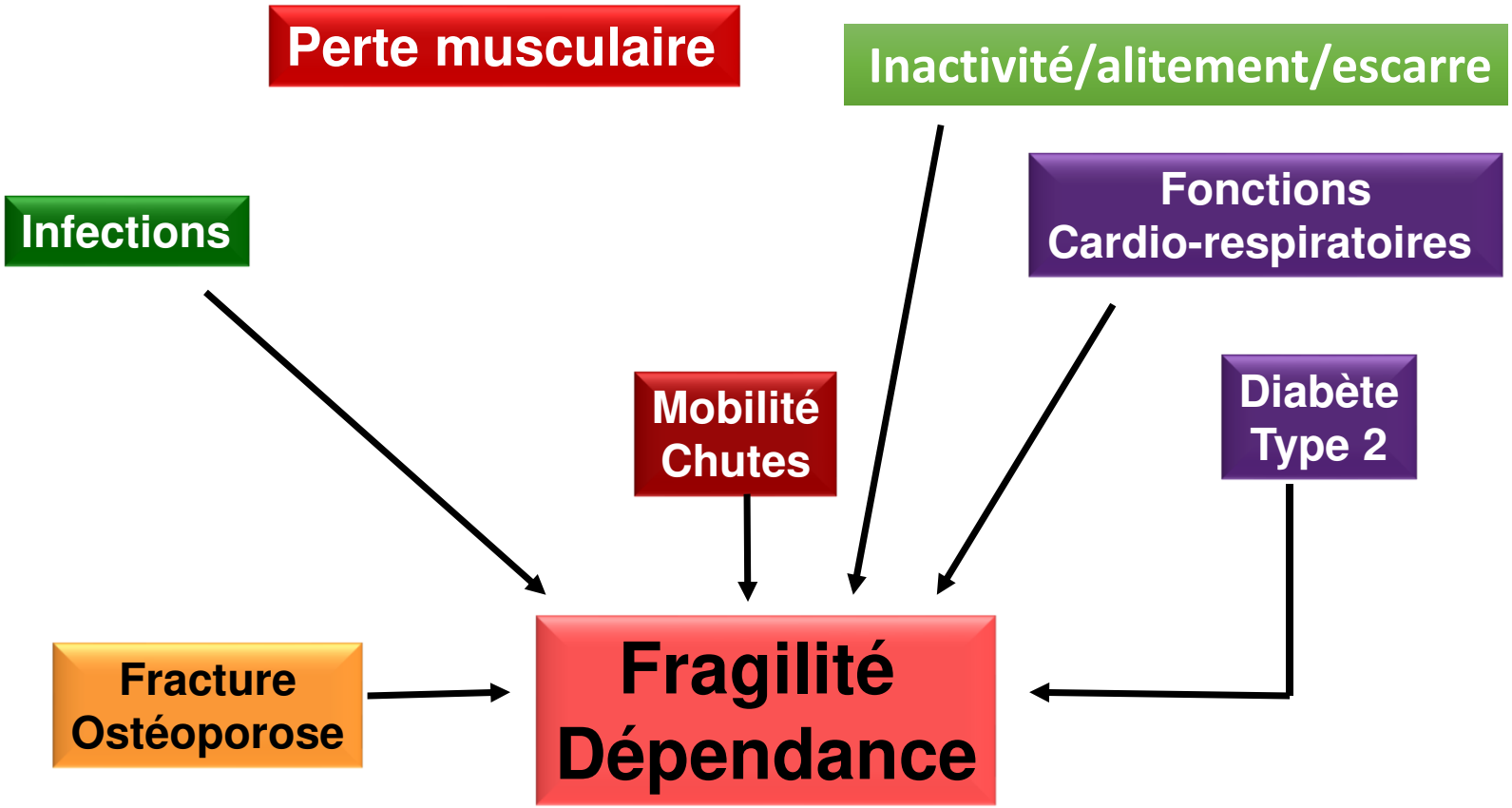
Impact de la perte musculaire sur la santé



Impact de la perte musculaire sur la santé



Nutrition protéique et santé

- **Une cible thérapeutique nutritionnelle : le muscle**
- **Résistance anabolique aux nutriments**
- **De nouvelles stratégies nutritionnelles**

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Consensus workshops on the definitions of sarcopenia

Sarcopenia: European consensus on definition and diagnosis

Cruz-Jentoft AJ, Age & Ageing 2010

Report of the European Working Group on Sarcopenia in Older People

ALFONSO J. CRUZ-JENTOFT[1], JEAN PIERRE BAEYENS[2], JÜRGEN M. BAUER[3], YVES BOIRIE[4], TOMMY CEDERHOLM[5], FRANCESCO LANDI[6], FINBARR C. MARTIN[7], JEAN-PIERRE MICHEL[8], YVES ROLLAND[9], STÉPHANE M. SCHNEIDER[10], EVA TOPINKOVÁ[11], MAURITS VANDEWOUDE[12], MAURO ZAMBONI[13]

EUGMS European Union Geriatric Medicine Society
Fostering geriatric medicine across Europe

ESPEN *The European Society for Clinical Nutrition and Metabolism*

Consensus definition of sarcopenia, cachexia and pre-cachexia: Joint document elaborated by Special Interest Groups (SIG) "cachexia-anorexia in chronic wasting diseases" and "nutrition in geriatrics"

Muscaritoli M, Clin Nutr 2010

M. Muscaritoli[a,*,n], S.D. Anker[b,n], J. Argilés[c,n], Z. Aversa[a,n], J.M. Bauer[d,o], G. Biolo[e,n], Y. Boirie[f,o], I. Bosaeus[g,o], T. Cederholm[h,o], P. Costelli[i,n], K.C. Fearon[j,n], A. Laviano[a,n], M. Maggio[k,o], F. Rossi Fanelli[a,n], S.M. Schneider[l,o], A. Schols[m,n], C.C. Sieber[d,o]

EUROPEAN REGION

Sarcopenia: An Undiagnosed Condition in Older Adults. Current Consensus Definition: Prevalence, Etiology, and Consequences

Fielding RA, JAMDA 2011

International Working Group on Sarcopenia
International Sarcopenia Consensus Conference Working Group Meeting*, Rome, Italy, November 18, 2009

The FNIH Sarcopenia Project: Rationale, Study Description, Conference Recommendations, and Final Estimates

FNIH Foundation for the National Institutes of Health

Studenski S, J Gerontol 2014

UCA Université Clermont Auvergne

Sarcopenia: European consensus on definition and diagnosis

Report of the European Working Group on Sarcopenia in Older People

- **Low muscle mass**
  - *DEXA, bio-impedance, CT-scan, IRM*

  ASM/h² = 7.23 kg/m² (H), 5.67 kg/m² (F)

+

- **Low muscle strength**
  - *Handgrip strength*

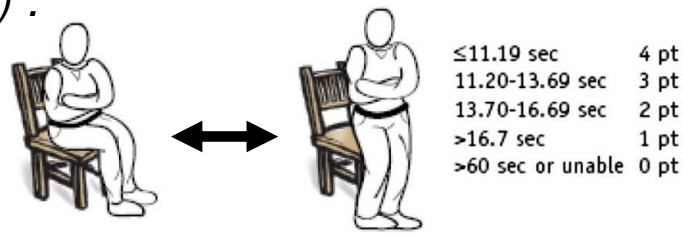
  < 30 kg (H), < 20 kg (F)

- **Low physical performance**
  - *Short physical performance battery (**SPPB**) :*

    Timed get-up-and-go test

    One-, two feet balance

    Gait speed < 0.8m/s



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Cruz-Jentoft AJ, Age & Ageing 2010

An Evidence-Based Comparison of Operational Criteria for the Presence of Sarcopenia

Table 1. Summary of Operational Definitions for Sarcopenia and Prevalence by Gend

Criteria	Operational Definition: Physical Performance	Muscle Strength	ALM
Foundation of NIH Sarcopenia Project			
Weakness and low lean mass	—	Grip strength Men: <26 kg	ALM_{BMI} Men: <0.789
			Women: ≤5.67 kg/m²
European Working Group on Sarcopenia Older Persons			
Sarcopenia	Gait speed: <0.8 m/s or Grip strength Men: <30 kg Women: <20 kg		ALM/ht² Men: ≤7.23 kg/m² Women: ≤5.67 kg/m²
Severe sarcopenia	Gait speed: <0.8 m/s	Grip strength Men: <30 kg Women: <20 kg	ALM/ht² Men: ≤7.23 kg/m² Women: ≤5.67 kg/m²

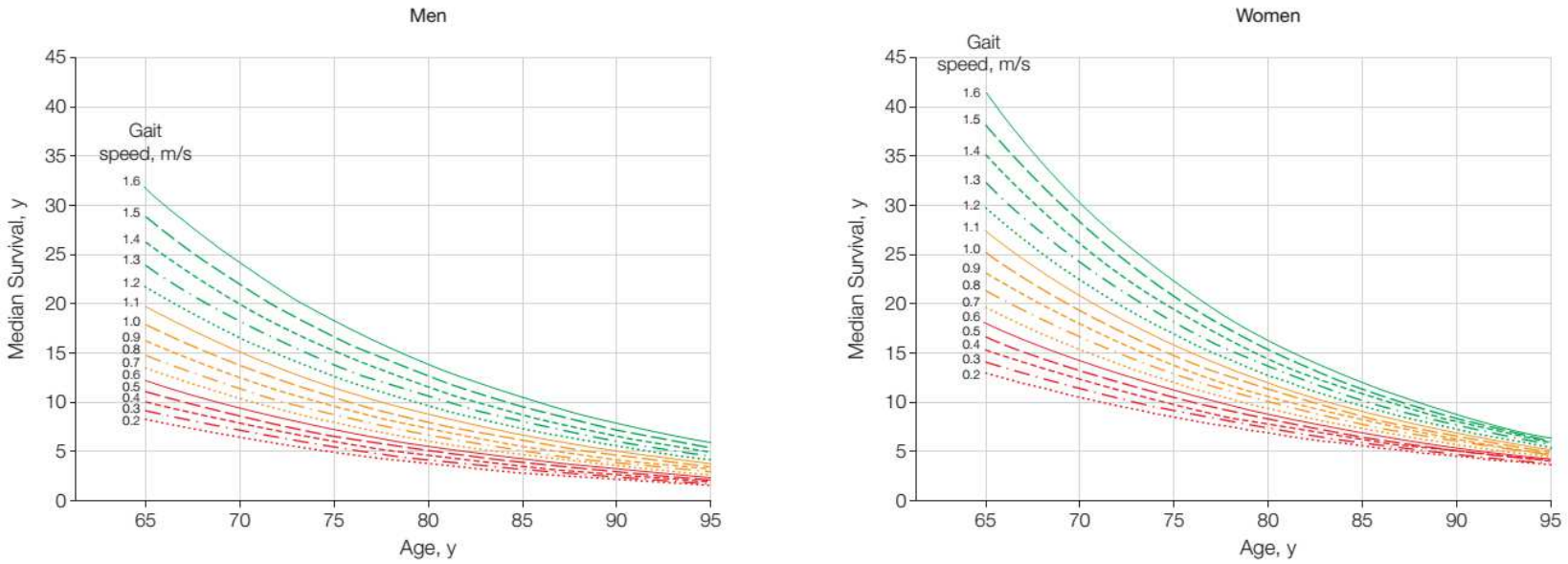
Note: ALM_{BMI} = ratio of appendicular lean mass over body mass index; ALM/ht² = ratio of appendicular lean mass over height

Prevalence is 5-13% in the 60-70y and 11-50% in the > 80y

Dam TT, J Gerontol 2014

Gait Speed and Survival in Older Adults

Figure 2. Predicted Median Life Expectancy by Age and Gait Speed



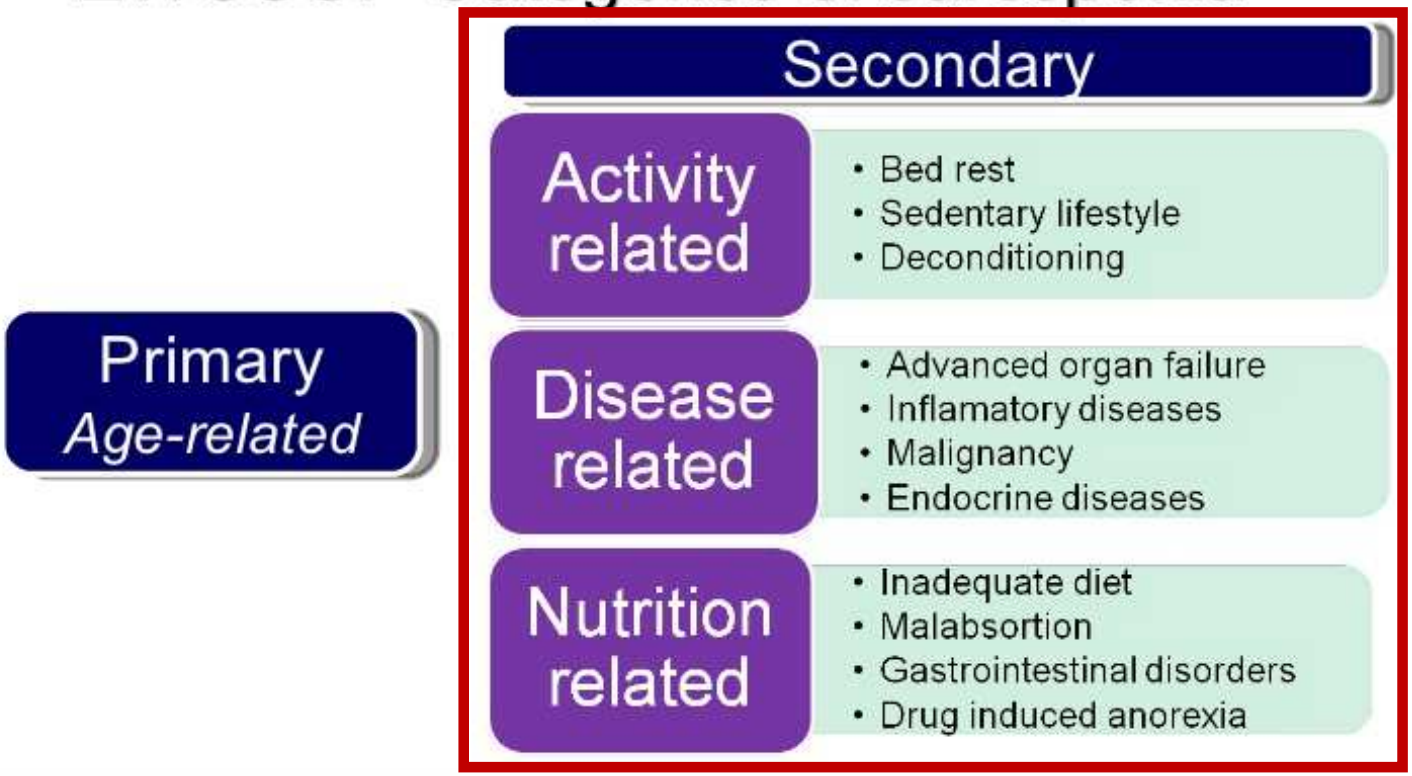
Walking speed is a strong valid marker of survival in older subjects

(as glycemia for diabetes or blood pressure for cardiovascular disease)

Studenski S, JAMA 2011

EWGSOP Working Definition of Sarcopenia

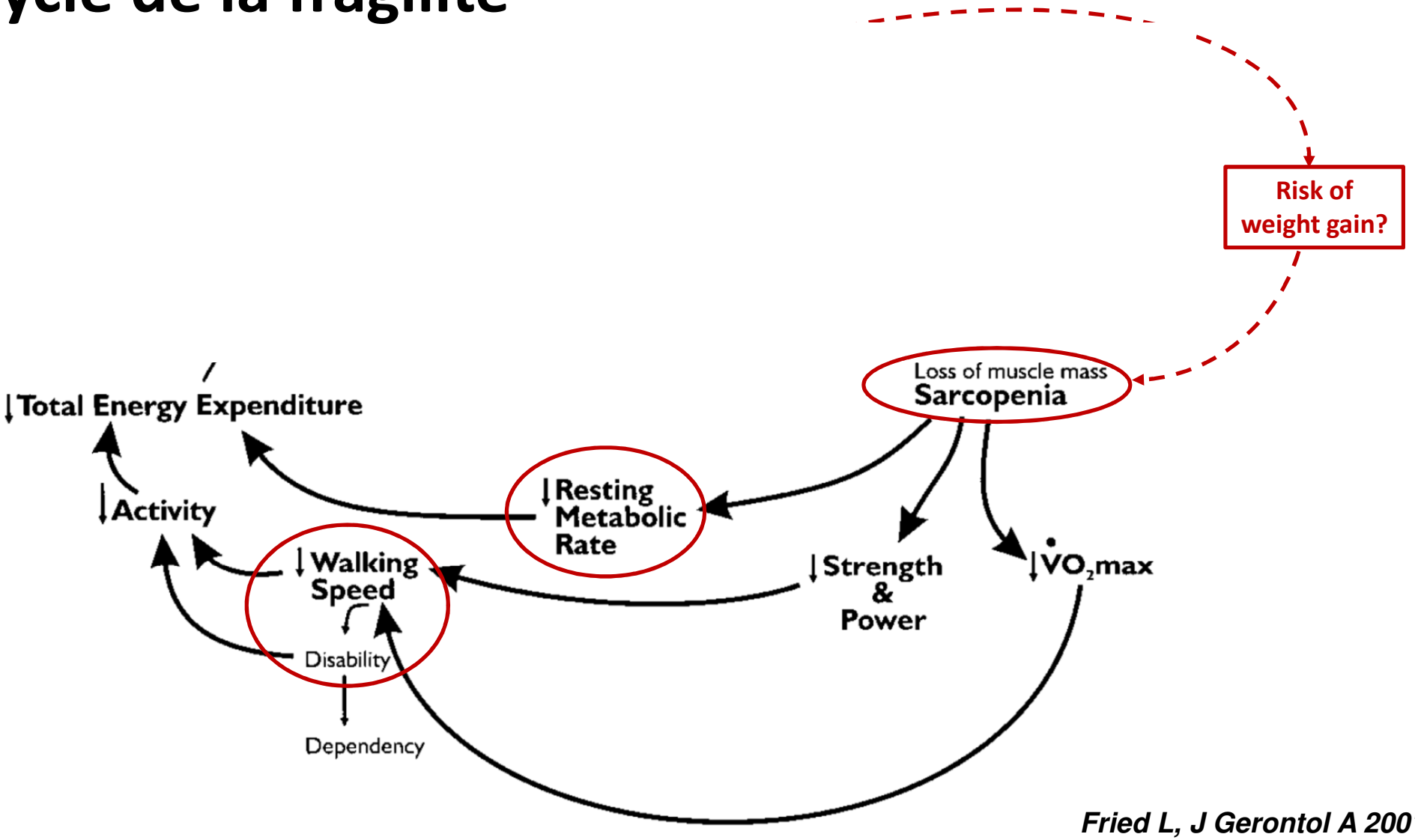
EWGSOP Categories of sarcopenia



?

Cruz-Jentoft AJ et al. Sarcopenia: European consensus on definition and diagnosis. Report of the European Working Group on Sarcopenia in Older People. Age Ageing 2010

Le cycle de la fragilité



Fried L, J Gerontol A 2001

1er message

- **Le muscle est une cible majeure pour maintenir les fonctions globales de l'organisme grâce à la préservation de la mobilité lors du vieillissement et des maladies chroniques**
- **La sarcopénie (nouveau code de classification internationale - ICD code M62.84) doit être dépistée précocément par des tests cliniques simples**
- **La nutrition est un acteur majeur de la mobilité**

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Les sujets âgés ont-ils les mêmes besoins nutritionnels que les adultes jeunes, notamment pour les protéines ?

Comment les changements liés à l'âge sur le plan de la physiologie, du métabolisme, de la composition corporelle, des capacités physiques affectent les besoins nutritionnels ?

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Nutrition protéique et santé

- **Une cible thérapeutique nutritionnelle : le muscle**
- **Résistance anabolique aux nutriments**
- **De nouvelles stratégies nutritionnelles**

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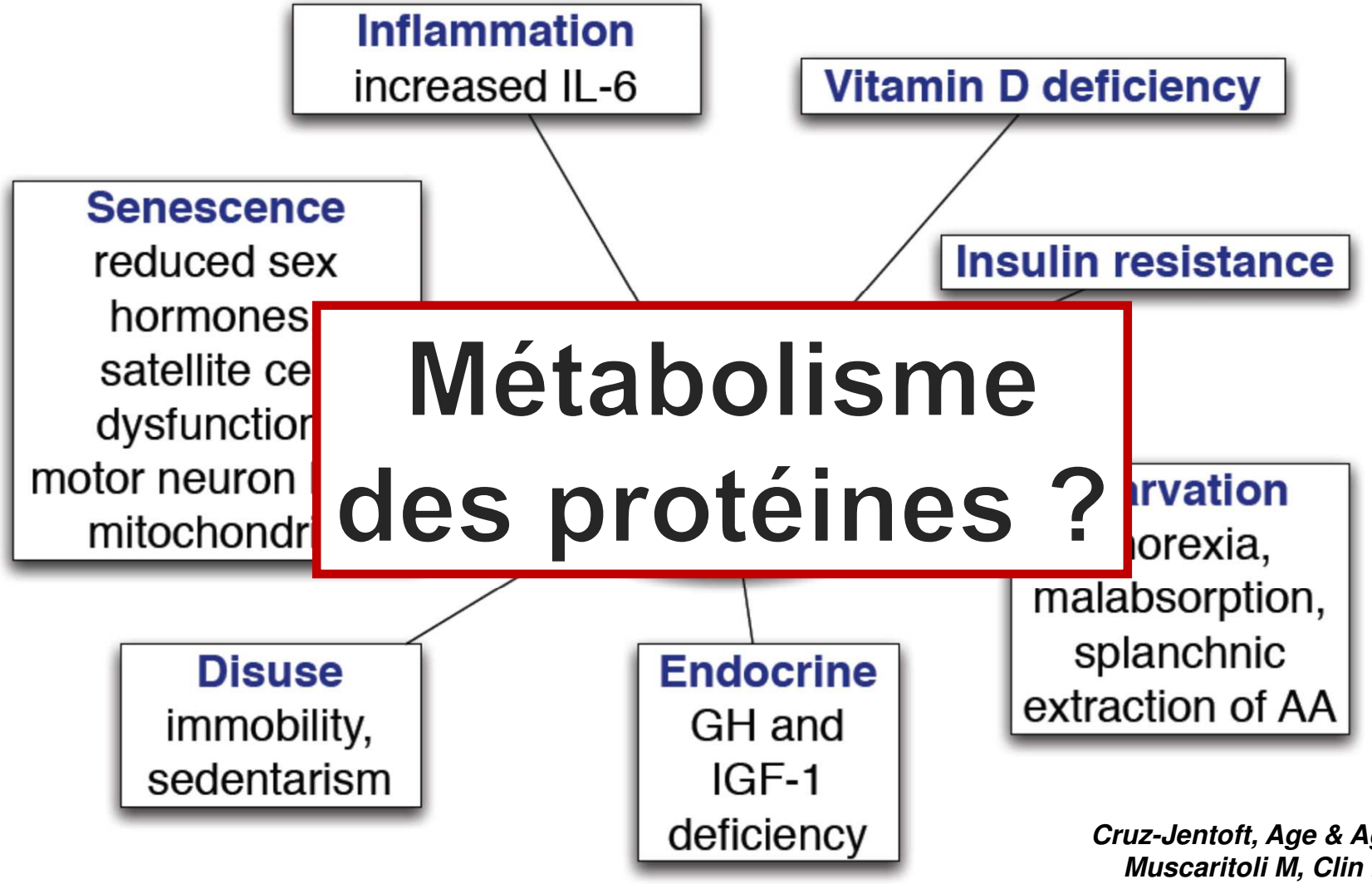
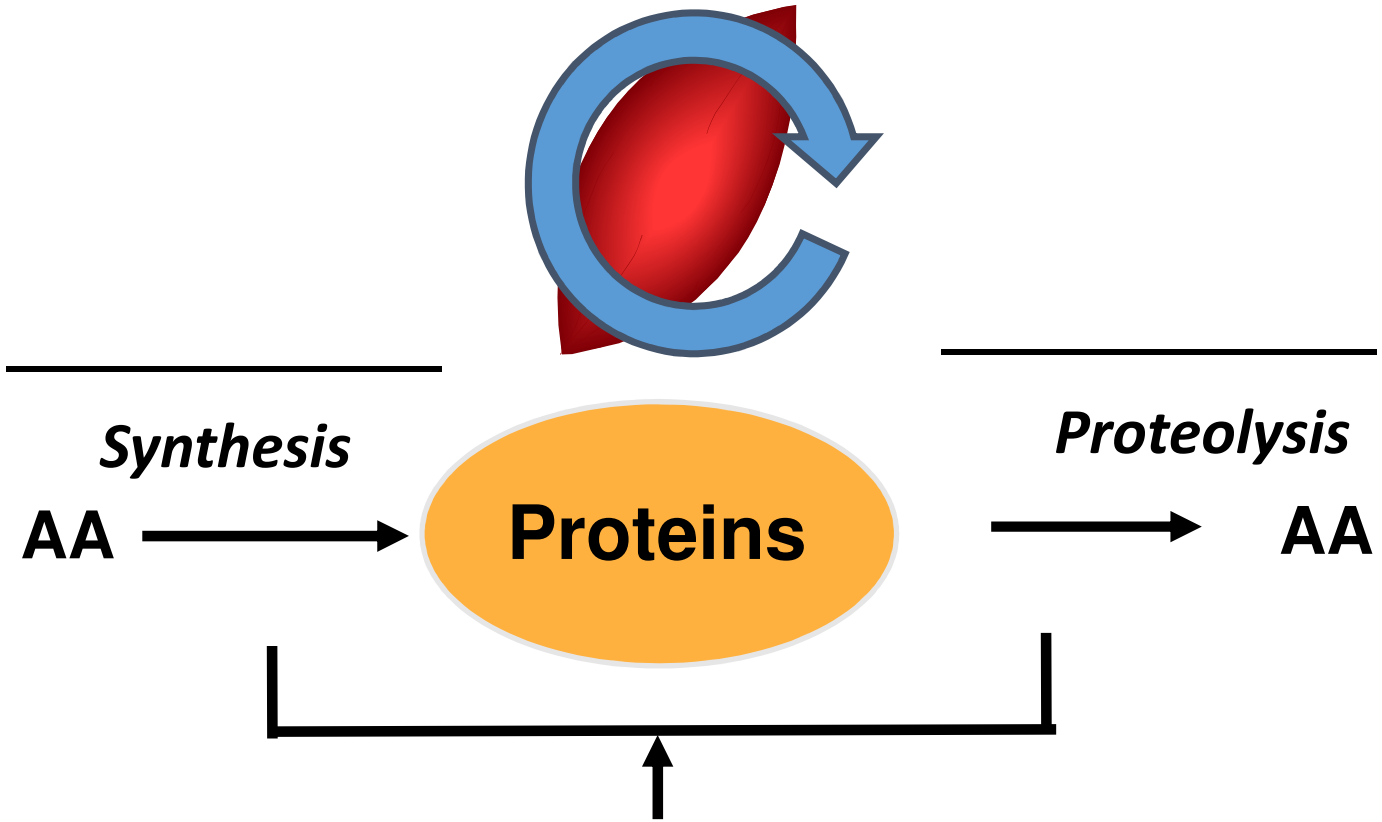
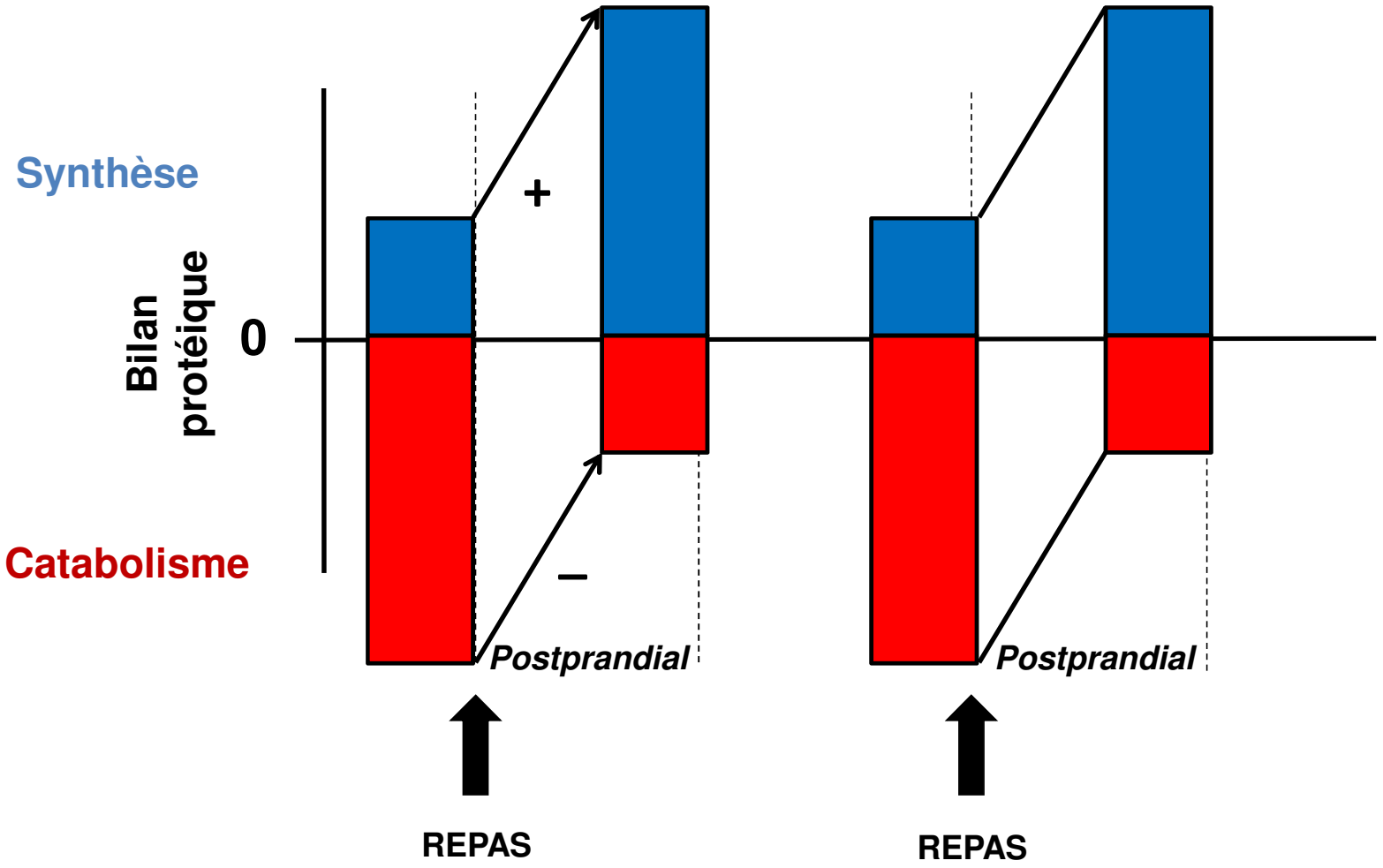


Cruz-Jentoft, Age & Aging 2010
Muscaritoli M, Clin Nutr 2010

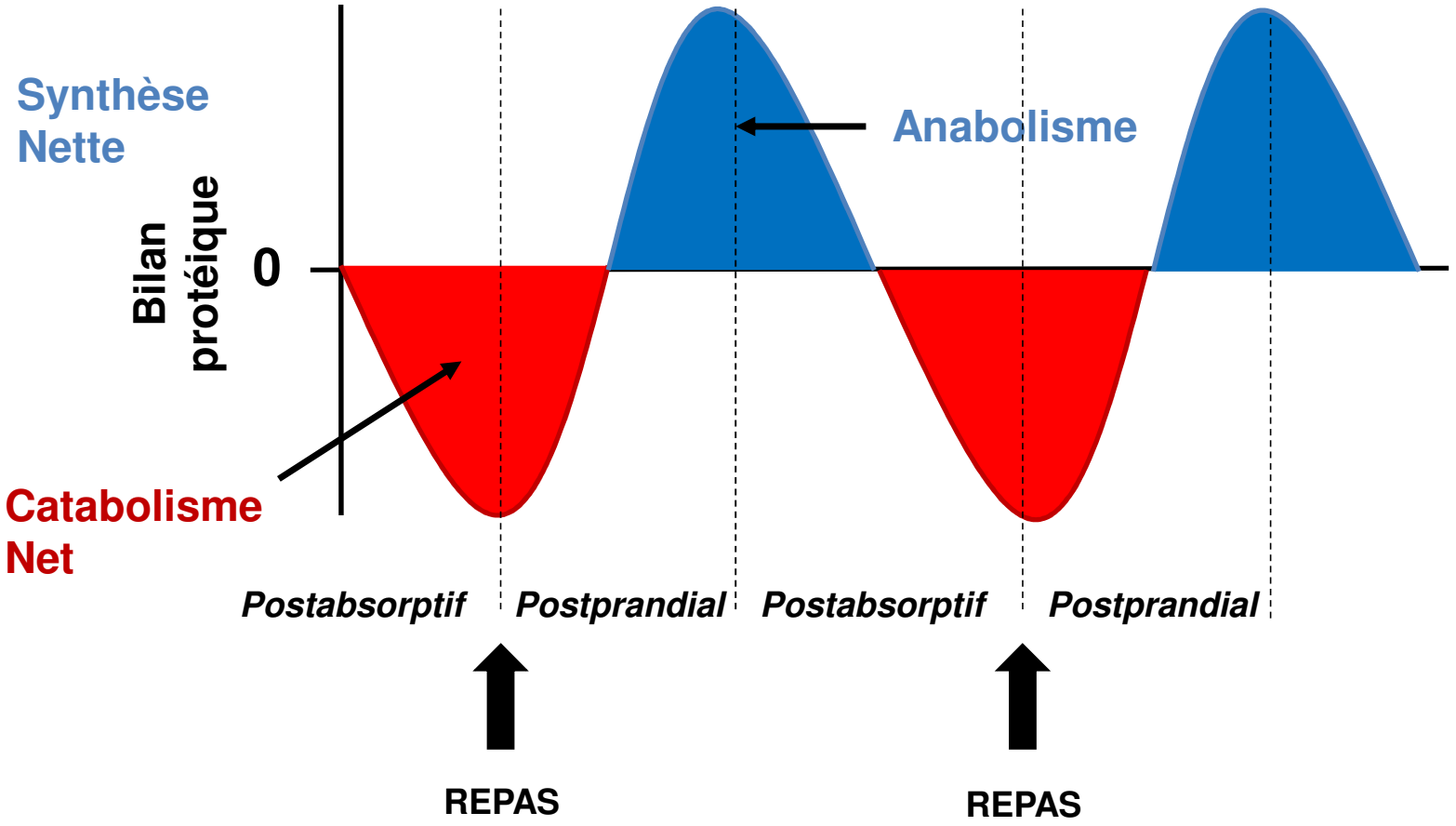
Postabsorptive muscle protein balance



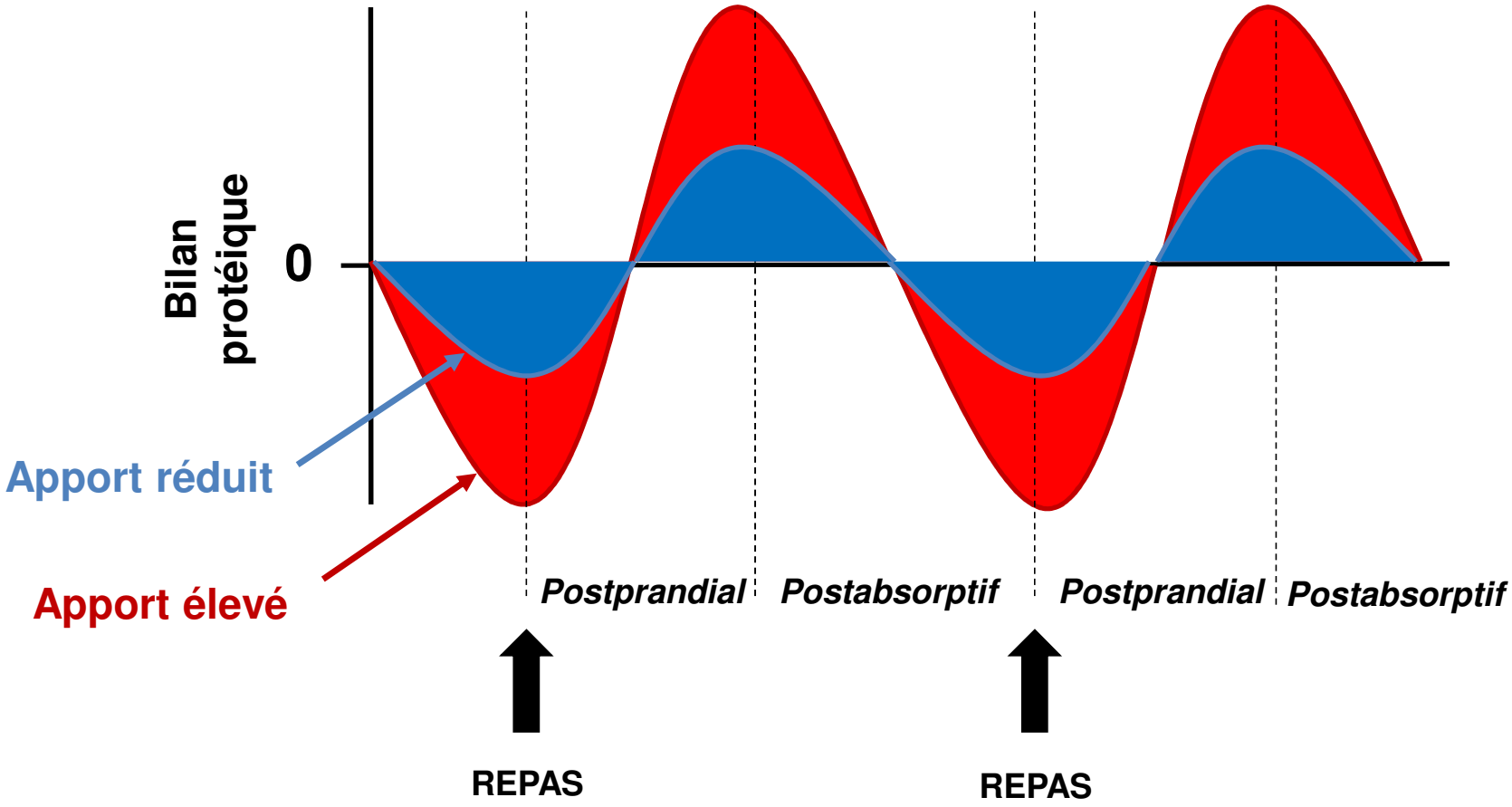
Impact du repas sur le métabolisme protéique



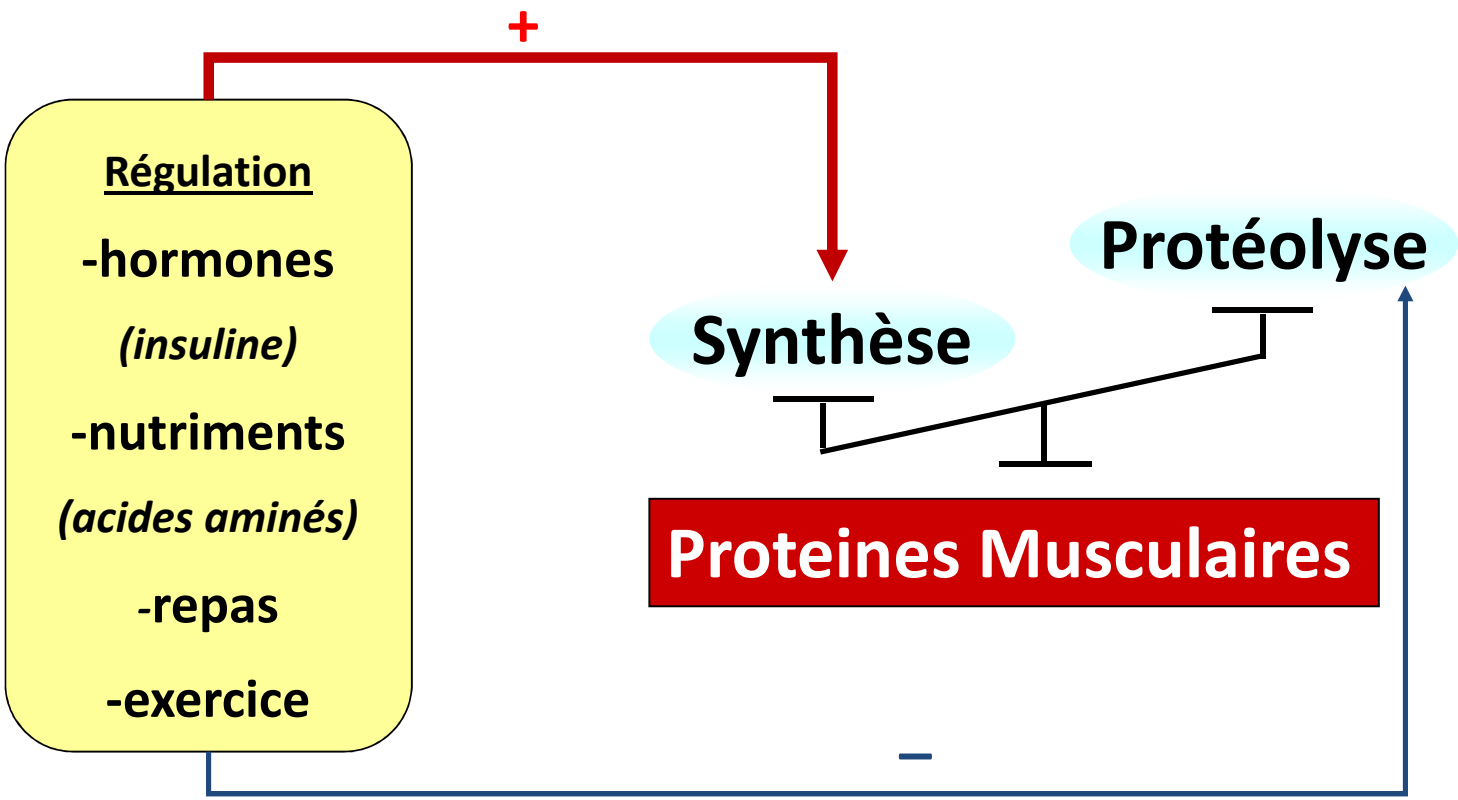
Impact du repas sur le métabolisme protéique



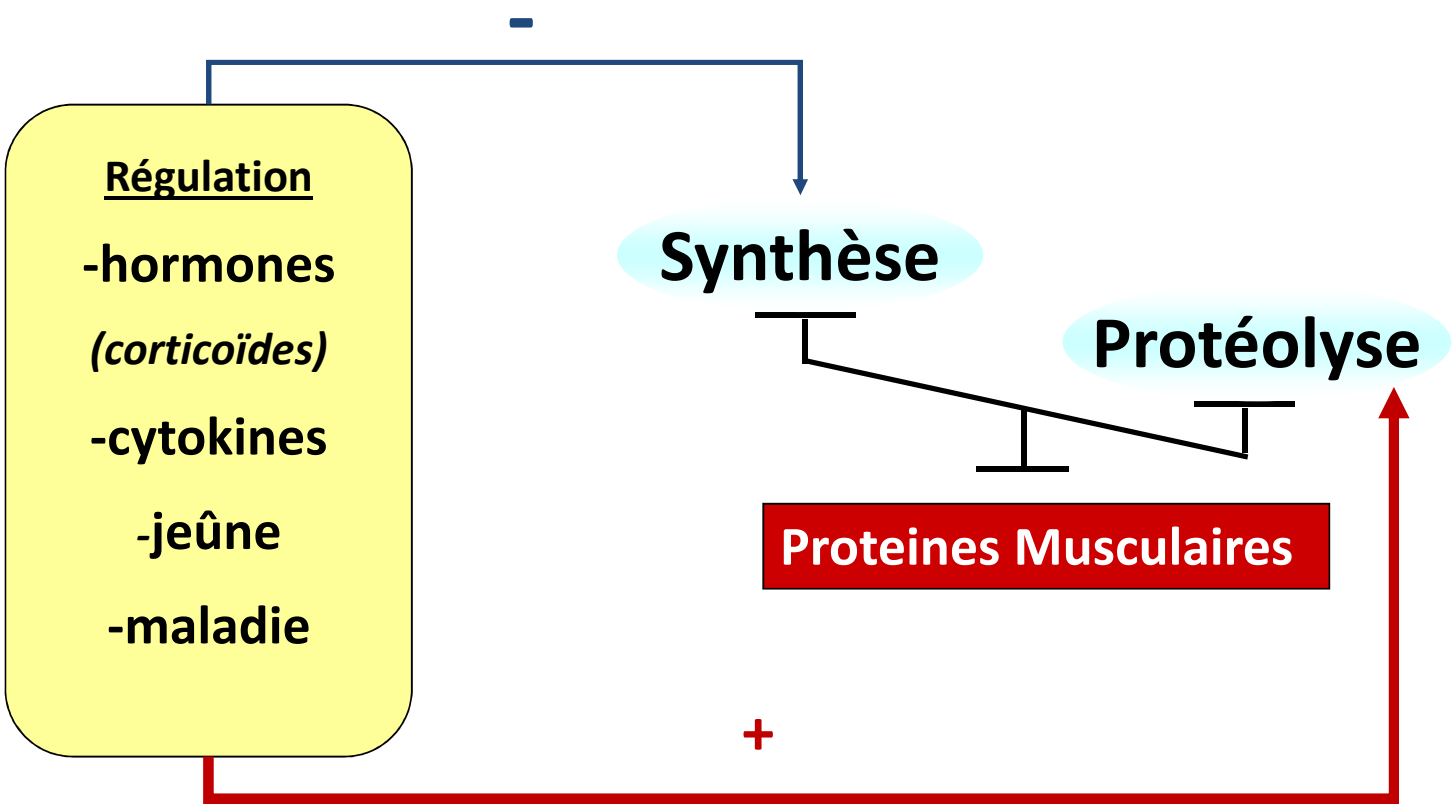
Impact de l'apport en protéines alimentaires



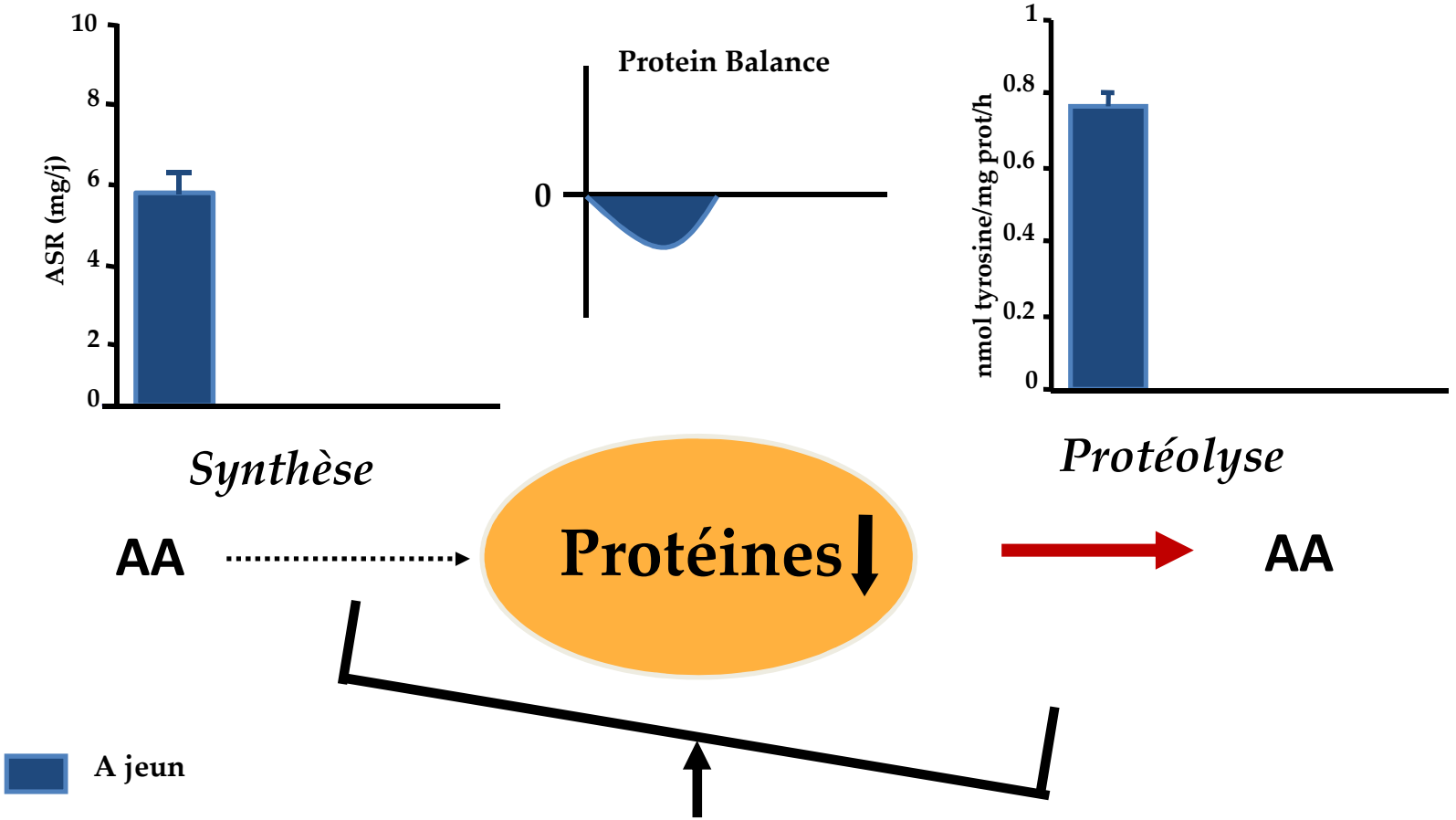
Renouvellement protéique permanent : contrôle par des facteurs anaboliques



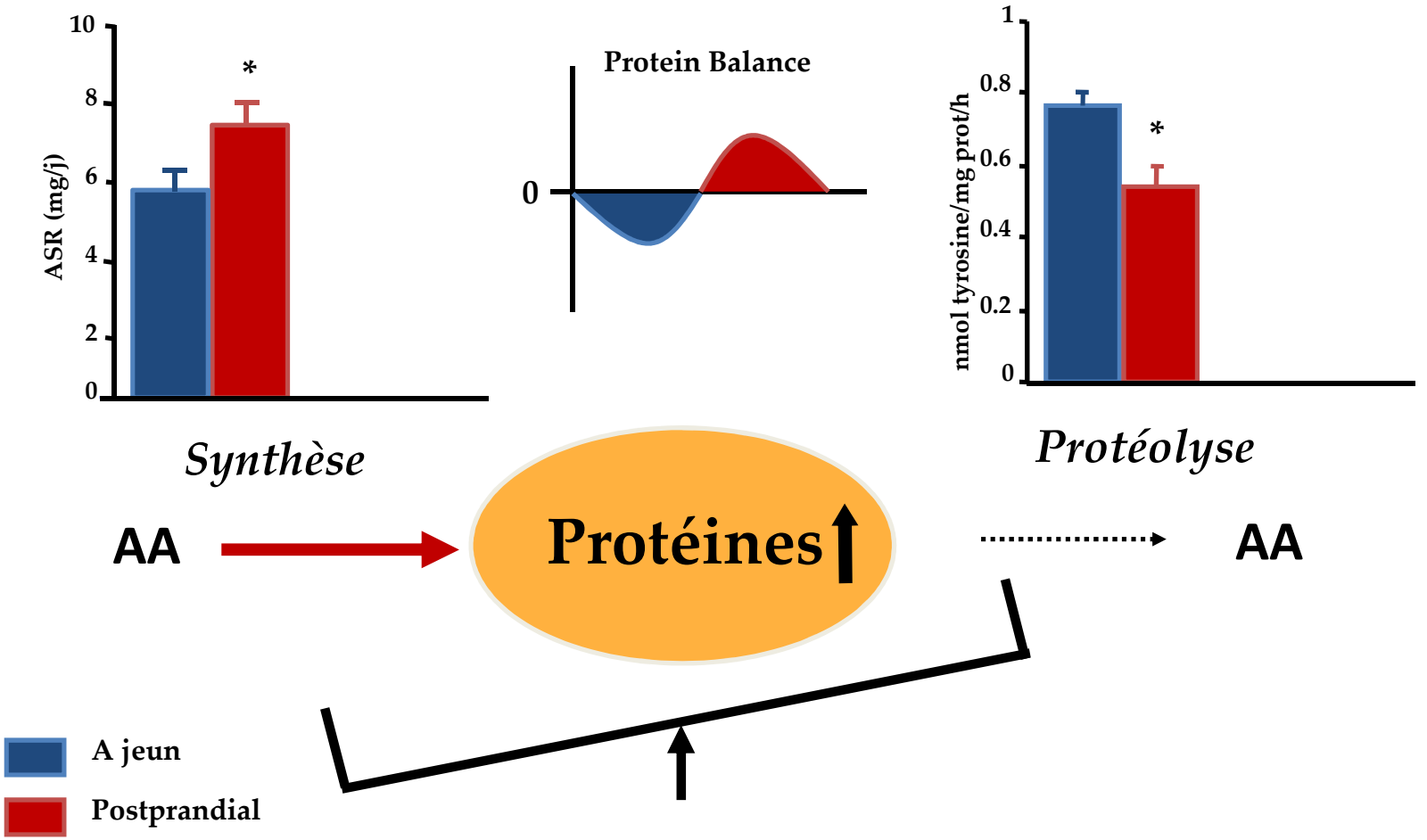
Renouvellement protéique permanent : Impact des facteurs cataboliques



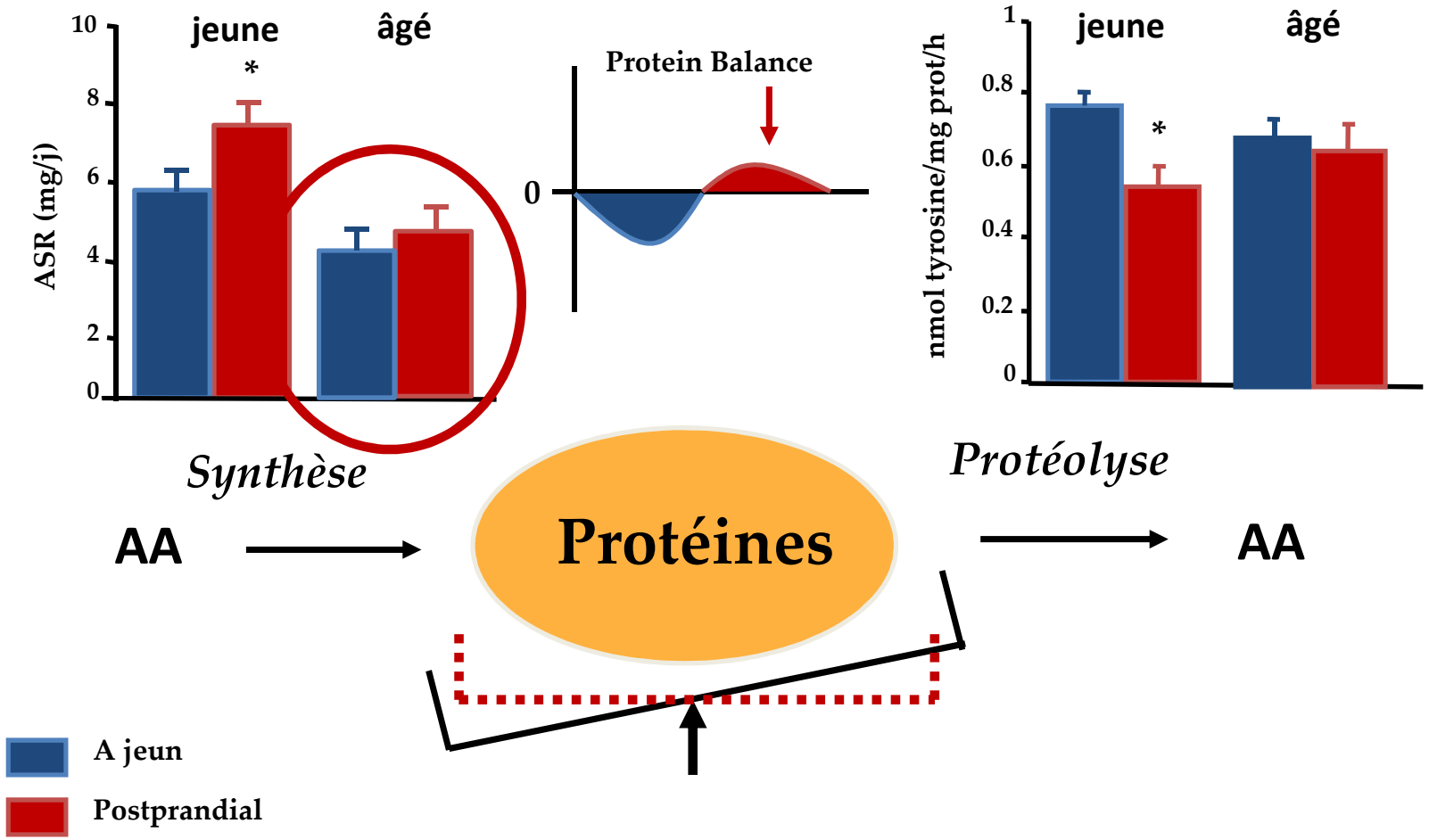
Bilan protéique dans le muscle à jeun



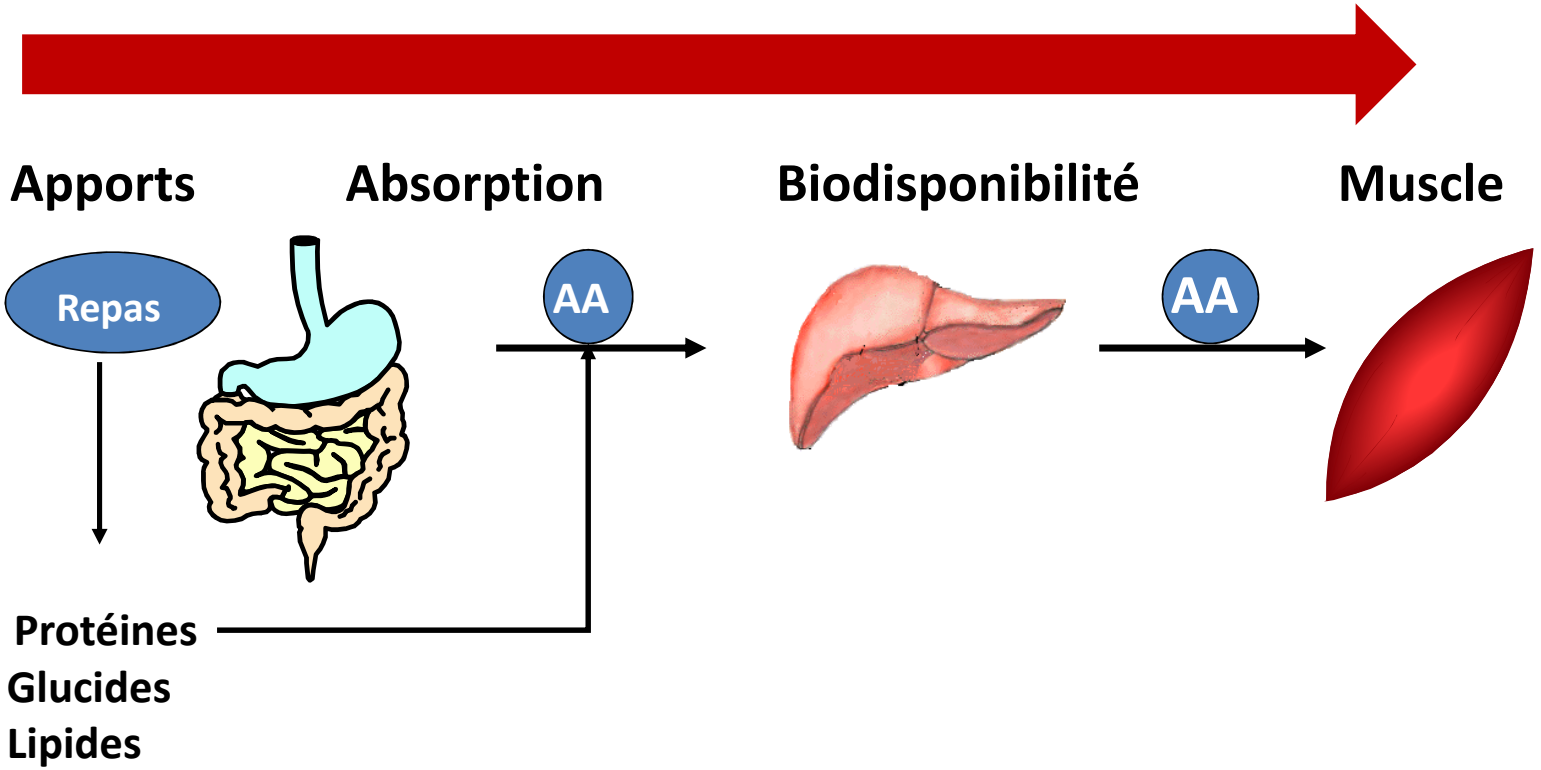
Bilan protéique musculaire postprandial



Résistance anabolique postprandiale

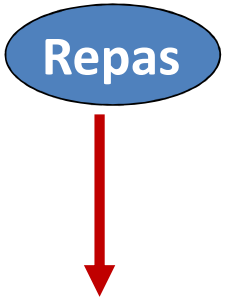


Résistance anabolique postprandiale



Résistance anabolique postprandiale

Apports



Protéines
Glucides
Lipides

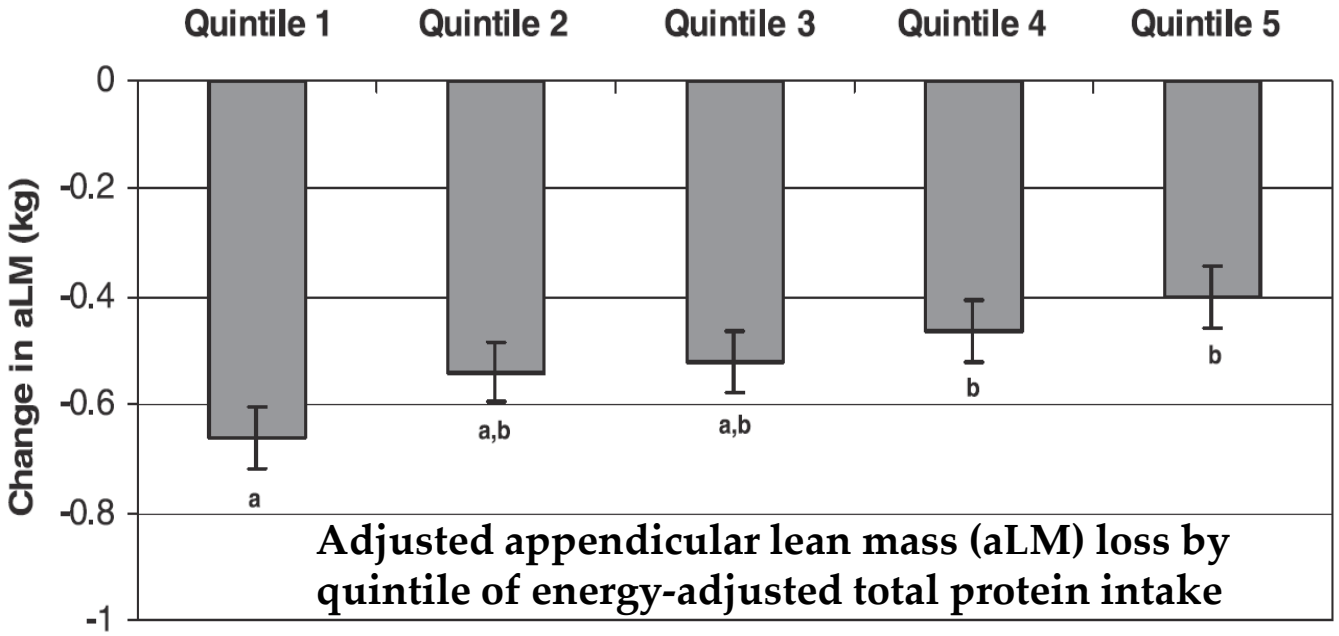
- **Quel apport protéique ?**
- **Quelle source et qualité ?**
- **Quel apport énergétique associé ?**
- **Distribution et vitesse d'absorption ?**

Augmentation des apports protéiques
= 1 g/kg/j (AFSSA 2007)

Apports protéiques < 1g/kg/j
30% des femmes âgées en Europe

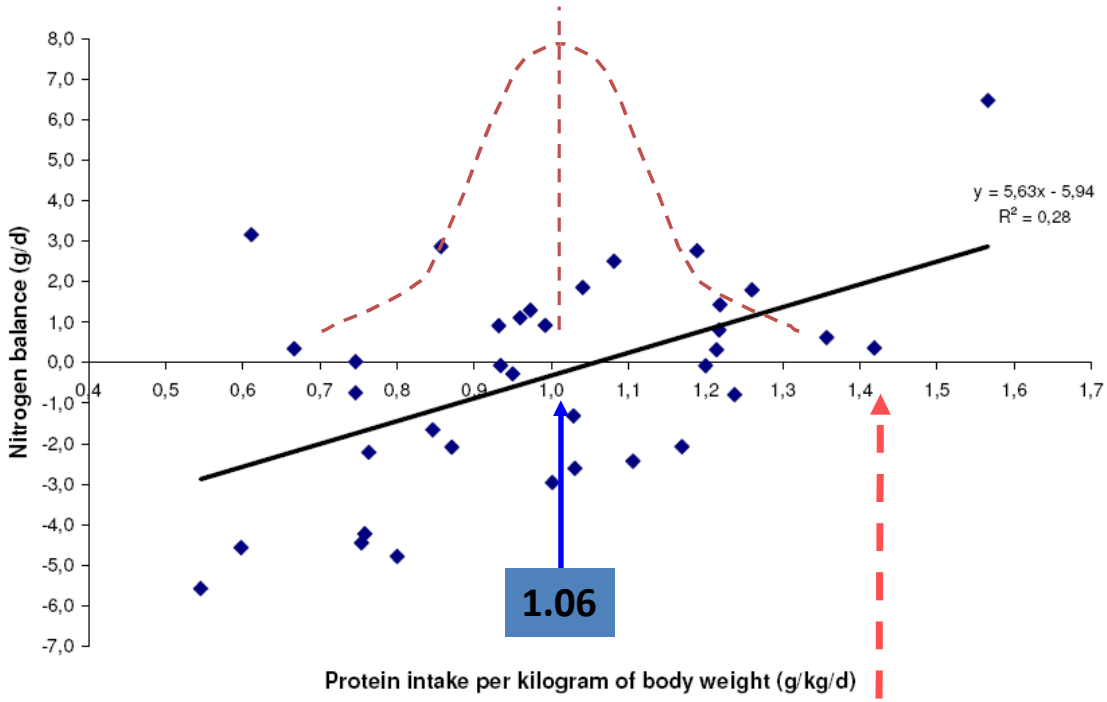
L'apport protéique alimentaire est associé aux changements de la masse maigre appendiculaire : The Health ABC Study

Apport protéique	**57g**	**54g**	**59g**	**67g**	**91g**
Protéines (% En.)	**11%**	**13%**	**14%**	**16%**	**19%**



Houston DK, Am J Clin Nutr 2008

Les besoins azotés sont accrus chez les patients hospitalisés pour fracture de hanche

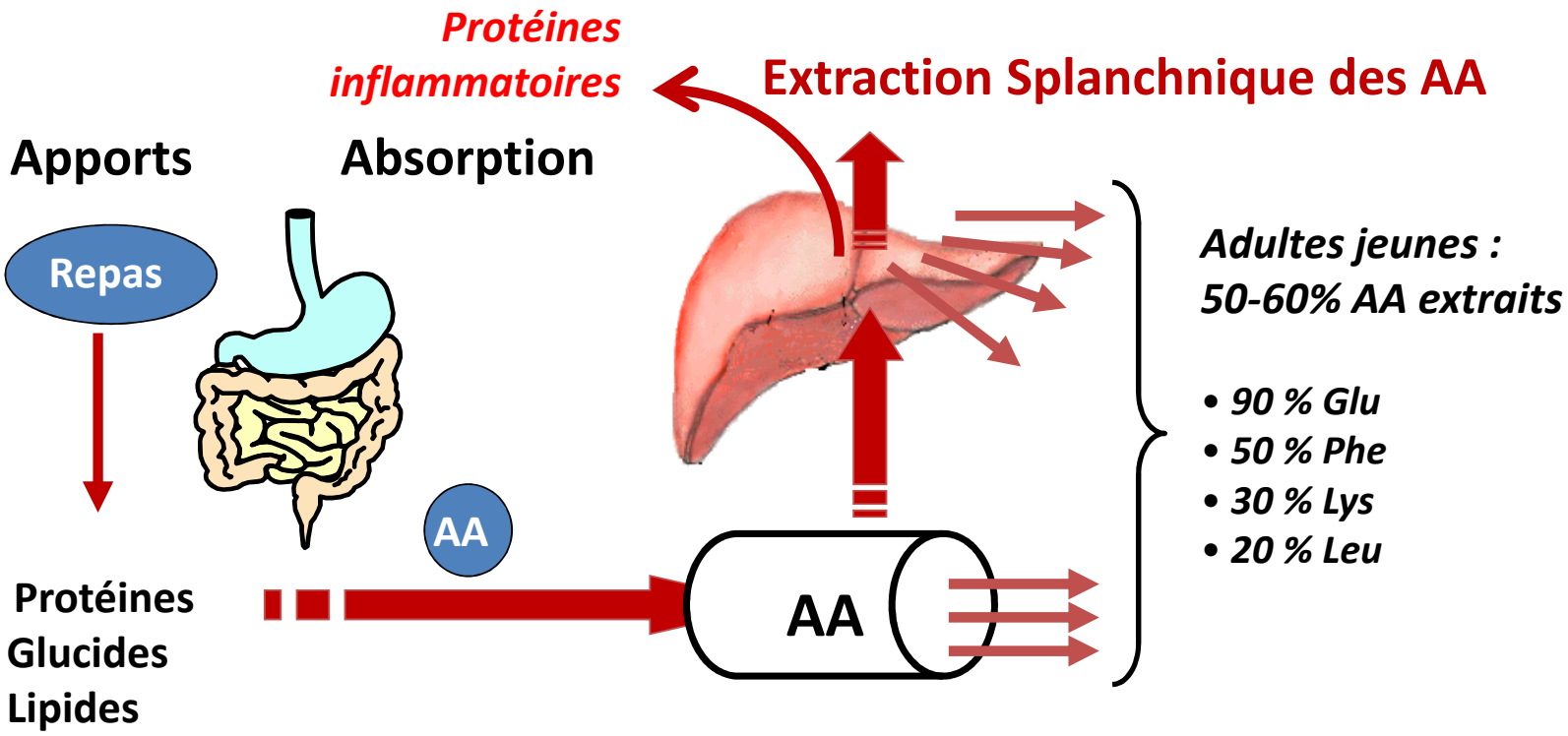


Apports protéique de sécurité **1.3-1.6 g/kg/d**

Similaire chez la femme et l'homme

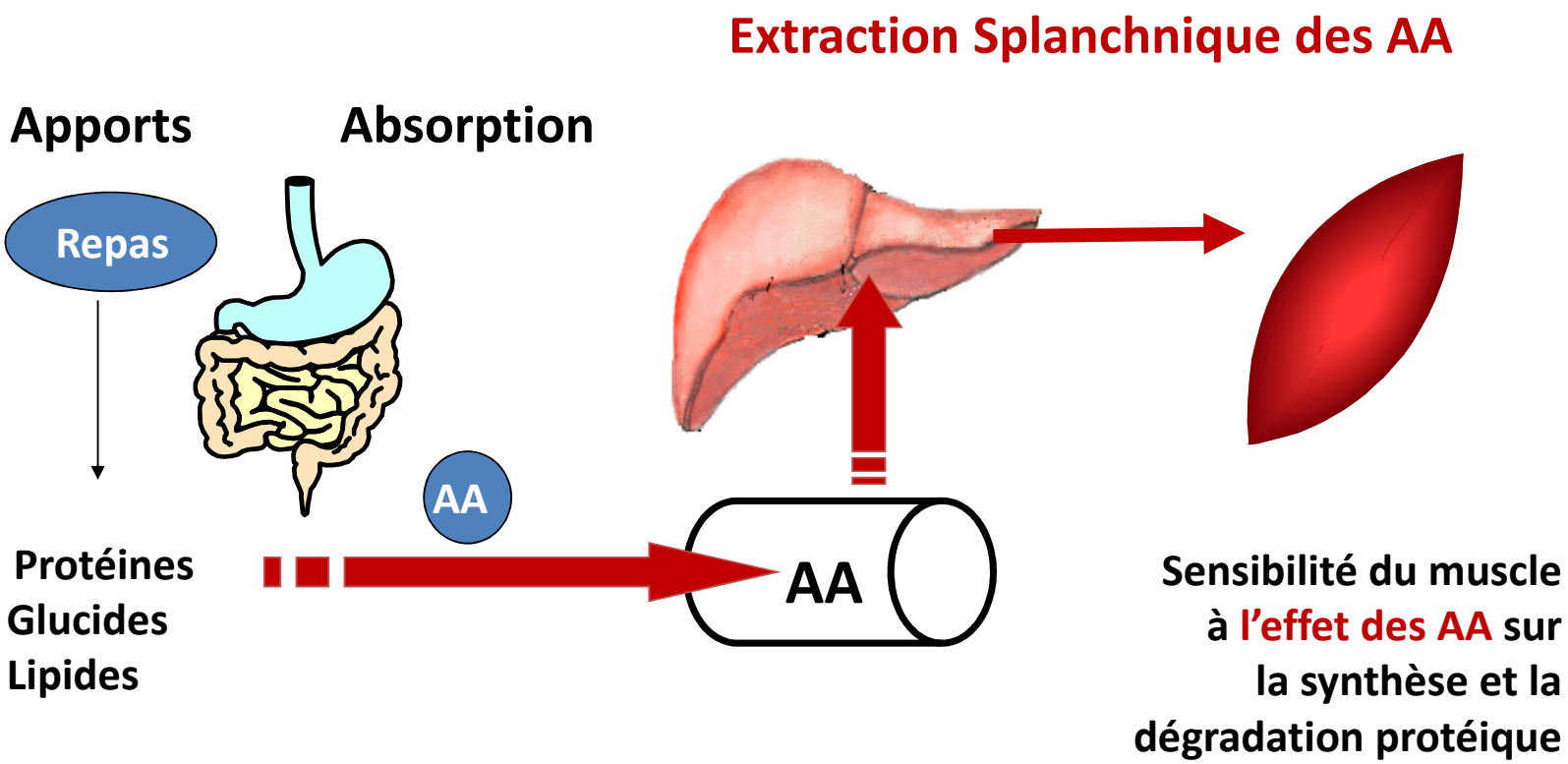
Gaillard C, JAGS 2008

Résistance anabolique postprandiale

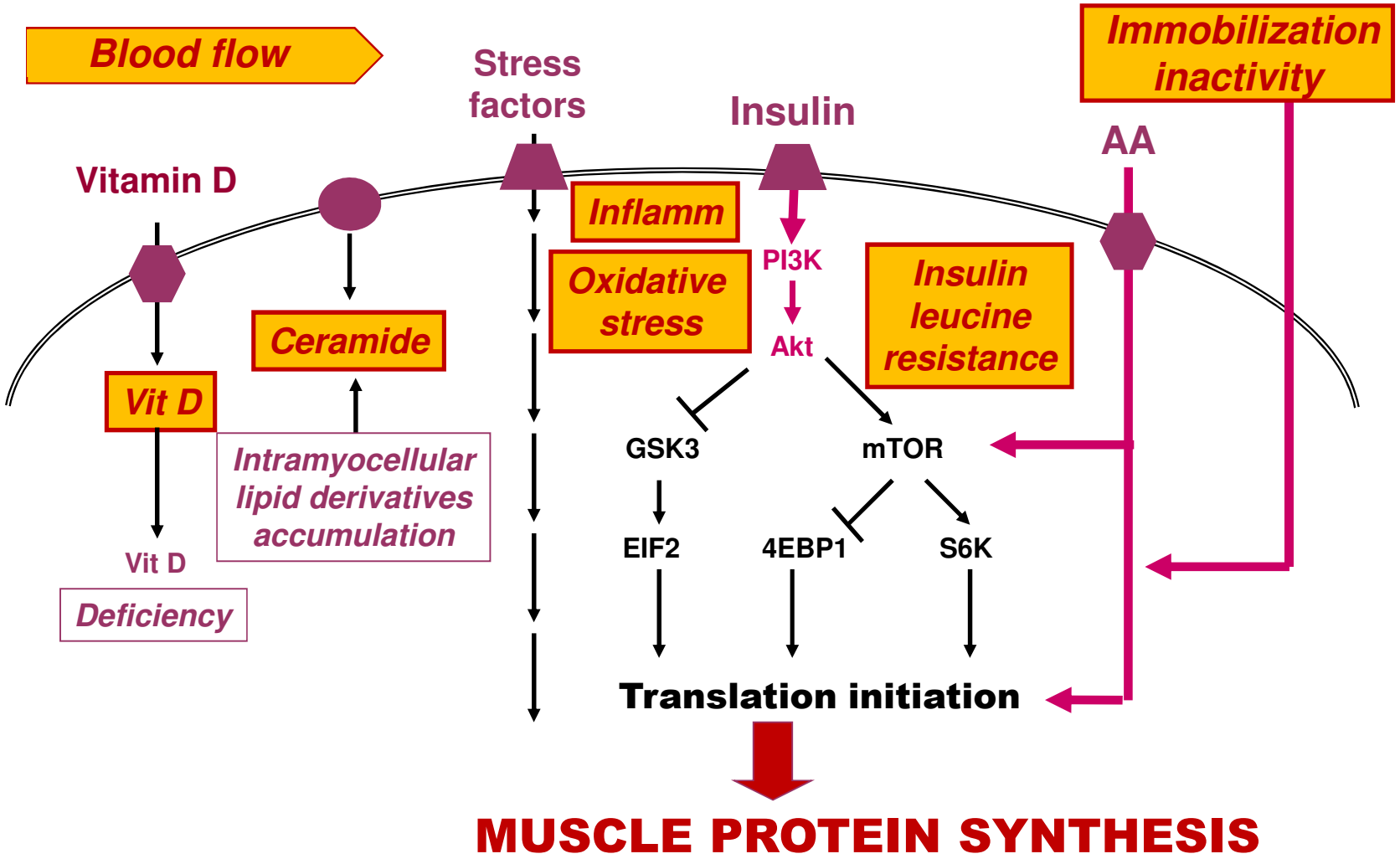


Impact de la séquestration splanchnique des AA sur l'anabolisme des tissus périphériques ?

Résistance anabolique postprandiale



Metabolic basis of muscle anabolic resistance: signaling pathways



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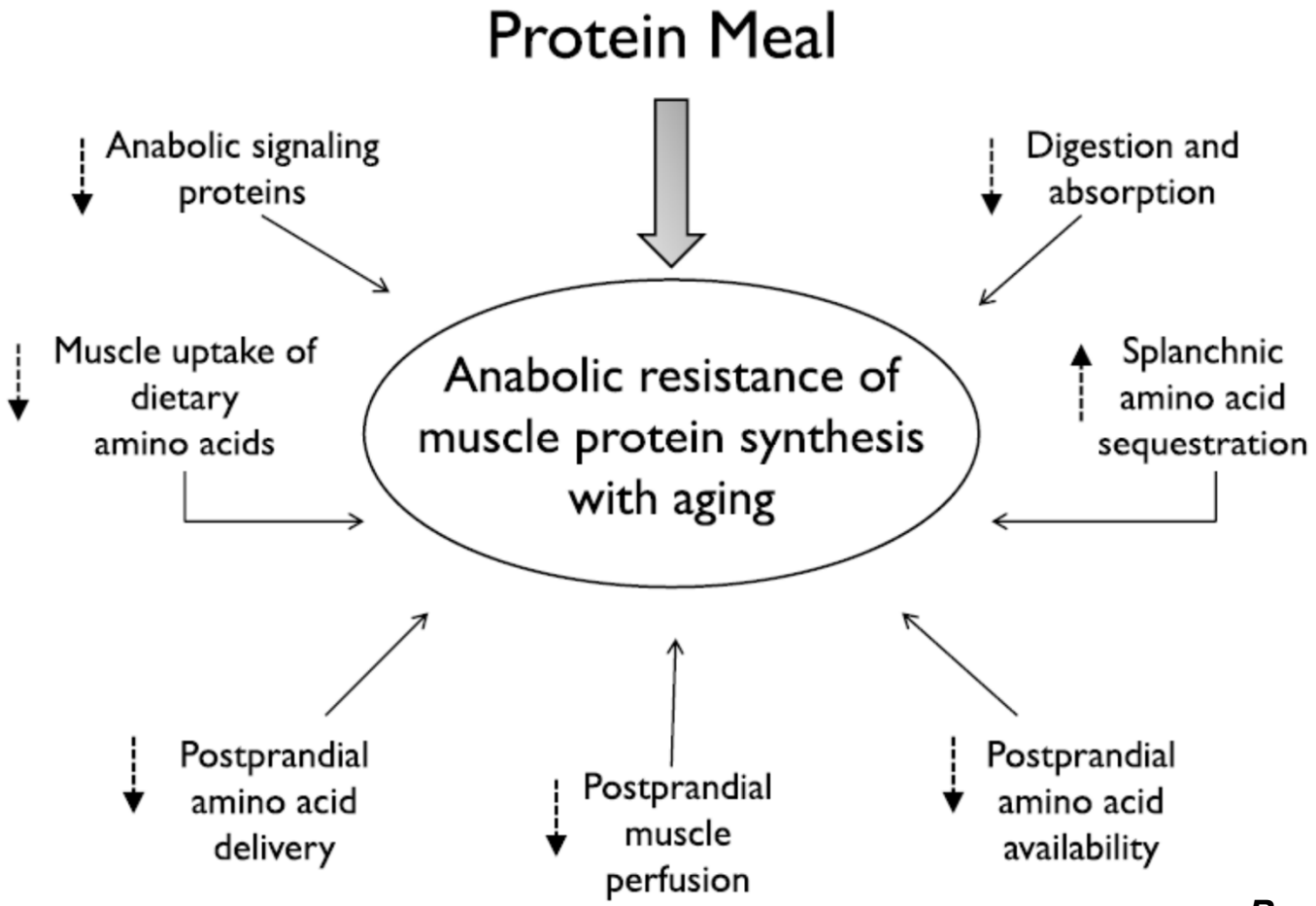
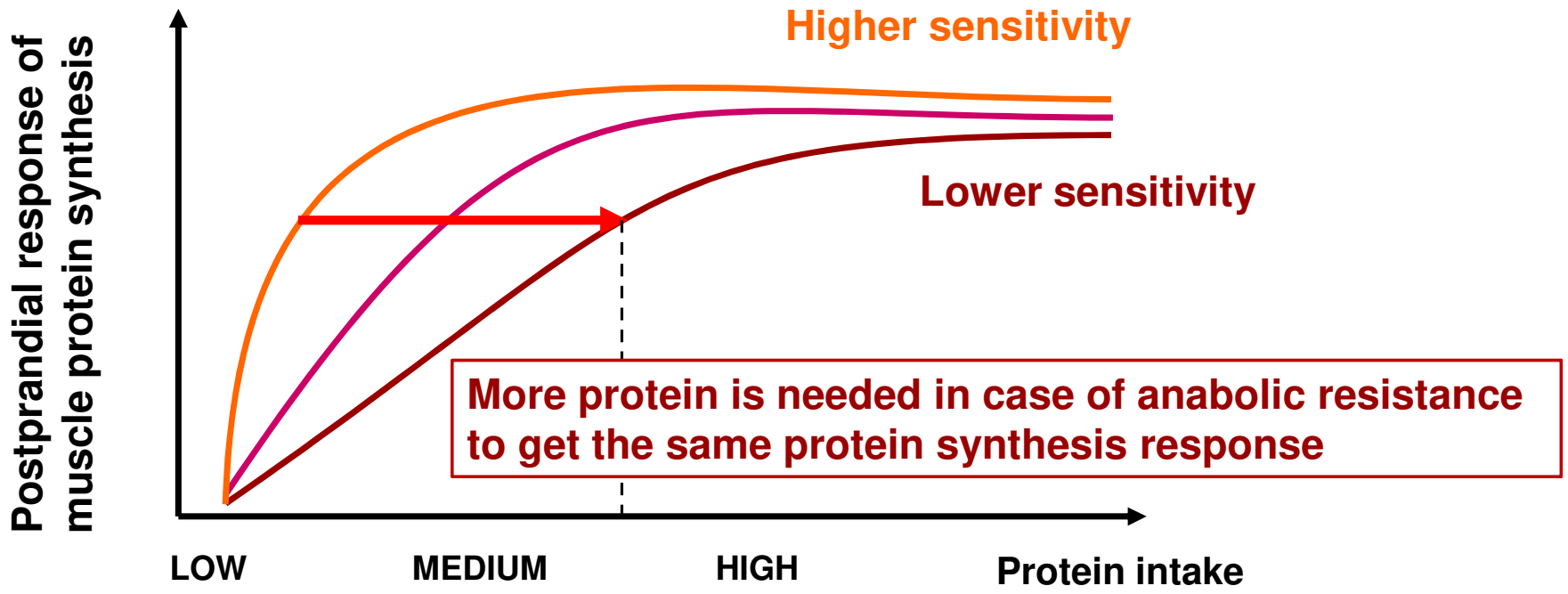
Anabolic Resistance of Muscle Protein Synthesis with Aging

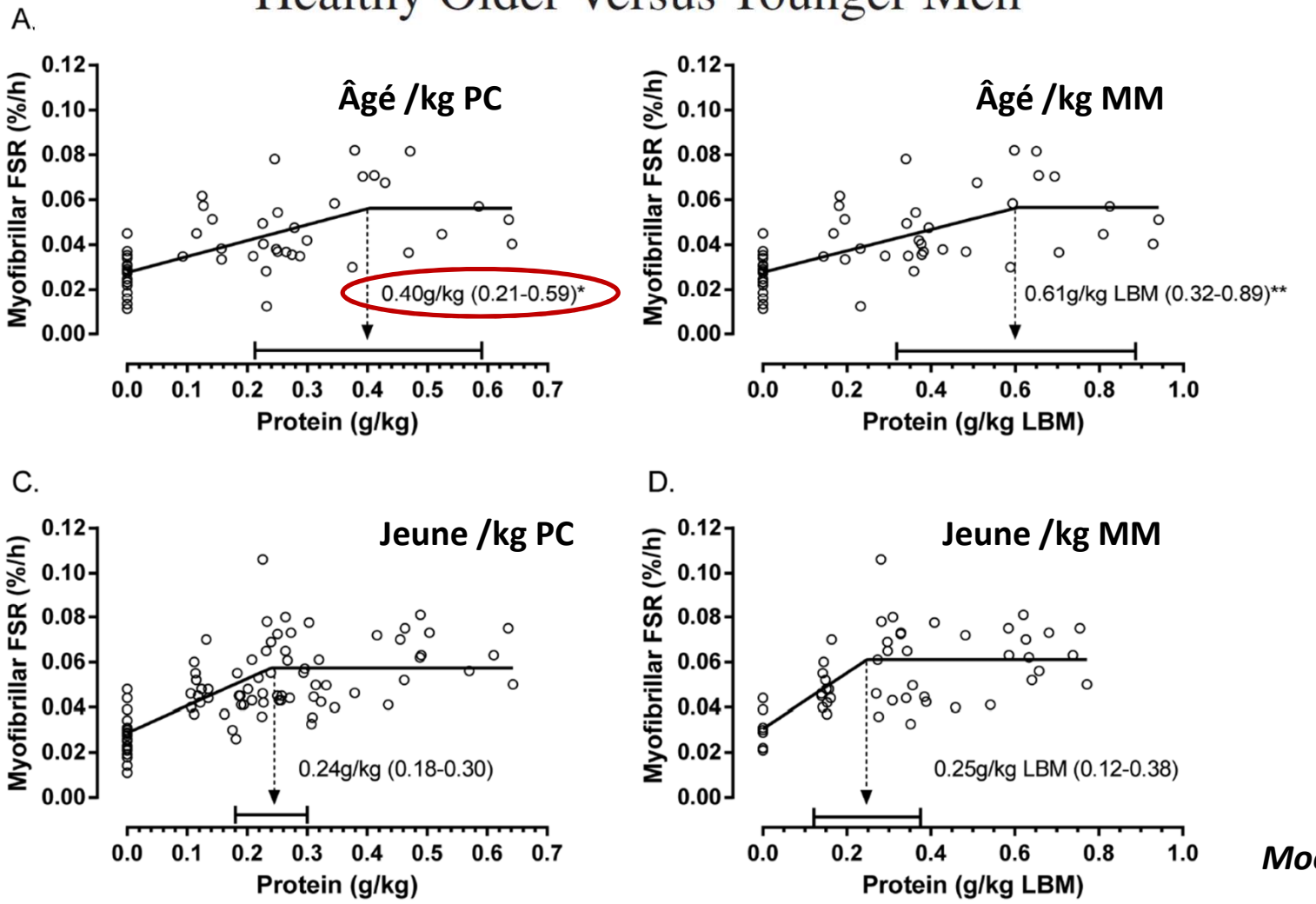


Burd NA, ESSR 2013

Anabolic resistance and protein intake



Protein Ingestion to Stimulate Myofibrillar Protein Synthesis Requires Greater Relative Protein Intakes in Healthy Older Versus Younger Men



Moore DR, J Gerontol 2015

2nd message

- La synthèse protéique musculaire en réponse au repas est réduite lors du vieillissement surtout en situation de maladie chronique
- Cette résistance anabolique a des origines multiples (alimentaires, digestives, métaboliques, vasculaires…)
- Un apport protéique suffisant en quantité et en qualité peut restaurer la synthèse protéique musculaire

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Nutrition protéique et santé

- **Une cible thérapeutique nutritionnelle : le muscle**
- **Résistance anabolique aux nutriments**
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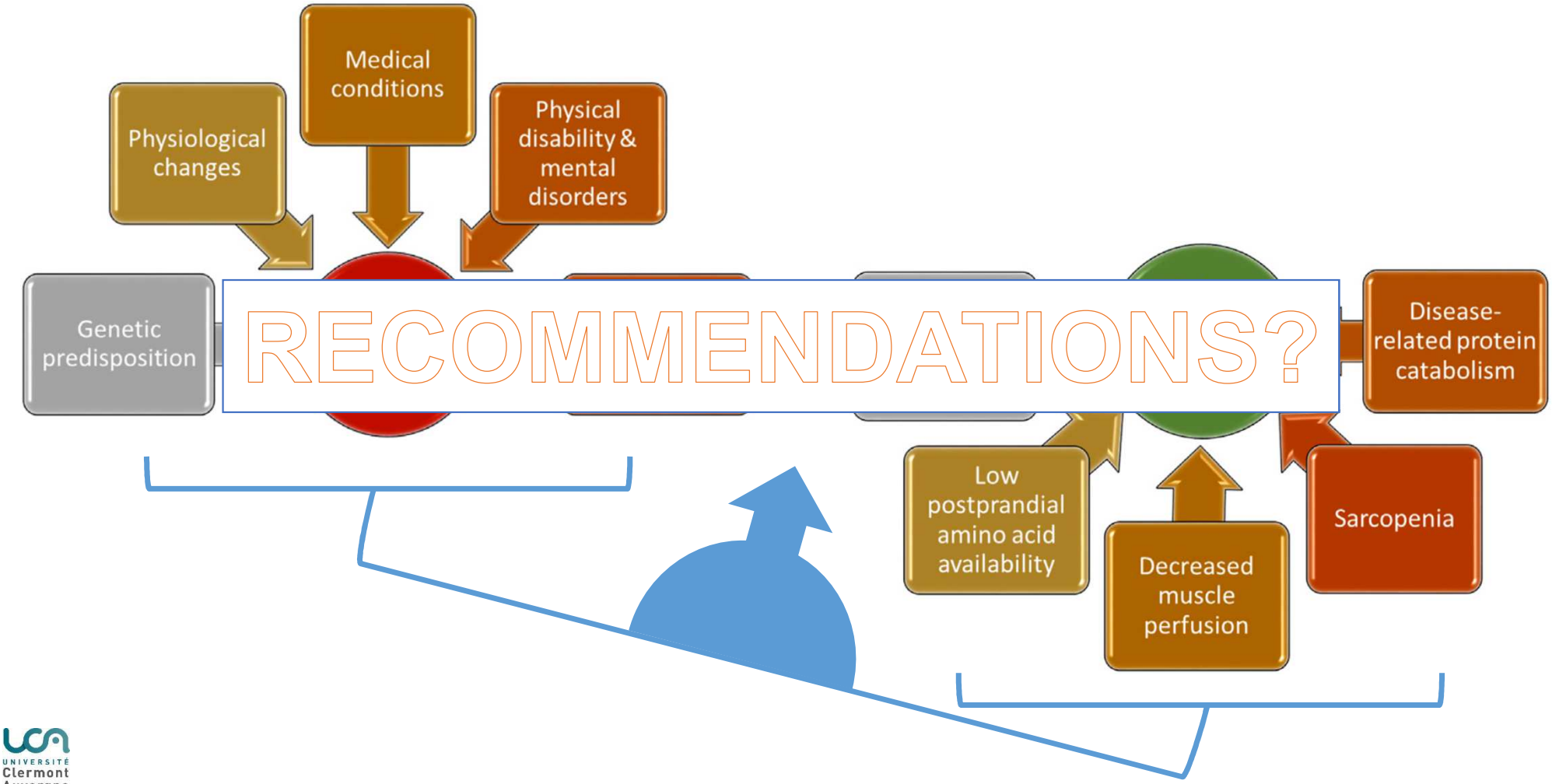

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Comment favoriser l'anabolisme musculaire par la nutrition ?

- Augmenter les apports protéiques ?
- Favoriser la consommation de certains AA ?
- Augmenter l'efficacité postprandiale des protéines ?
- Trouver de nouvelles synergies ?

Evidence-based Recommendations for Optimal Dietary Protein Intake in Older People: A Position Paper From the PROT-AGE Study Group

Jürgen Bauer MD [a,*], Gianni Biolo MD, PhD [b], Tommy Cederholm MD, PhD [c], Matteo Cesari MD, PhD [d], Alfonso J. Cruz-Jentoft MD [e], John E. Morley MB, BCh [f], Stuart Phillips PhD [g], Cornel Sieber MD, PhD [h], Peter Stehle MD, PhD [i], Daniel Teta MD, PhD [j], Renuka Visvanathan MBBS, PhD [k], Elena Volpi MD, PhD [l], Yves Boirie MD, PhD [m]

EUGMS
European Union Geriatric Medicine Society
Fostering geriatric medicine across Europe

Recommandations pour les sujets adultes âgés :

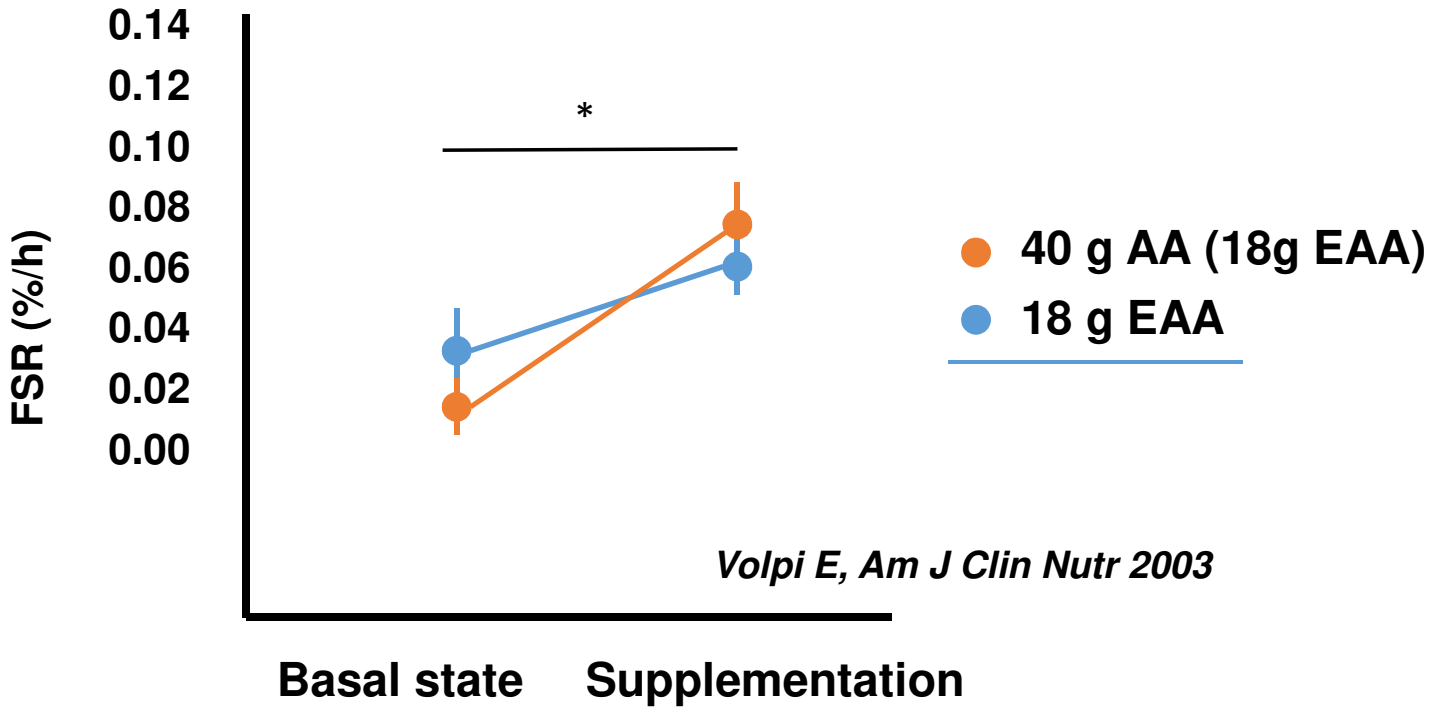
- ***Les personnes âgées ont besoin de plus de protéines que les jeunes adultes, soit un apport moyen journalier de 1.0 to 1.2 g/kg/j***
- ***Maladie aigüe ou chronique : 1.2-1.5 g/kg/j***
- ***Si insuffisance rénale sévère sans dialyse (FG < 30mL/min) : apport protéique limité***

Bauer J, J Am Med Dir Assoc 2013

Comment favoriser l'anabolisme musculaire par la nutrition ?

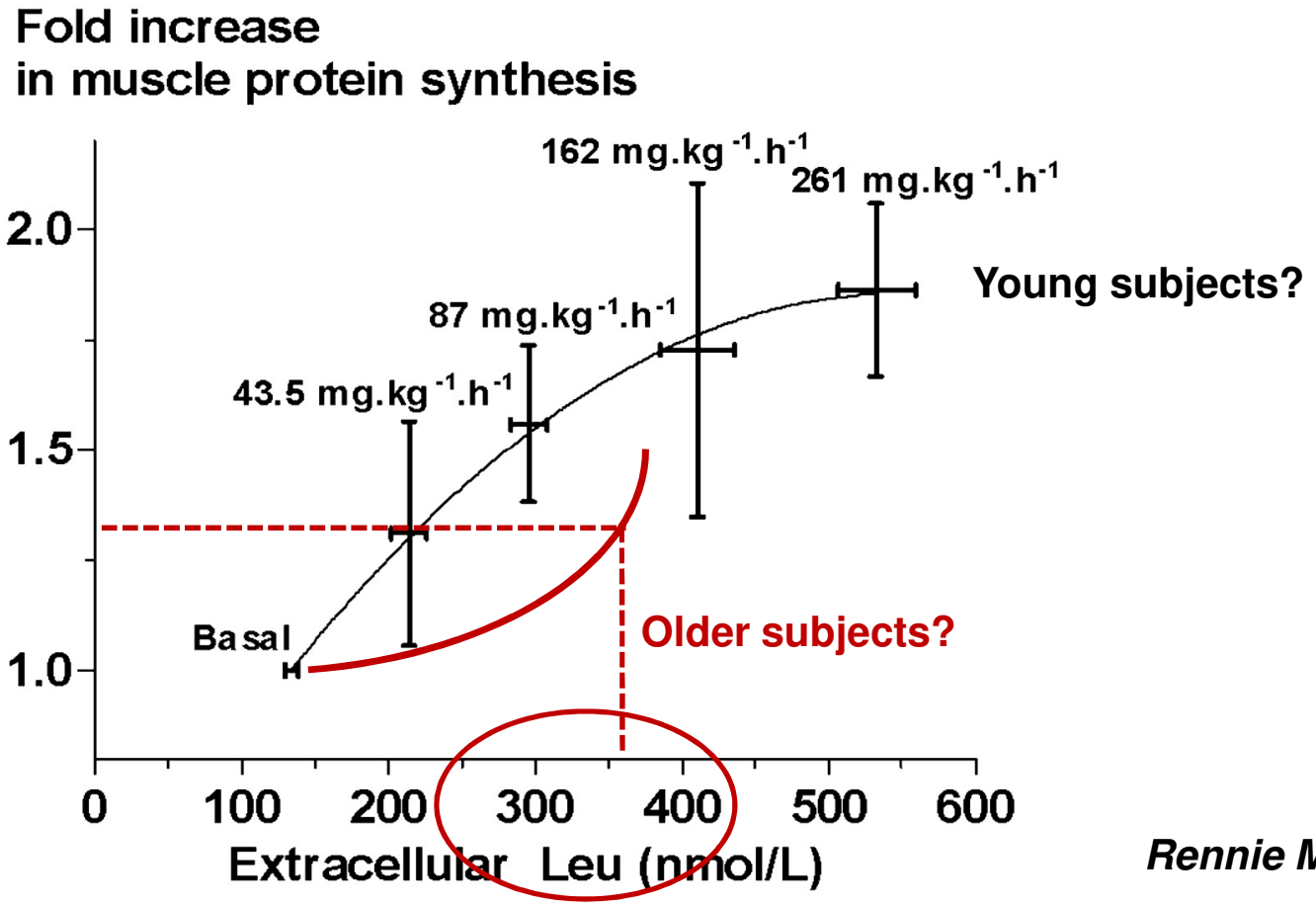
- **Augmenter les apports protéiques ?**
- **Favoriser la consommation de certains AA ?**
- **Augmenter l'efficacité postprandiale des protéines ?**
- **Trouver de nouvelles synergies ?**

Essential amino acids are responsible for stimulation of muscle protein synthesis in elderly adults



… but how much, which and molecular form?

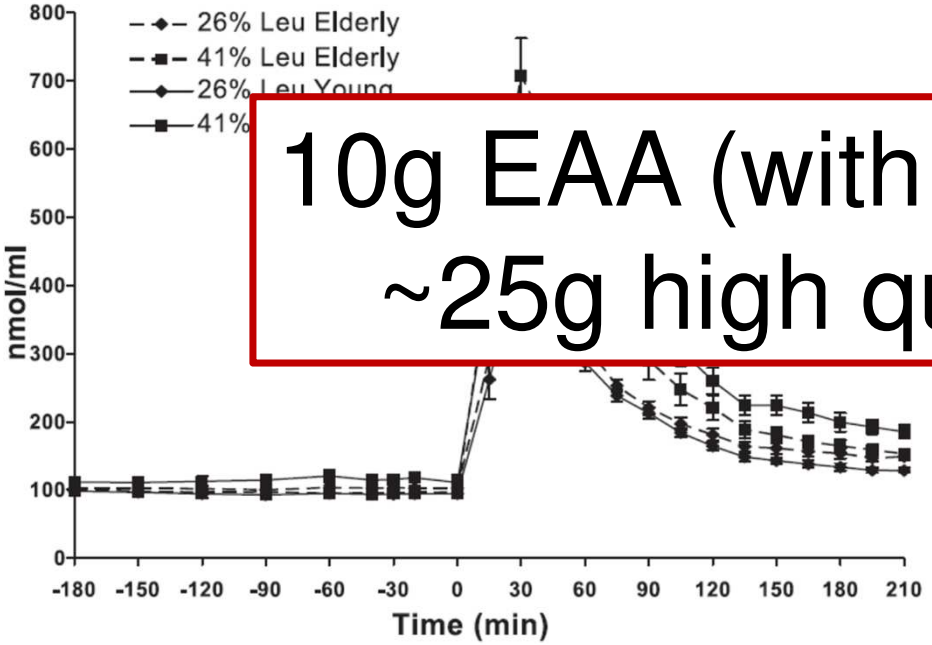
Relation between increase in muscle protein synthesis and plasma leucine concentration during infusion of mixed AA



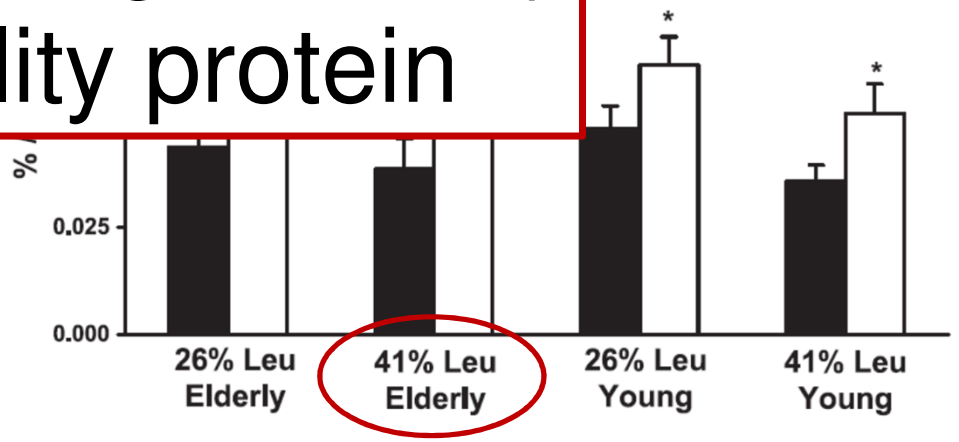
Rennie MJ, J Nutr 2006

A high proportion of leucine is required for optimal stimulation of the rate of muscle protein synthesis by essential amino acids in the elderly

Christos S. Katsanos,[1] Hisamine Kobayashi,[2] Melinda Sheffield-Moore,[3]
Asle Aarsland,[4] and Robert R. Wolfe[1]



10g EAA (with >2.5g leucine)
~25g high quality protein



Katsanos CS, Am J Physiol 2006

Essential Amino Acid and Carbohydrate Supplementation Ameliorates Muscle Protein Loss in Humans during 28 Days Bedrest

Paddon-Jones, 2004

Muscle mass and muscle strength / AA seuls

Effect of amino acid supplementation on muscle mass, strength and physical function in elderly☆

Børsheim E, Clin Nutr 2008

Muscle mass and muscle strength / AA seuls

Amino Acid Supplementation Increases Lean Body Mass, Basal Muscle Protein Synthesis, and Insulin-Like Growth Factor-I Expression in Older Women

Dillon EL, JCEM 2009

Muscle mass / AA seuls

Effects of Exercise and Amino Acid Supplementation on Body Composition and Physical Function in Community-Dwelling Elderly Japanese Sarcopenic Women: A Randomized Controlled Trial

Kim HK, JAGS 2012

Muscle mass and muscle strength / AA + EX résistance

Y-a-t-il d'autres acides aminés potentiels ?

- **HMB** ***(Deutz, 2013; Flakoll 2004; Stout 2013; Vukovich 2001)***
- **Glutamine/Glutamate ?**
- **Arginine/Citrulline ?**
- **Cystéine/Methionine ?**

Malgré des actions métaboliques clairement démontrées, les études à long terme sur les capacités physiques manquent et des essais cliniques sont nécessaires

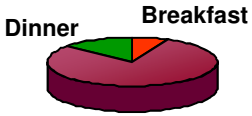
Comment favoriser l'anabolisme musculaire par la nutrition ?

- **Augmenter les apports protéiques ?**
- **Favoriser la consommation de certains AA ?**
- **Augmenter l'efficacité postprandiale des protéines ?**
- **Trouver de nouvelles synergies ?**

Protein ingestion as “pulse-feeding” (chrononutrition)

Spread-feeding

Pulse-feeding



Lunch (80%)

Pulse feeding: ↗ nitrogen retention in elderly

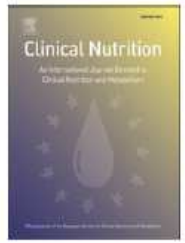
Arnal MA, AJCN 1999 & 2002

Application in patients

Contents lists available at SciVerse ScienceDirect

Clinical Nutrition

journal homepage: http://www.elsevier.com/locate/clnu



Randomized control trials

Impact of protein pulse feeding on lean mass in malnourished and at-risk hospitalized elderly patients: A randomized controlled trial☆

UNIVERSITÉ Clermont Auvergne

Bouillanne O, Clin Nutr 2012

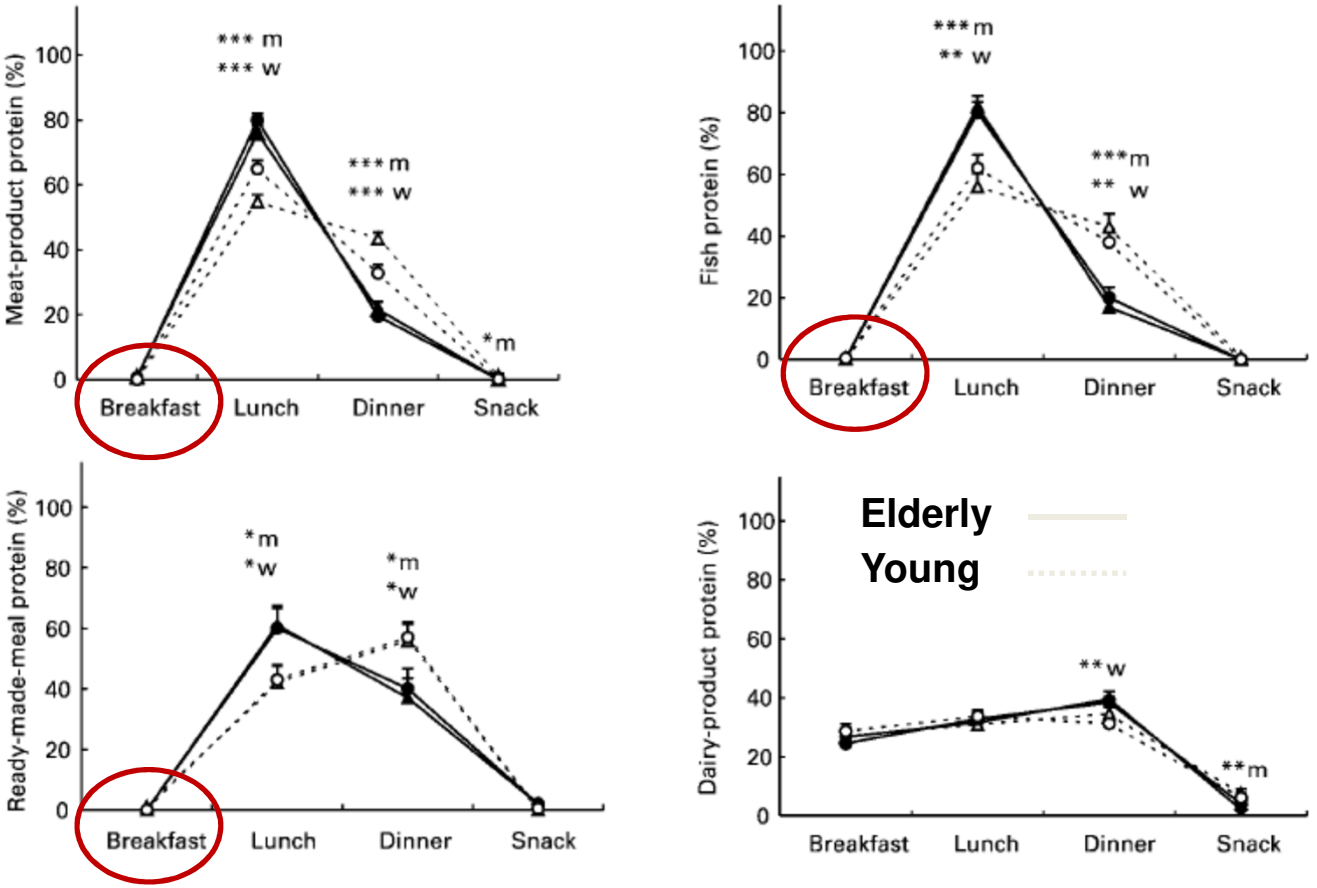
Exemples de 3 menus « pulsés » de 60g au déjeuner

Déjeuner	Œuf mimosa Filet de Hoki Lentille Fromage Quatre-quart sauce chocolat enrichie	Maquereau vin blanc Cuisse de volaille confite Coquillette Fromage Semoule au lait enrichie	Pâté en croûte Filet de cabillaud Purée PdT[a] Fromage Ile flottante enrichie
Dîner	Velouté de légumes Jardinière de légumes Salade de fruits frais	Velouté de légumes Tarte à l'oignon Salade Pêche	Velouté de légumes Riz cantonnais Melon à la menthe

[a] Il est aussi possible d'enrichir la purée.

Aussel C, Cah Nut Diet 2013

Spontaneous protein feeding pattern in healthy elderly subjects



Rousset S, Br J Nutr 2001

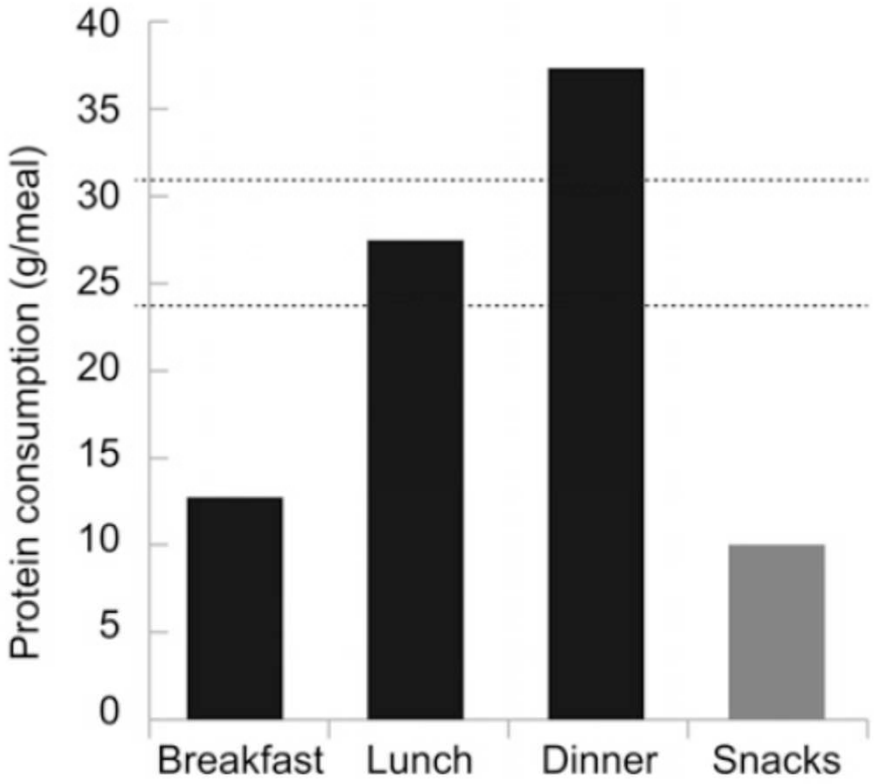


FIGURE 2 Protein consumption per meal for adults (aged ≥19 y) in the United States shows a skewed intake pattern. Data were adapted from NHANES 2001–2008 (30). The dotted line approximates the amount of protein required per meal to maximally stimulate muscle protein synthesis

Paddon-Jones D, Am J Clin Nutr 2015

The relationship between nutrition and frailty: Effects of protein intake, nutritional supplementation, vitamin D and exercise on muscle metabolism in the elderly. A systematic review

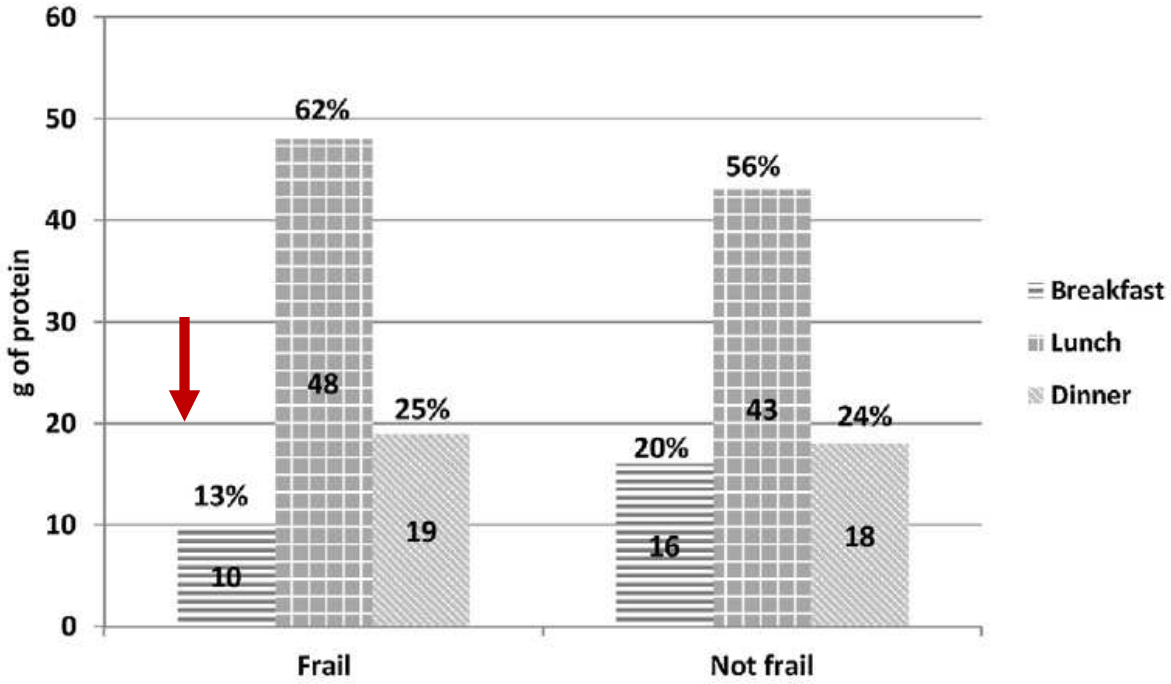


Fig. 3. Distribution of protein intake during the day in frail and not-frail subjects. A small increase in the concentration of protein of the breakfast, and a minimum reduction of protein for lunch, are associated with a significant reduction of the prevalence of frailty [86].

Artaza Maturitas 2016

Dietary Protein Distribution Positively Influences 24-h Muscle Protein Synthesis in Healthy Adults[1–3]

Madonna M. Mamerow,[4] Joni A. Mettler,[4] Kirk L. English,[4] Shanon L. Casperson,[6] Emily Arentson-Lantz,[4] Melinda Sheffield-Moore,[6] Donald K. Layman,[7] and Douglas Paddon-Jones[4,5]*

TABLE 2 Seven-day mean energy and macronutrient intake in healthy adults consuming diets with an EVEN or SKEW protein distribution[1]

Meal	Energy	Protein	Protein	Carbohydrate	Fat
	kcal	*g*	*g/kg*	*g*	*g*
Breakfast					
EVEN	848 ± 47.8	31.5 ± 1.3	0.41 ± 0.01	83.8 ± 2.8	43.0 ± 2.2
SKEW	537 ± 34.1	10.7 ± 0.8	0.14 ± 0.01	79.3 ± 7.4	19.7 ± 1.5
Lunch					
EVEN	820 ± 28.6	29.9 ± 1.6	0.39 ± 0.02	116 ± 11.1	26.0 ± 1.1
SKEW	683 ± 33.6	16.0 ± 0.5	0.21 ± 0.01	113 ± 9.5	18.4 ± 1.0
Dinner					
EVEN	727 ± 47.6	32.7 ± 1.6	0.42 ± 0.01	112 ± 7.3	16.4 ± 1.1
SKEW	1100 ± 49.3	63.4 ± 3.7	0.82 ± 0.03	115 ± 9.3	43.6 ± 1.4
Daily total[2]					
EVEN	2400 ± 121	94.1 ± 3.7	1.22 ± 0.02	312 ± 17.8	85.4 ± 4.0
SKEW	2320 ± 113	90.1 ± 4.6	1.17 ± 0.04	307 ± 24.1	81.7 ± 3.0

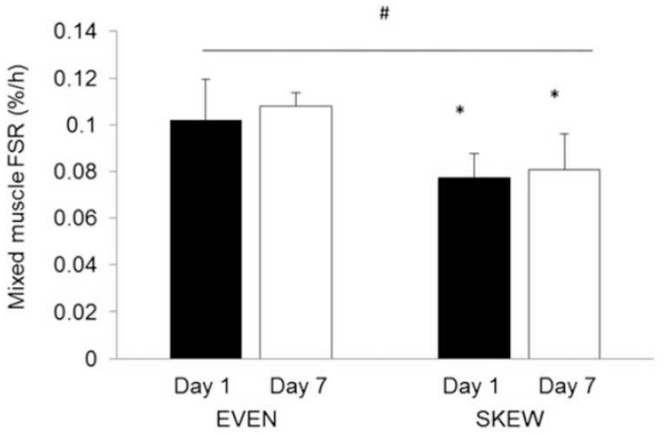


FIGURE 2 Mixed muscle protein FSRs in healthy adults on days 1 and 7 after the ingestion of a breakfast meal containing 30 g (EVEN) or 10 g (SKEW) of protein. Values are means ± SEMs; *n* = 8.

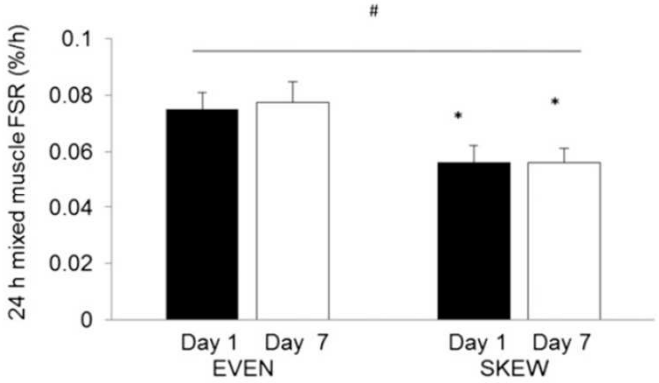
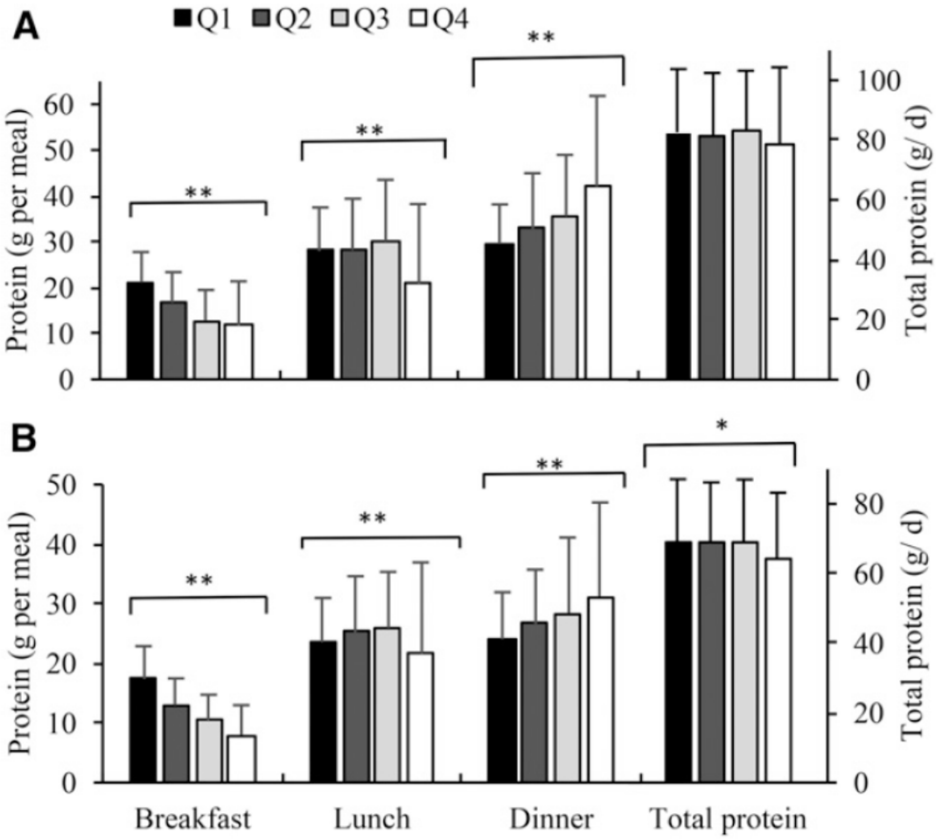


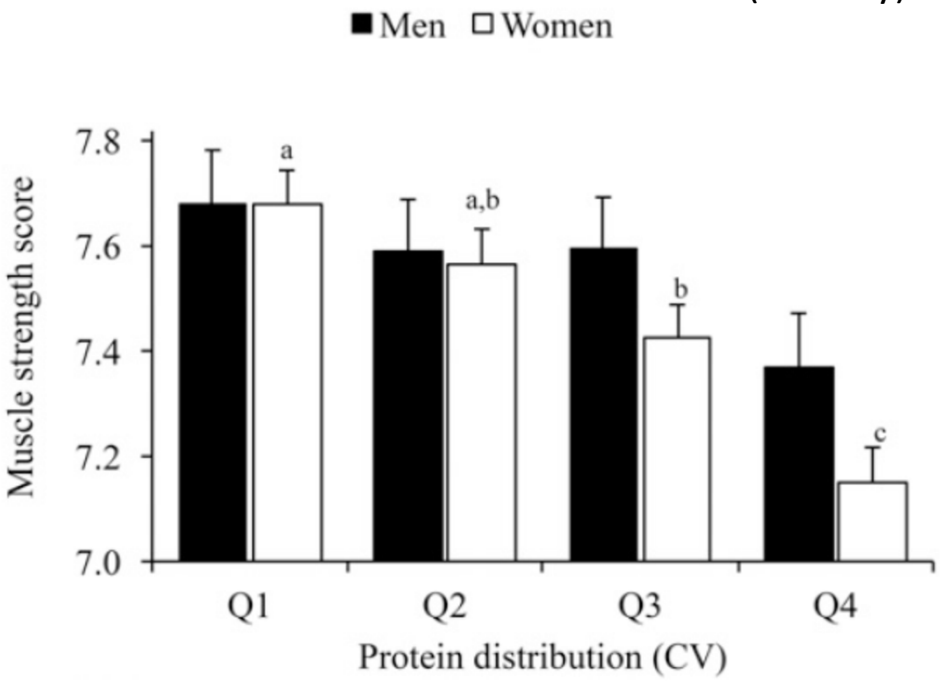
FIGURE 3 Twenty-four-hour mixed muscle protein FSRs in healthy adults on days 1 and 7 after the ingestion of diets with an EVEN or SKEW protein distribution. Values are means ± SEMs; *n* = 8.

Mamerow MM, J Nutr 2014

Even mealtime distribution of protein intake is associated with greater muscle strength, but not with 3-y physical function decline, in free-living older adults: the Quebec longitudinal study on Nutrition as a Determinant of Successful Aging (NuAge study)

914 women
827 men
(67–84 y)

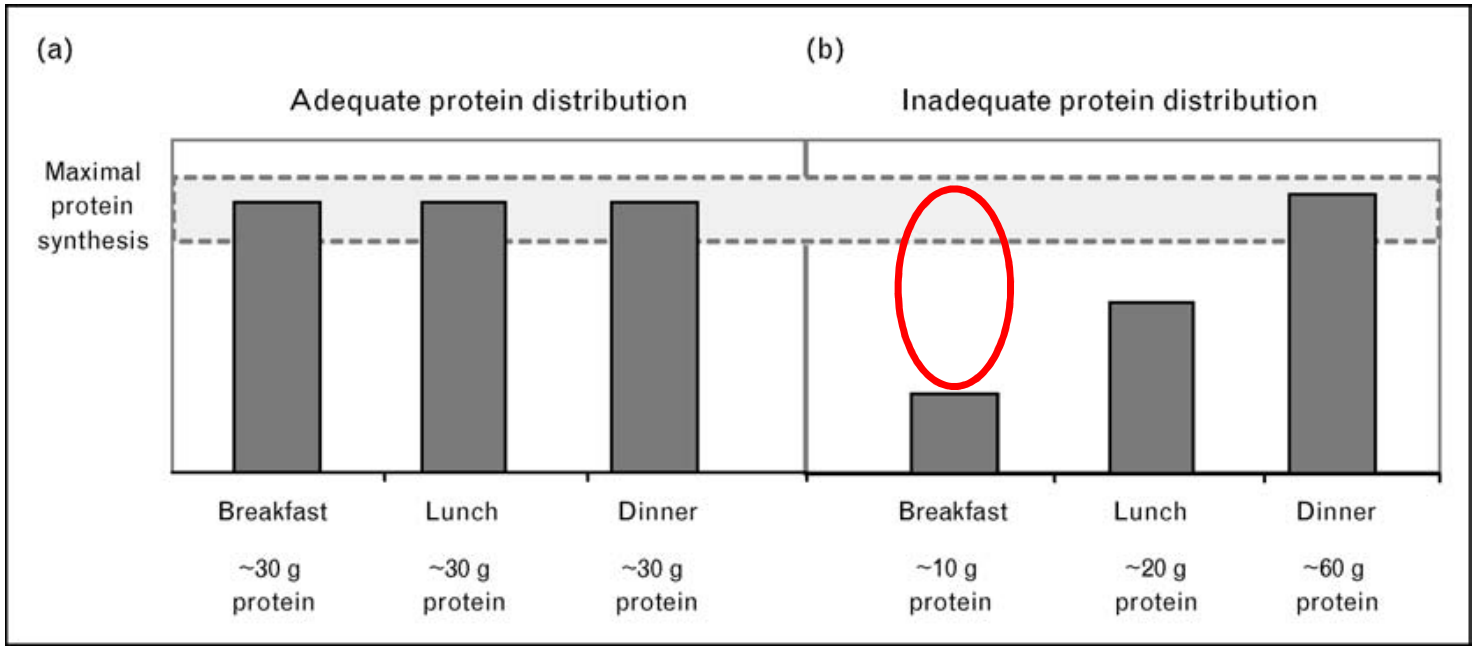




Farsijani, Am J Clin Nutr 2016 and 2017

Optimal stimulation of muscle protein synthesis at breakfast?

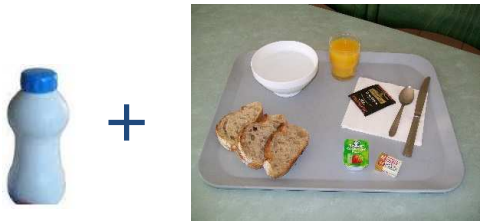
proposed relationship between the amount of protein ingested per meal and the resultant anabolic response



Paddon-Jones, Curr Opin Clin Nutr Metab Care 2009

Supplementing Breakfast with a Vitamin D and Leucine–Enriched Whey Protein Medical Nutrition Drink Enhances Postprandial Muscle Protein Synthesis and Muscle Mass in Healthy Older Men

Study Design



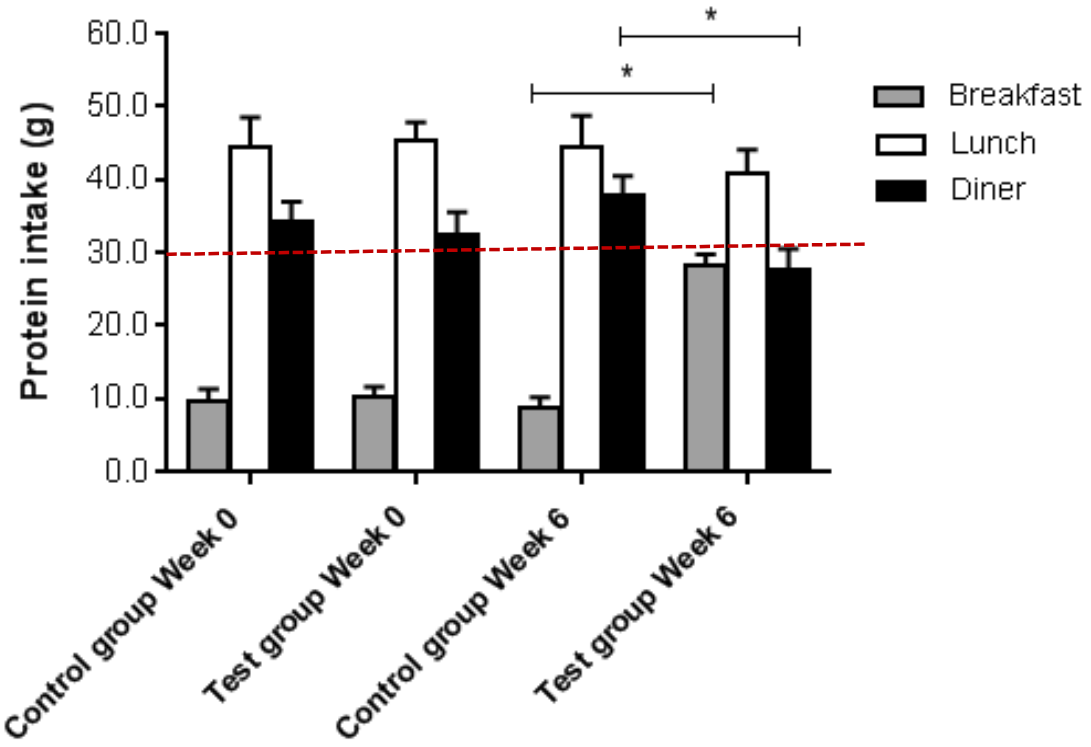
V0= Screening
V1= Handgrip strength, SPPB, Dxa

V2= First isotope study visit (randomisation, questionnaires)

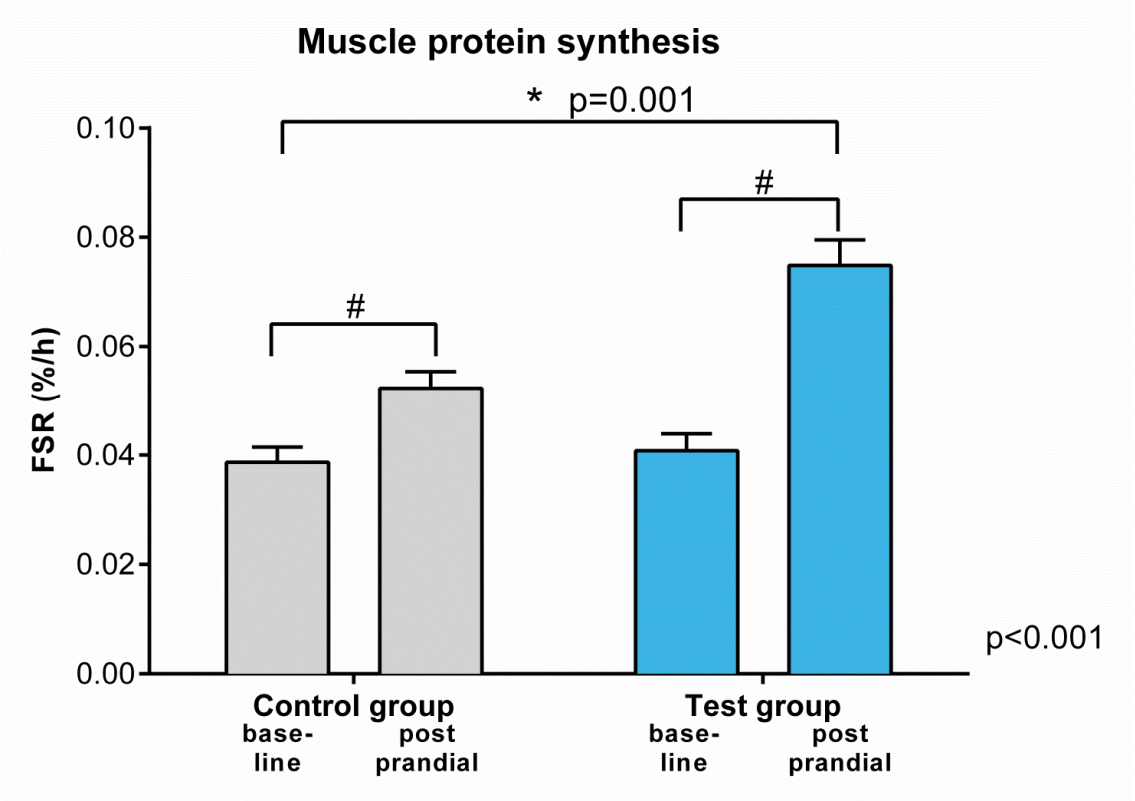
V3 = Handgrip strength., SPPB, Dxa

Chanet A, J Nutr 2017

Supplementation changed total protein intake distribution over meals during the day

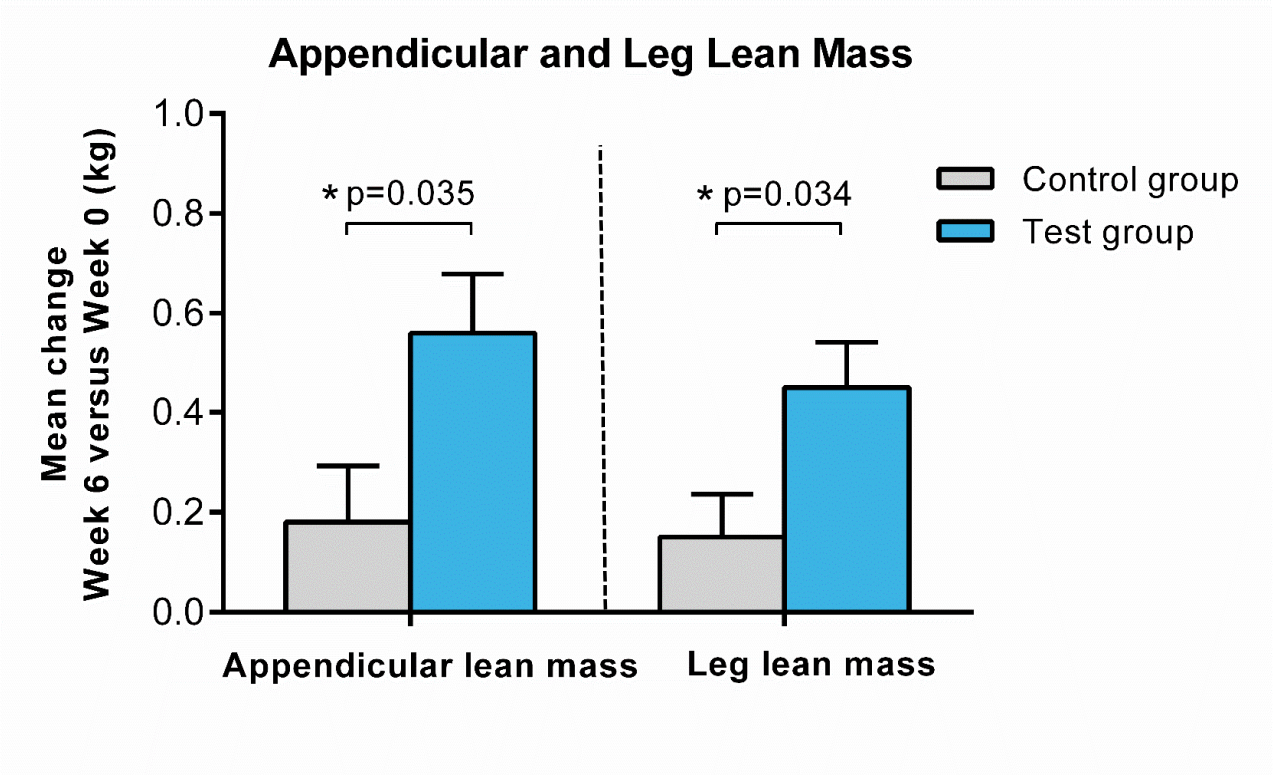


Primary outcome parameter: acute stimulation of muscle protein synthesis after products and breakfast



Chanet A, J Nutr 2017

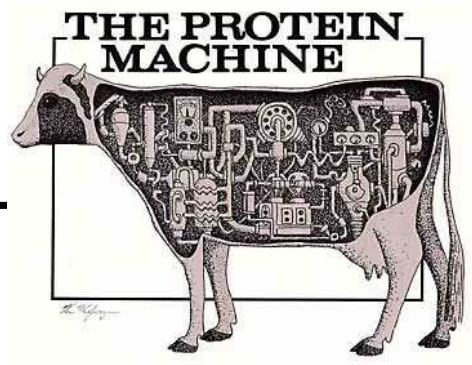
Muscle gain as appendicular and leg lean mass after 6 weeks supplementation



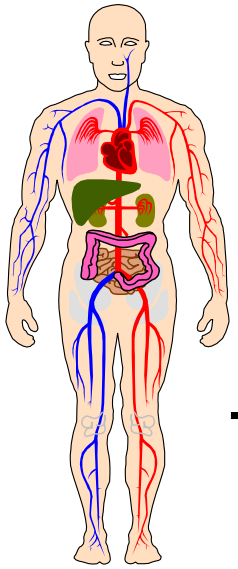
Chanet A, J Nutr 2017

Vite et haut !

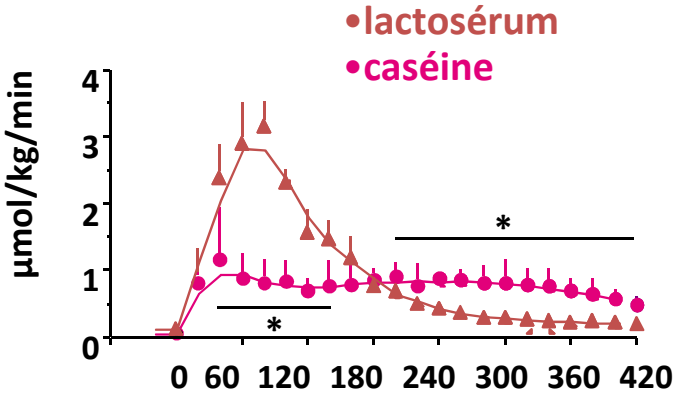
Protéines "marquées" :
- lactosérum
- caséine



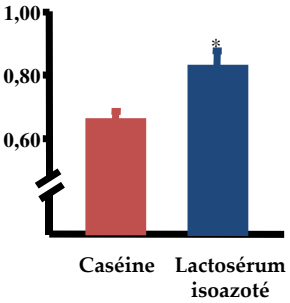
^{13}C-AA



Vitesse de digestion protéique : protéine « lente » vs « rapide »

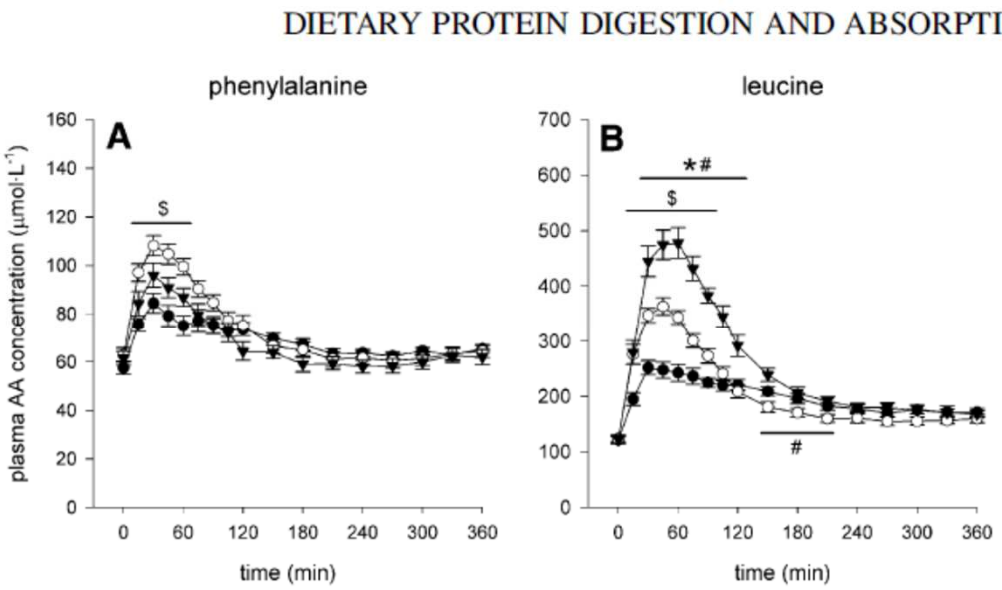


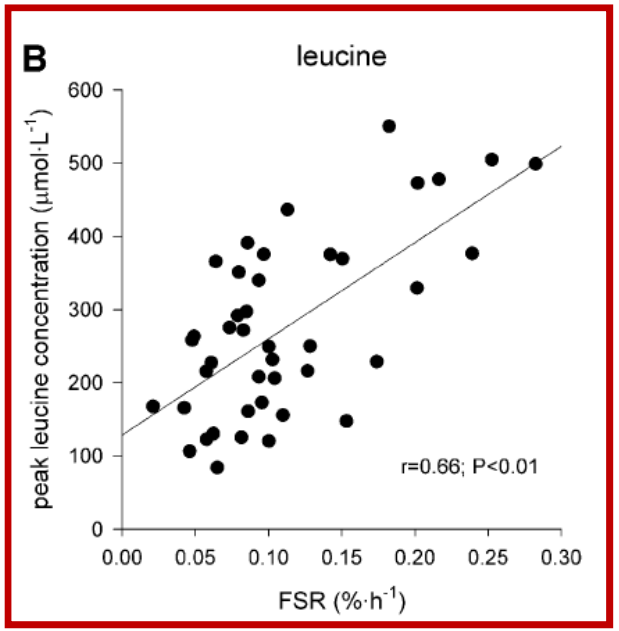
Bilan protéique postprandial modifié

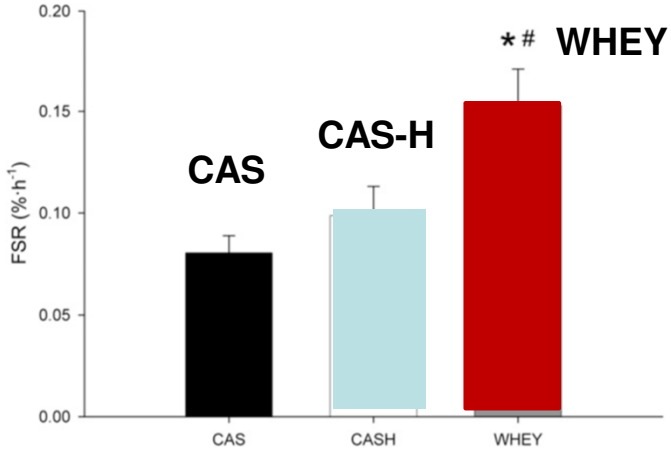


Boirie Y, Am J Physiol 1996 ; PNAS USA 1997; Dangin M, J Physiol 2003

Whey protein stimulates postprandial muscle protein accretion more effectively than do casein and casein hydrolysate in older men[1–3]



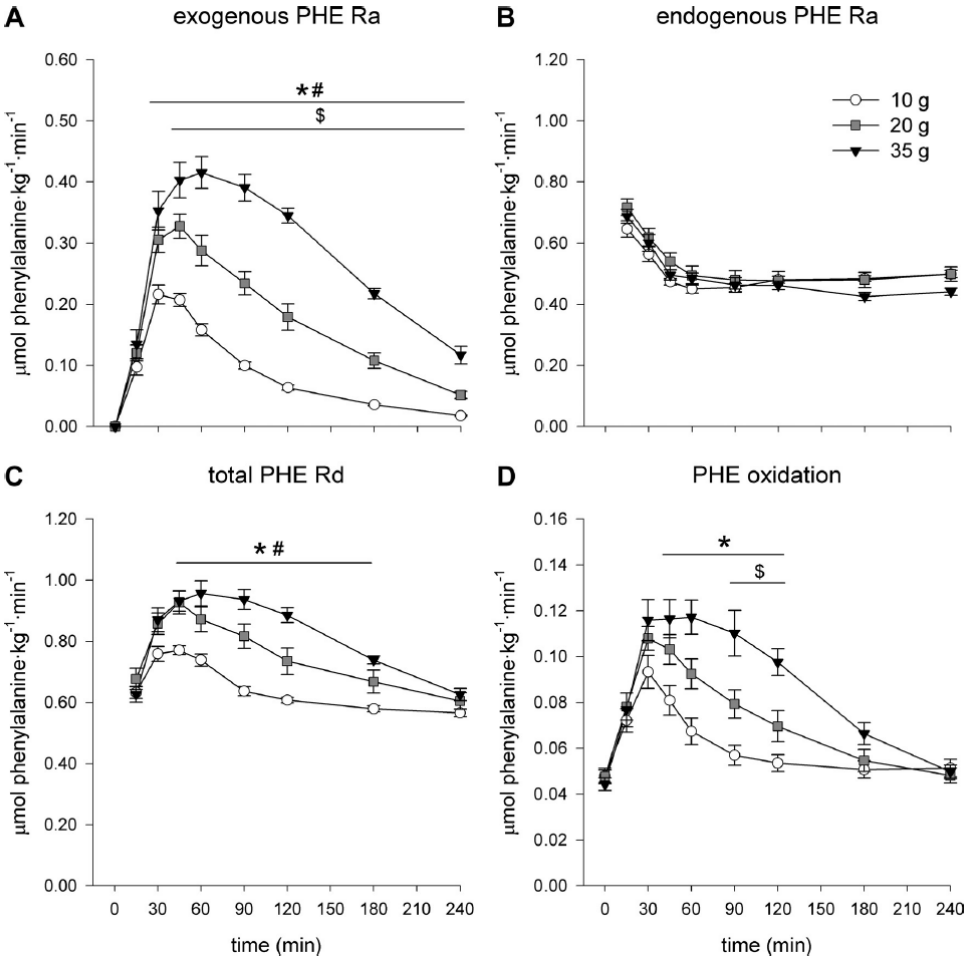


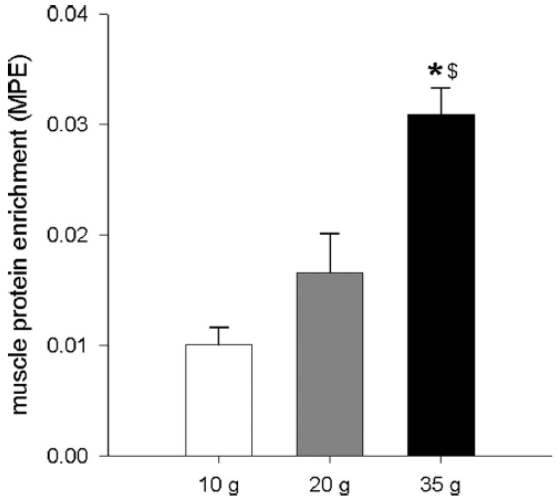


Pennings B, Am J Clin Nutr 2011

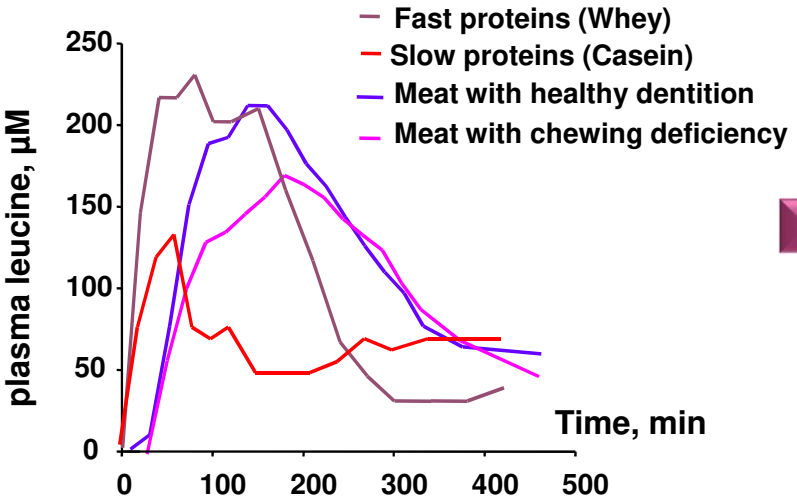
Amino acid absorption and subsequent muscle protein accretion following graded intakes of whey protein in elderly men

Bart Pennings,[1,2] Bart Groen,[1,2] Anneke de Lange,[2] Annemie P. Gijsen,[3] Antoine H. Zorenc,[2] Joan M. G. Senden,[1,2] and Luc J. C. van Loon[1,2]





Speed of protein digestion (fast/slow proteins)



Fast Protein:
↗ postprandial protein anabolism

Boirie Y, PNAS 1997 ; Dangin, AJP 2001
Remond D, Am J Clin Nutr 2006
Pennings B, Am J Clin Nutr 2011

Application in patients

Contents lists available at ScienceDirect

Clinical Nutrition

journal homepage: http://www.elsevier.com/locate/clnu

Original article

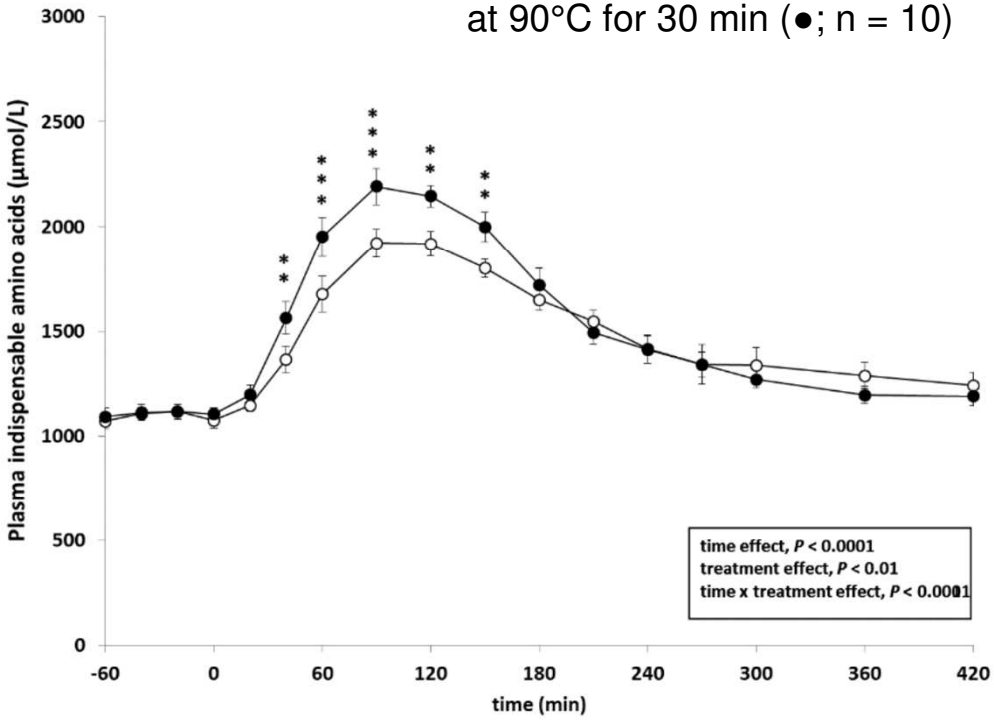
Fast-digestive protein supplement for ten days overcomes muscle anabolic resistance in healthy elderly men

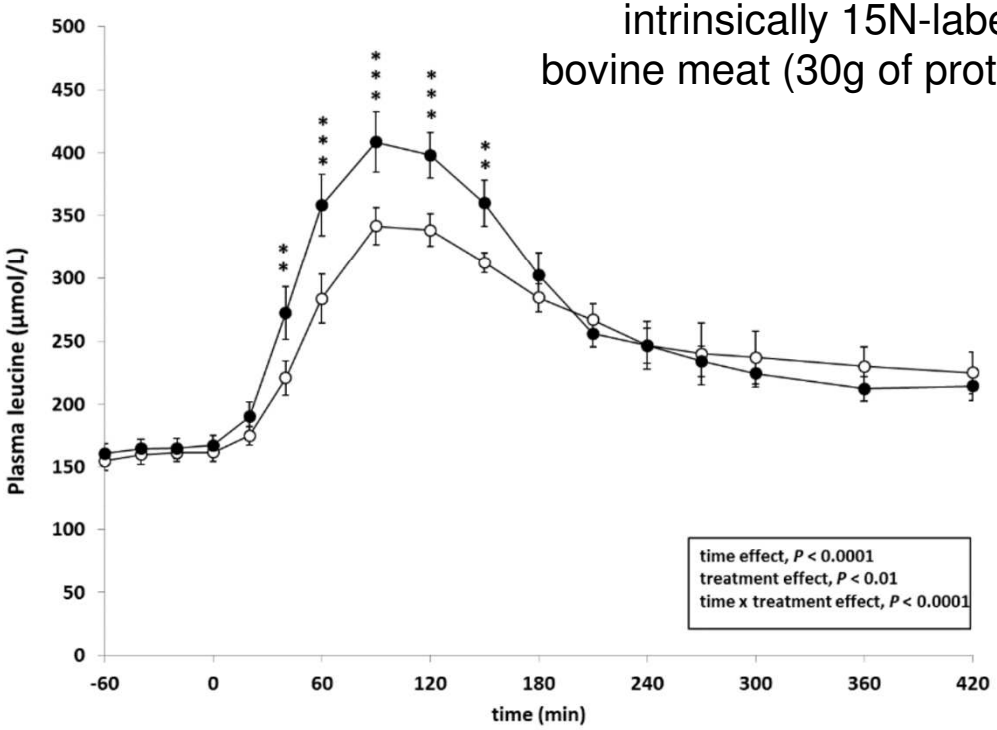
Walrand S, Clin Nutr 2016

In elderly, meat protein assimilation is reduced when meat is poorly cooked

consumption of meat cooked either
at 55°C for 5 min (○; n = 10) or
at 90°C for 30 min (●; n = 10)

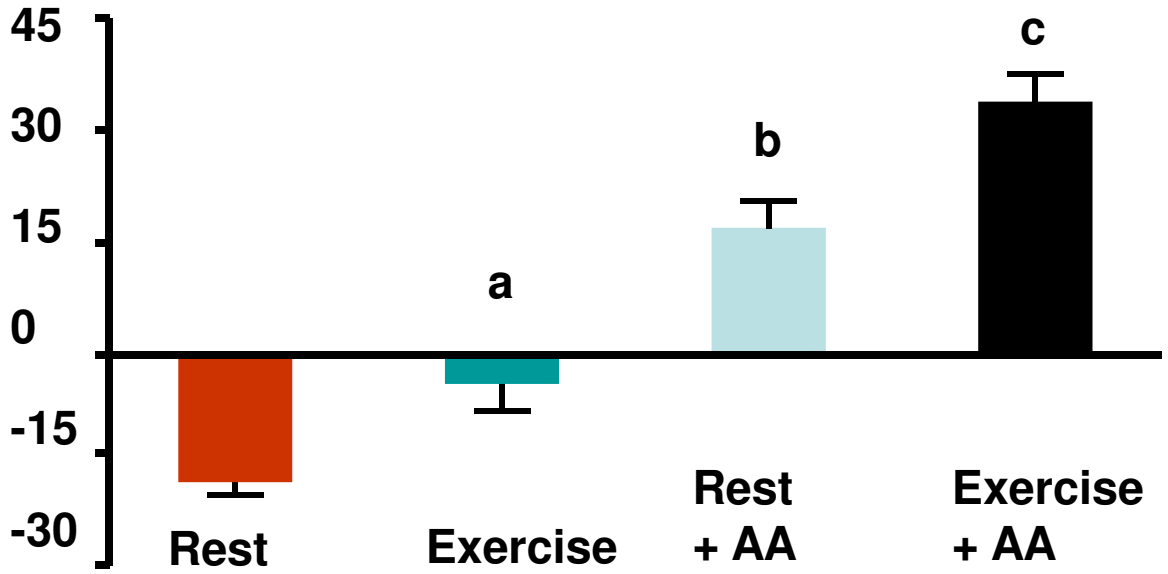
aged 70-82 y
2 separate occasions
test meal
intrinsically 15N-labeled
bovine meat (30g of protein)





Buffière C, Am J Clin Nutr 2017

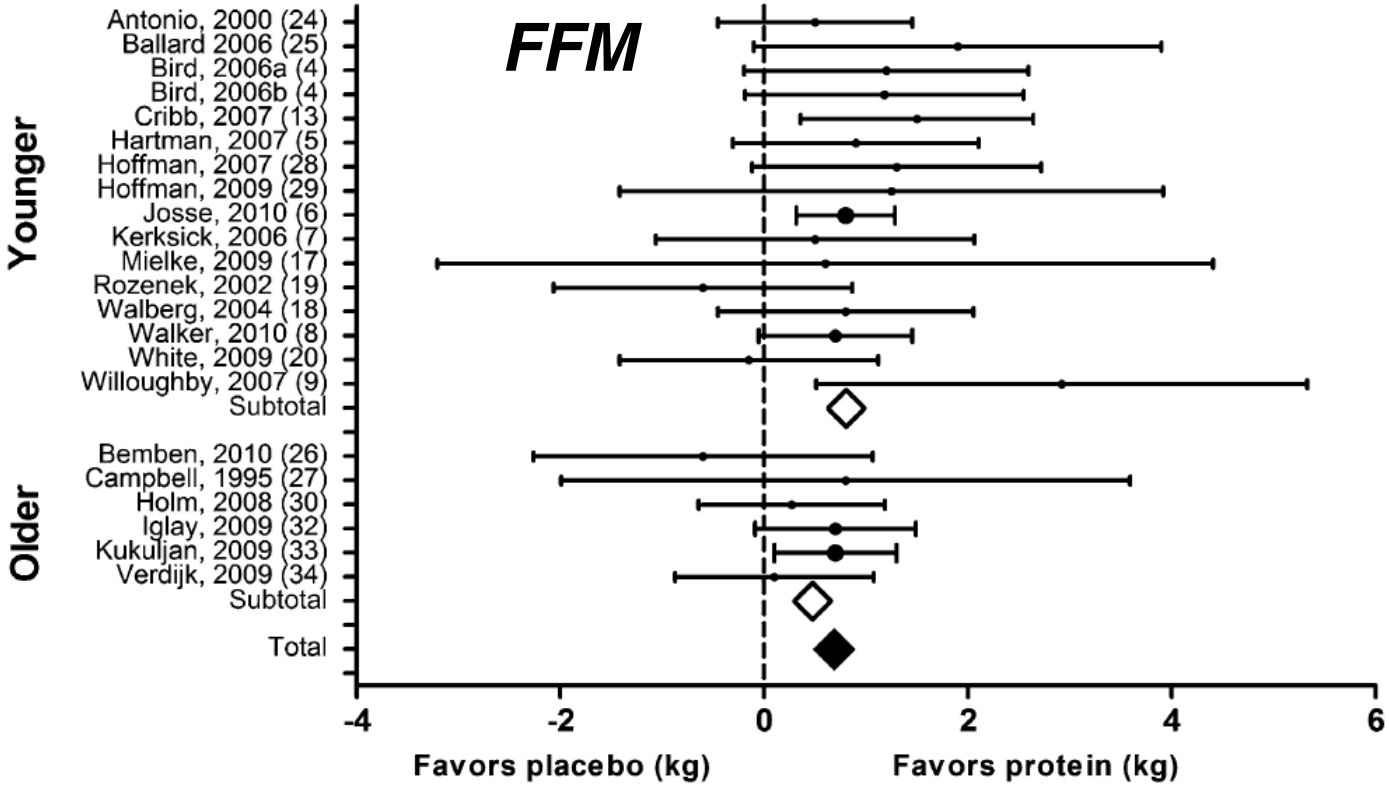
Physical exercise potentiates the anabolic impact of amino acid



Biolo G, J Clin Invest 1995

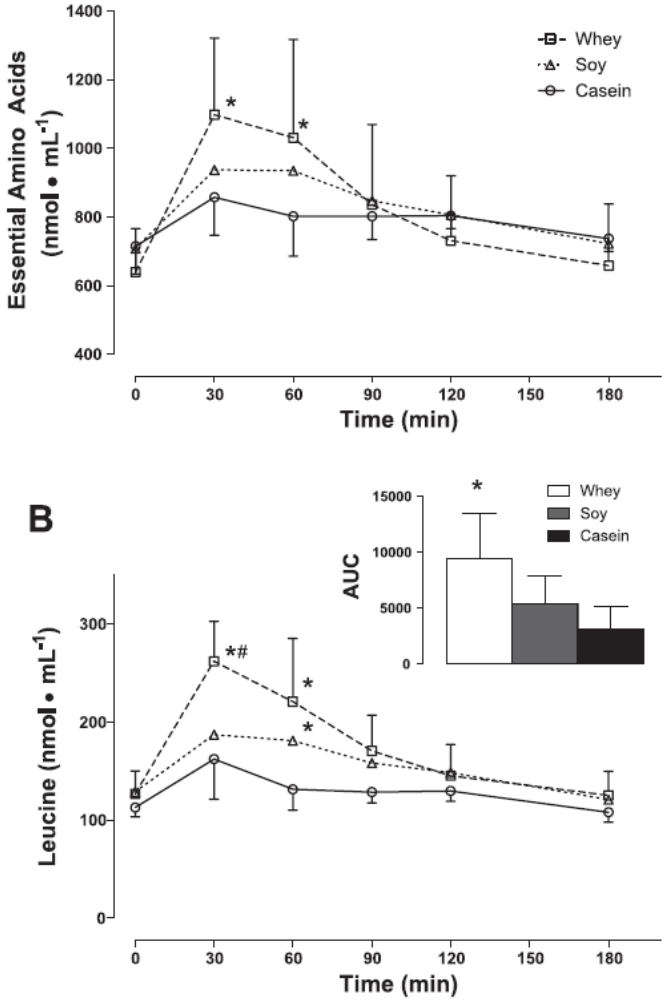
Protein supplementation augments the adaptive response of skeletal muscle to resistance-type exercise training: a meta-analysis[1–3]

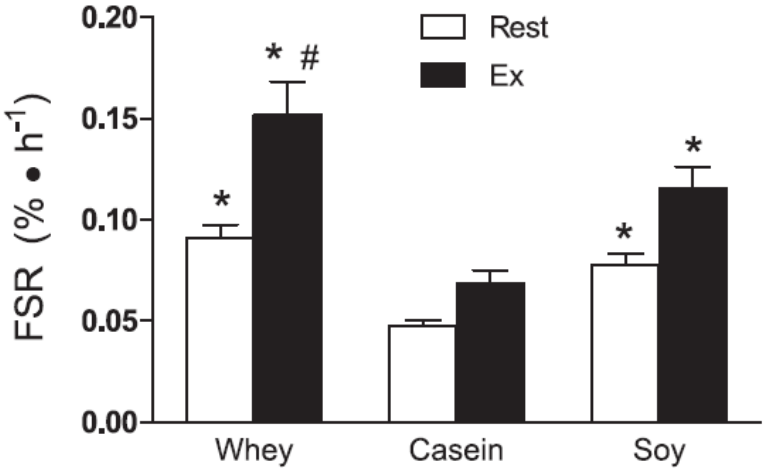
Naomi M Cermak, Peter T Res, Lisette CPGM de Groot, Wim HM Saris, and Luc JC van Loon



Cermak NM, Am J Clin Nutr 2012

Ingestion of whey hydrolysate, casein, or soy protein isolate: effects on mixed muscle protein synthesis at rest and following resistance exercise in young men





Tang JE, J Appl Physiol 2009

Greater stimulation of myofibrillar protein synthesis with ingestion of whey protein isolate v. micellar casein at rest and after resistance exercise in elderly men

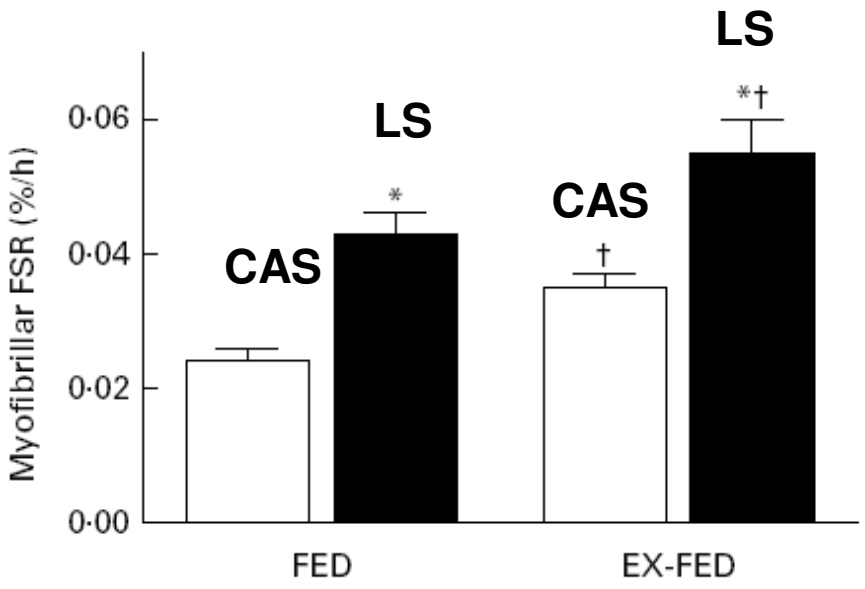


Fig. 1. Myofibrillar protein synthesis (fractional synthetic rate (FSR)) after ingestion of 20 g whey protein isolate (■) or micellar casein (□) at rest (FED) and after resistance exercise (EX-FED). Values are means with their standard errors represented by vertical bars (*n* 7). * Mean values were significantly different from those of the micellar casein group for the same condition ($P<0·05$). † Mean values were significantly different from those of the FED group ($P<0·05$).

- **20g whey protein results in higher <u>myofibrillar</u> protein synthesis in elderly vs 20g casein**
- **Exercise (further) stimulates MPS in both groups**

Burd N, Br J Nutr 2012

Protein intake and exercise for optimal muscle function with aging: Recommendations from the ESPEN Expert Group

Nicolaas E.P. Deutz [a,*], Jürgen M. Bauer [b], Rocco Barazzoni [c], Gianni Biolo [c], Yves Boirie [d], Anja Bosy-Westphal [e], Tommy Cederholm [f,g], Alfonso Cruz-Jentoft [h], Zeljko Krznariç [i], K. Sreekumaran Nair [j], Pierre Singer [k], Daniel Teta [l], Kevin Tipton [m], Philip C. Calder [n,o]

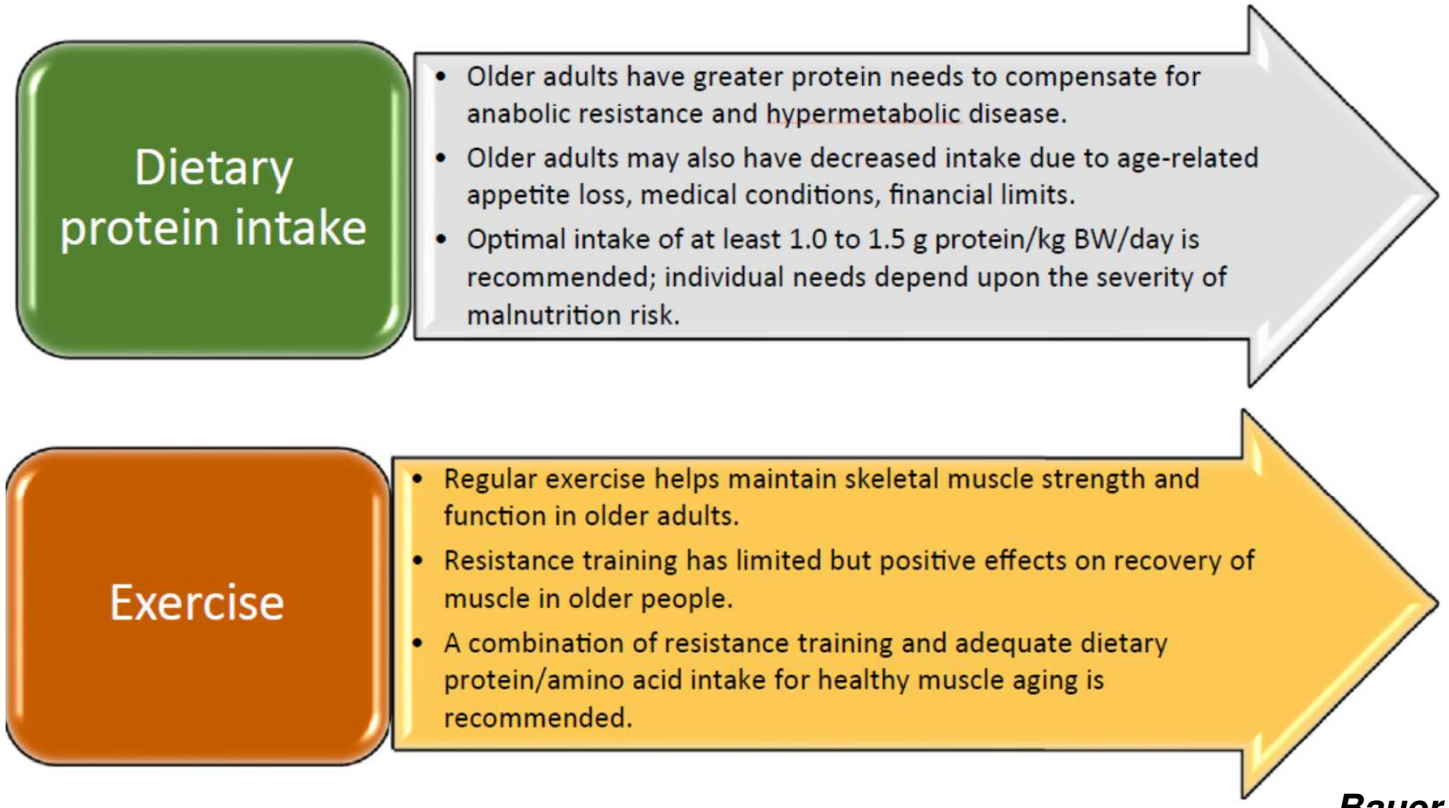


Fig. 3. Recommendations for maintaining healthy muscle with aging.

Bauer J, J Am Med Dir Assoc 2014
Deutz NEP, Clin Nutr 2014

Comment favoriser l'anabolisme musculaire par la nutrition ?

- **Augmenter les apports protéiques ?**
- **Favoriser la consommation de certains AA ?**
- **Augmenter l'efficacité postprandiale des protéines ?**
- **Trouver de nouvelles synergies ?**

Low Vitamin D and High Parathyroid Hormone Levels as Determinants of Loss of Muscle Strength and Muscle Mass (Sarcopenia): The Longitudinal Aging Study Amsterdam

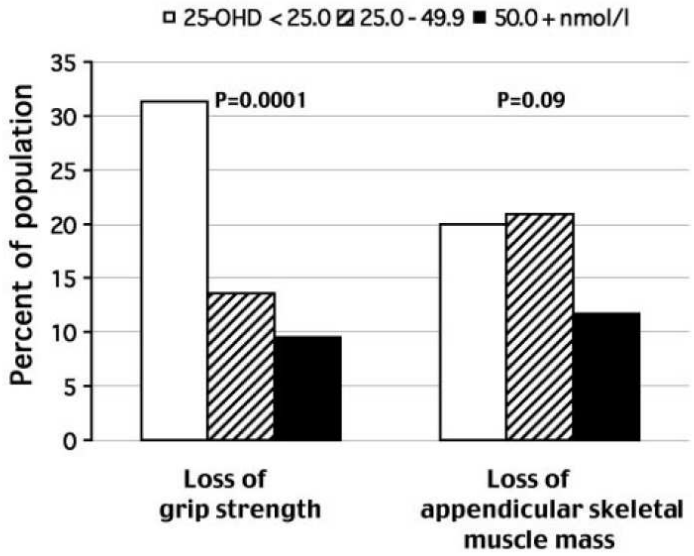


FIG. 1. Prevalence of grip strength loss (defined as loss >40%, study sample n = 1,008) and appendicular muscle mass loss (defined as loss >3%, study sample n = 331) during 3-yr follow-up according to categories of baseline serum 25-OHD concentration. P value of χ^2 test.

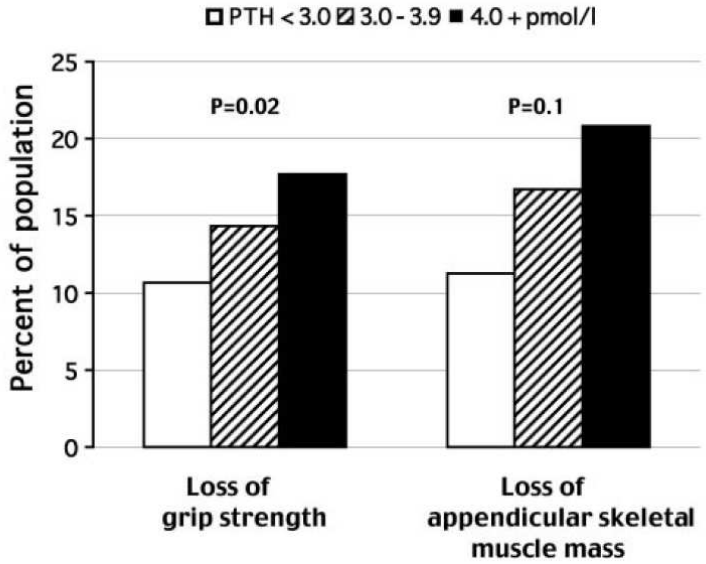


FIG. 2. Prevalence of grip strength loss (defined as loss >40%, study sample n = 1,008) and appendicular muscle mass loss (defined as loss >3%, study sample n = 331) during 3-yr follow-up according to tertiles of baseline serum PTH concentration. P value of χ^2 test.

Visser M, JCEM 2003

Intérêt des oméga 3 pour le métabolisme et la fonction musculaire

Dietary omega-3 fatty acid supplementation increases the rate of muscle protein synthesis in older adults: a randomized controlled trial[1–3]

Gordon I Smith, Philip Atherton, Dominic N Reeds, B Selma Mohammed, Debbie Rankin, Michael J Rennie, and Bettina Mittendorfer

Am J Clin Nutr 2011

Fish oil–derived n–3 PUFA therapy increases muscle mass and function in healthy older adults[1]

Gordon I Smith,[2] Sophie Julliand,[2] Dominic N Reeds,[2] David R Sinacore,[3] Samuel Klein,[2] and Bettina Mittendorfer[2]*

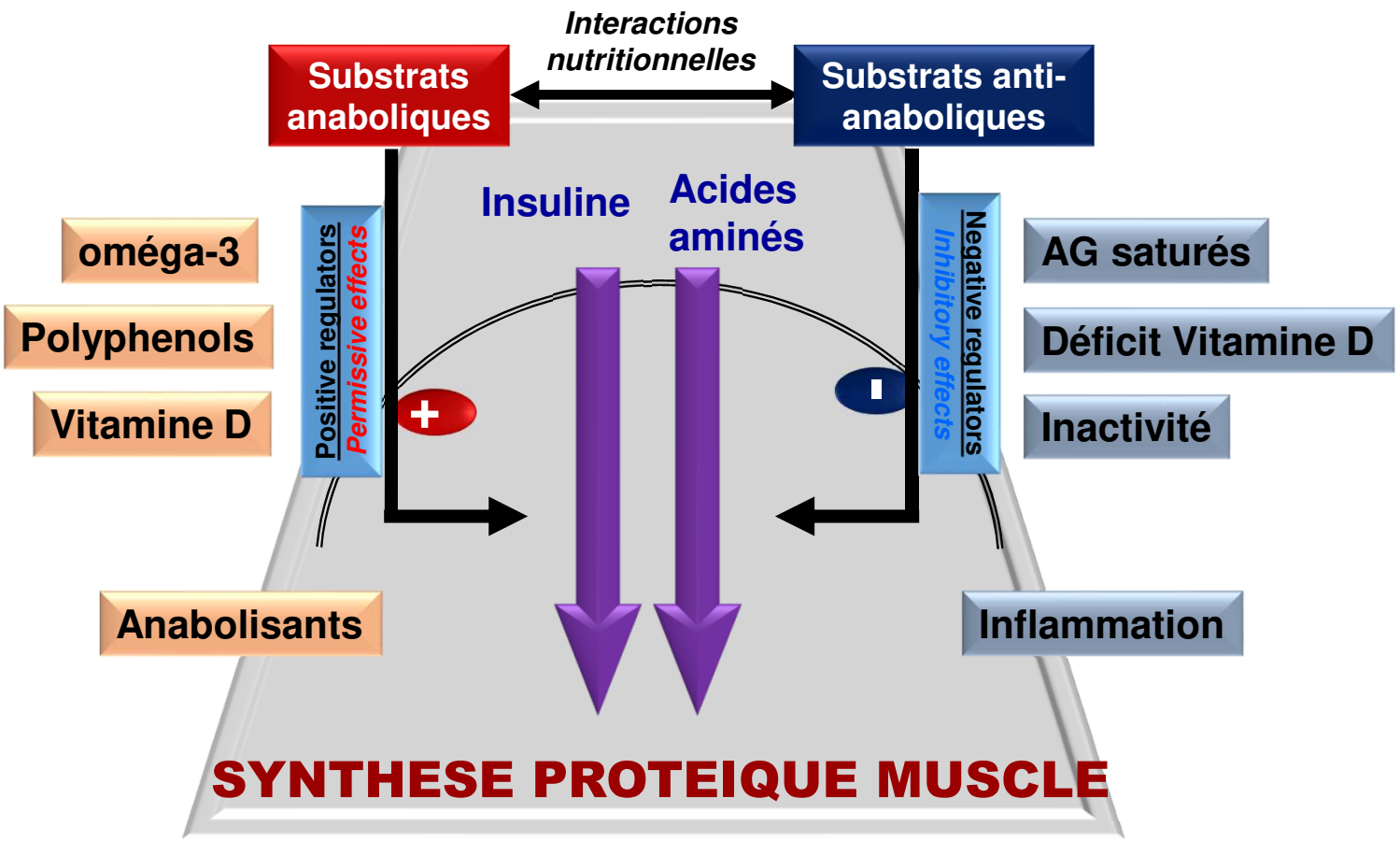
Am J Clin Nutr 2015

Plasma fatty acid biomarkers are associated with gait speed in community-dwelling older adults: The Three-City-Bordeaux study

Eric Frison [a, b], Yves Boirie [c, d, e], Evelyne Peuchant [f, g], Maturin Tabue-Teguo [a, b], Pascale Barberger-Gateau [a, b], Catherine Féart [a, b, *]

Clin Nutr 2016

Des protéines oui mais…



… d'autres synergies sont possibles

Multimodal approach to counteract sarcopenia

Effects of a Vitamin D and Leucine-Enriched Whey Protein Nutritional Supplement on Measures of Sarcopenia in Older Adults, the PROVIDE Study: A Randomized, Double-Blind, Placebo-Controlled Trial

JAMDA, 2015

Jürgen M. Bauer MD, PhD [a,*], Sjors Verlaan MSc [b,c], Ivan Bautmans PhD [d],

Whey protein, amino acids, and vitamin D supplementation with physical activity increases fat-free mass and strength, functionality, and quality of life and decreases inflammation in sarcopenic elderly[1,2]

AJCN, 2016

Mariangela Rondanelli,[3] Catherine Klersy,[6] Gilles Terracol,[7] Jacopo Talluri,[8] Roberto Maugeri,[7] Davide Guido,[4] Milena A Faliva,[3] Bruno S Solerte,[5] Marisa Fioravanti,[5] Henry Lukaski,[9] and Simone Perna[3]*

Sufficient levels of 25-hydroxyvitamin D and protein intake required to increase muscle mass in sarcopenic older adults – The PROVIDE study

Clin Nutr, 2017 *(in press)*

Sjors Verlaan [a, b, *], Andrea B. Maier [c, d], Jürgen M. Bauer [e], Ivan Bautmans [f], Kirsten Brandt [g], Lorenzo M. Donini [h], Marcello Maggio [i], Marion E.T. McMurdo [j], Tony Mets [f], Chris Seal [g], Sander L.J. Wijers [a], Cornel Sieber [k], Yves Boirie [l, m], Tommy Cederholm [n]

Comment favoriser l'anabolisme musculaire par la nutrition ?

- **Augmenter les apports protéiques ?**
  - *Prévention : 1-1,2 g Protéine/kg/j*
  - *Récupération : 1,2-1,5 g Protéine/kg/j*
- **Favoriser la consommation de certains AA ?**
  - *2,5-3 g Leucine*
  - *HMB, autres AA ?*
- **Augmenter l'efficacité postprandiale des protéines ?**
  - *Protéines « rapides »*
  - *Distribution journalière*
- **Trouver de nouvelles synergies ?**
  - *Vitamine D*
  - *Acides gras polyinsaturés*
  - *Antioxydants*

+ exercice (résistance ?)

3ème message

La synthèse protéique musculaire :

- **augmente après une charge suffisante de protéines de haute valeur biologique (avec apport optimal en leucine)**
- **dépend de la disponibilité en AA en intensité, vitesse et distribution**
- **peut être potentialisée par l'activité physique mais aussi par d'autres composés nutritionnels (à préciser sur le plan des effets cliniques)**

Merci de votre attention

Unité de Nutrition Humaine

CHU CLERMONT FERRAND

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