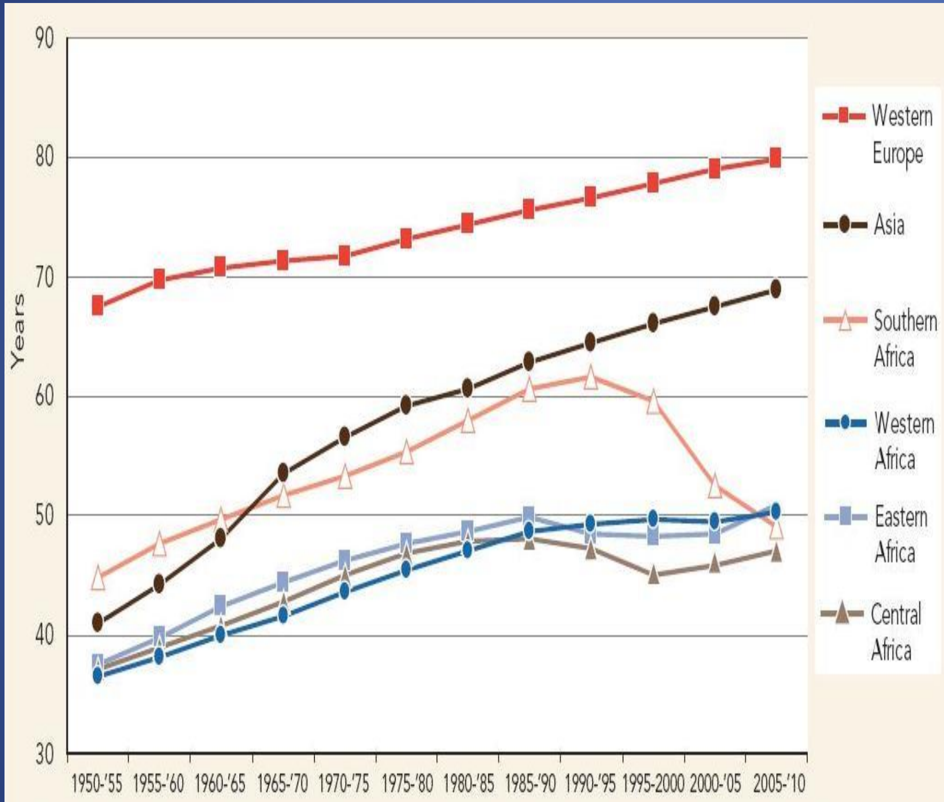
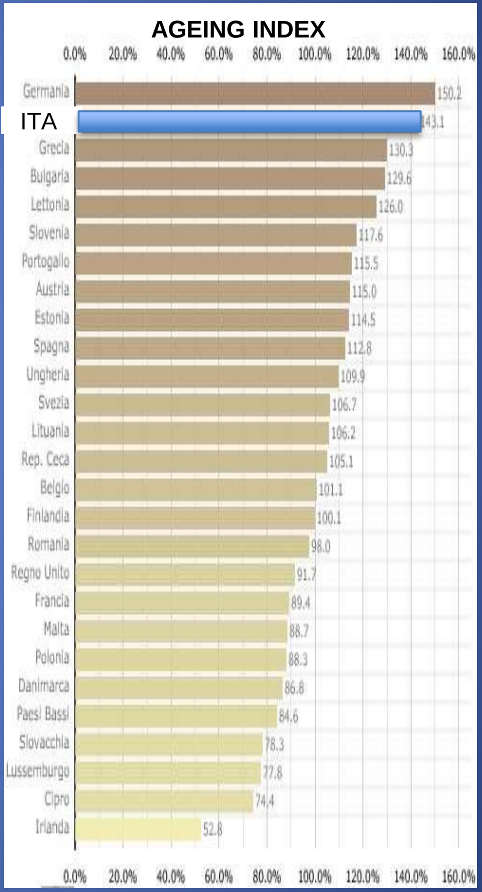
Società moderna



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2006 Revision, http://esa.un.org/unpp

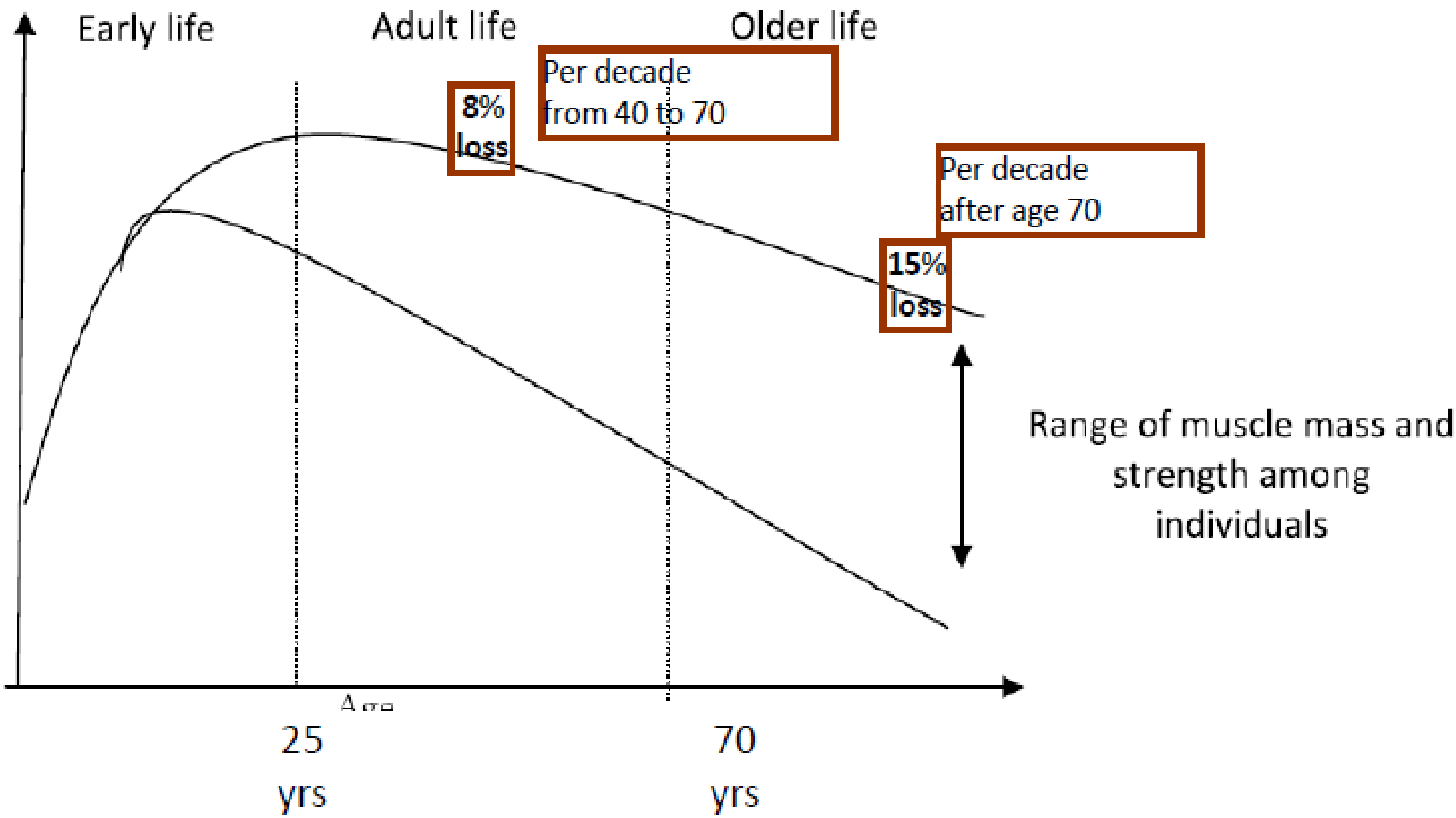


- % of people over 65y

Società moderna

Johanna Quaas, 86 years old

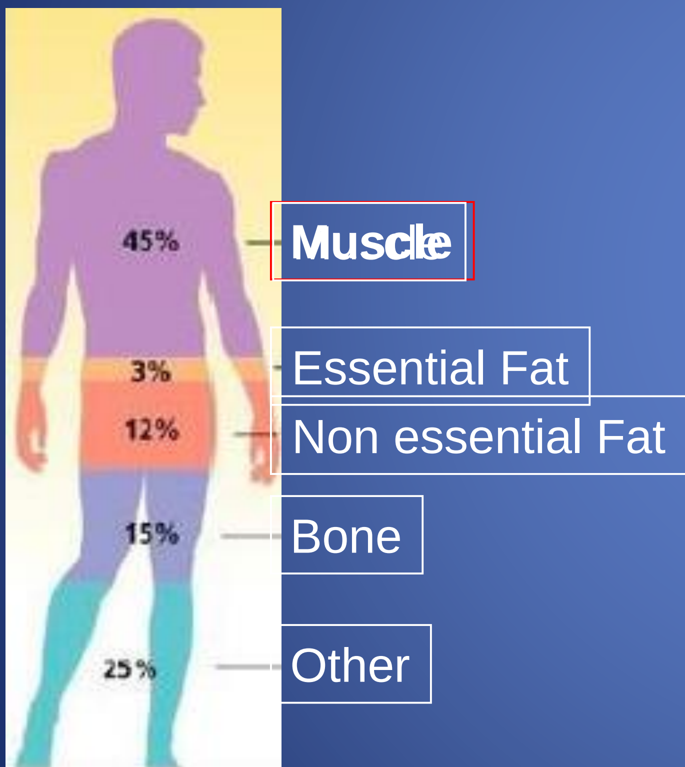
Lignano (ITA) Master Games 2011



Hairi N, www.intechopen.com 2008

INTRODUCTION

BODY COMPOSITION



MUSCLE:

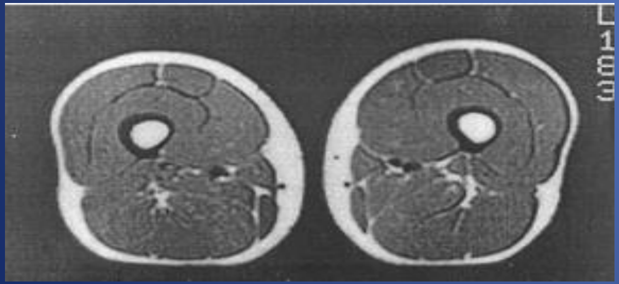
- the most represented tissue in the body
- 20% is proteins
- the tissue containing most of body proteins
- has multiple functions:
    - Movement-posture
    - Metabolism
    - Endocrine (myokines)

INTRODUCTION

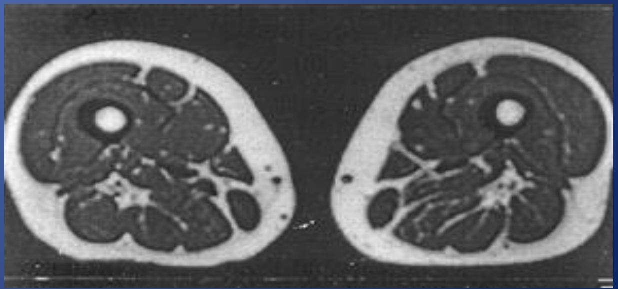
SARCOPENIA

“syndrome characterized by progressive and generalized loss of skeletal muscle mass and strength, with a risk of adverse outcomes such as physical disability, poor quality of life and death”

European Working Group on Sarcopenia in Older People (EWGSOP)
2012



Young woman
(21y, BMI 24.3 kg/m^2)



Elderly woman
(73y, BMI 24.5 kg/m^2)

SARCOPENIA

ANABOLIC RESISTANCE TO AMINO ACID AND PROTEIN

MUSCLE ATROPHY

FAT MASS DEPOSITION

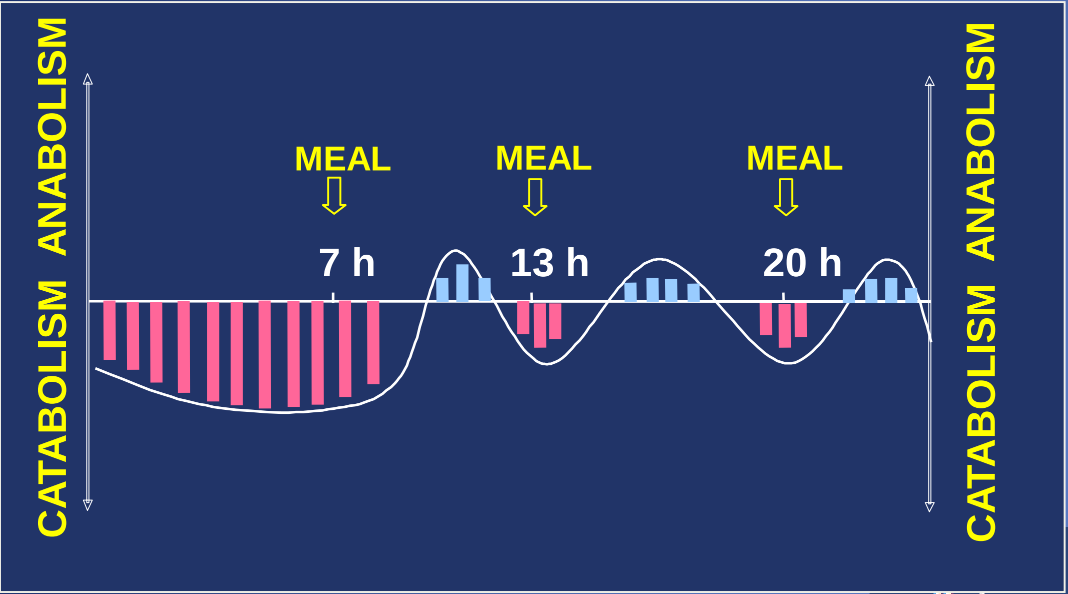
REDUCTION IN PHYSICAL ACTIVITY

OXIDATIVE STRESS

SYSTEMIC CHRONIC INFLAMMATION

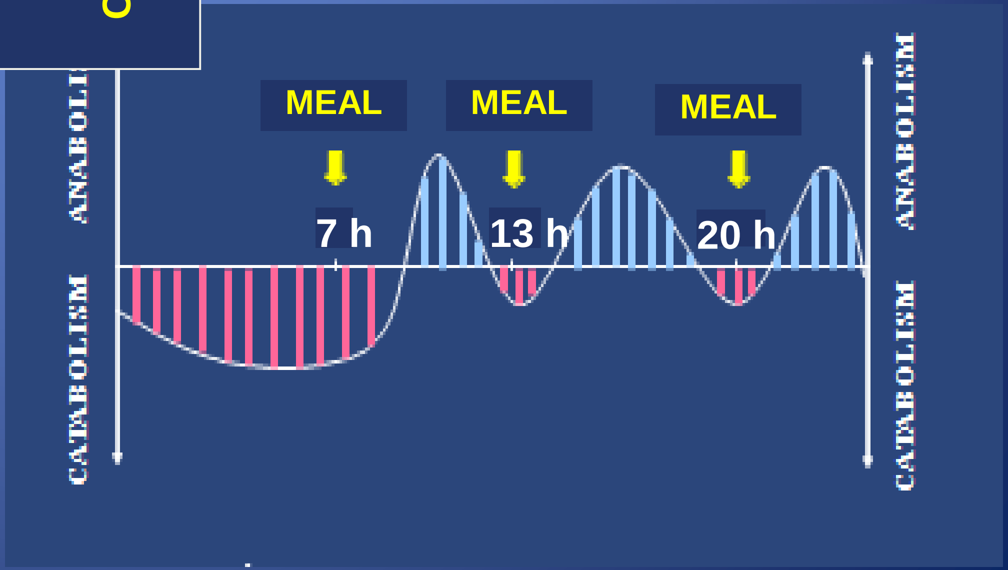
INSULIN-RESISTANCE

SARCOPENIA: Anabolic resistance



the inability to increase protein synthesis in response to a meal induced higher amino acid availability.

Biolo G et al. *Clin Nutr 2014*

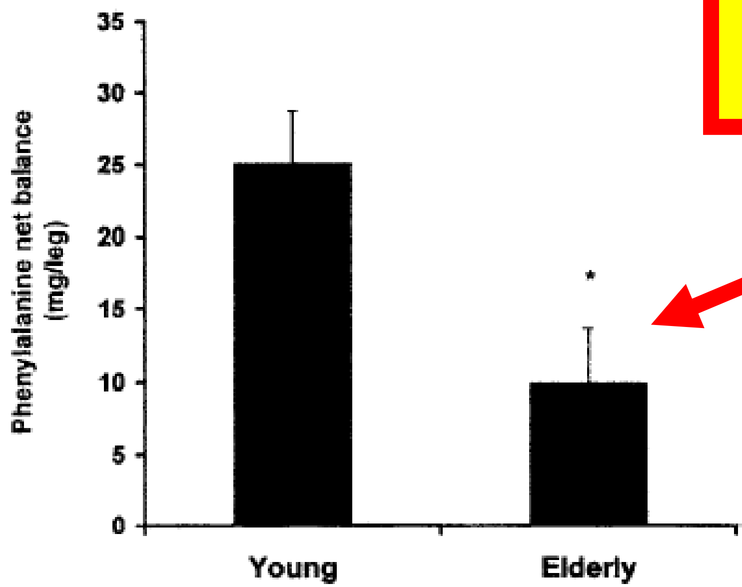


Aging is associated with diminished accretion of muscle proteins after the ingestion of a small bolus of essential amino acids[1–3]

Christos S Katsanos, Hisamine Kobayashi, Melinda Sheffield-Moore, Asle Aarsland, and Robert R Wolfe

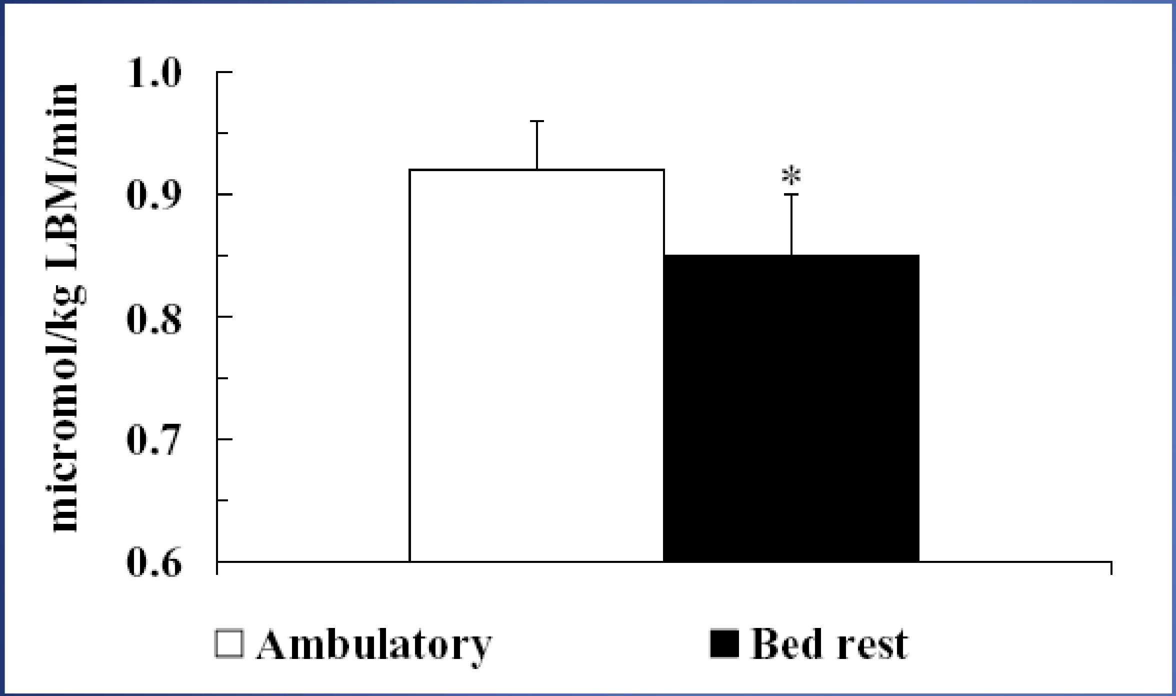
Am J Clin Nutr 2005;82:1065–73.

Anabolic resistance of aging



Mean (±SEM) leg phenylalanine net balance 3.5 h after the ingestion of essential amino acids calculated by measuring the area under the phenylalanine net balance response curve (in the calculations, basal net balance was taken as zero) in the elderly ($n = 11$) and the young ($n = 8$). Data were analyzed with a t test. *Significantly different from the young, $P = 0.010$.

SARCOPENIA: effects of immobilization

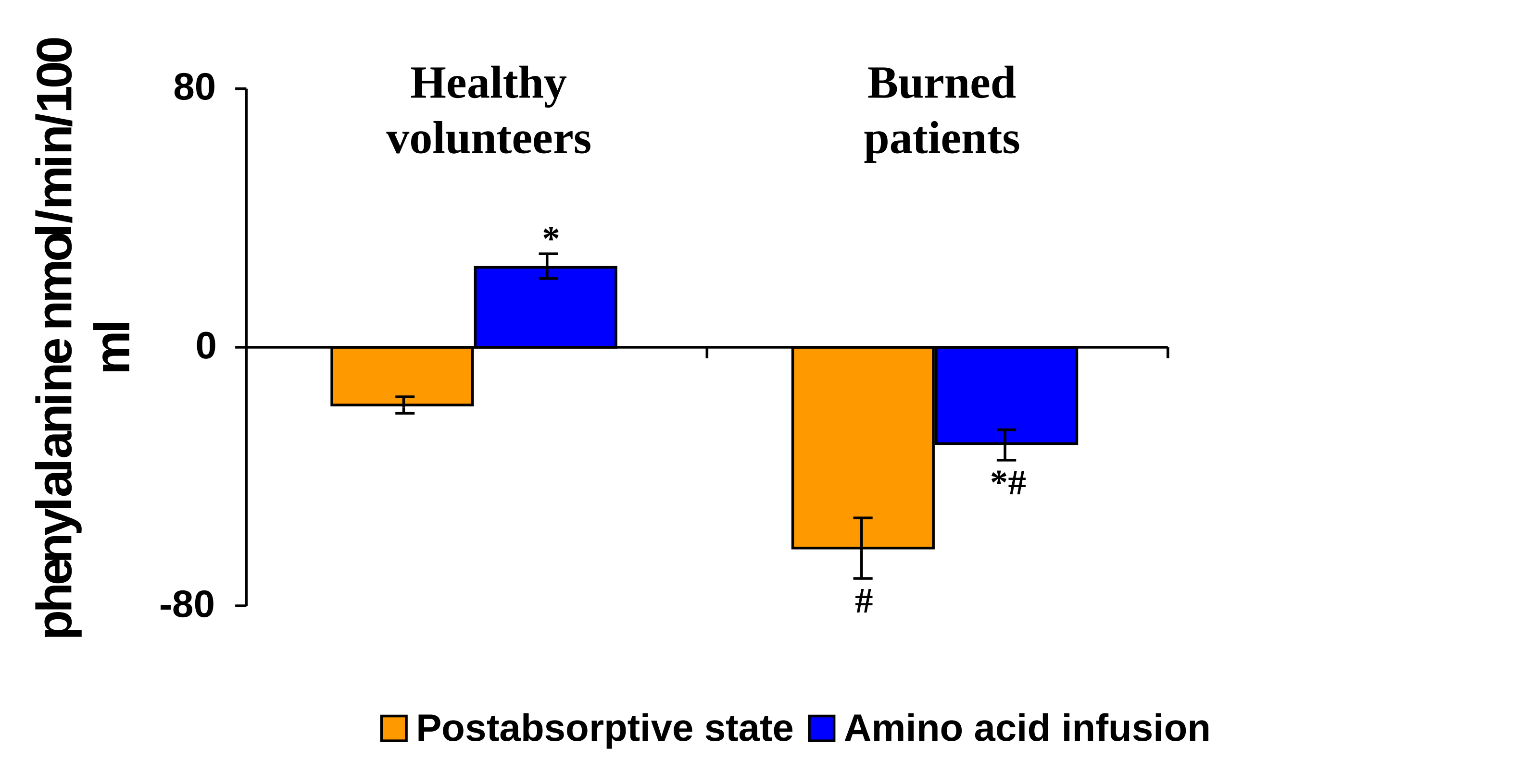


BED REST

Short-term bed rest impairs amino acid-induced protein anabolism in humans

Biolo et al., J Physiol 2004

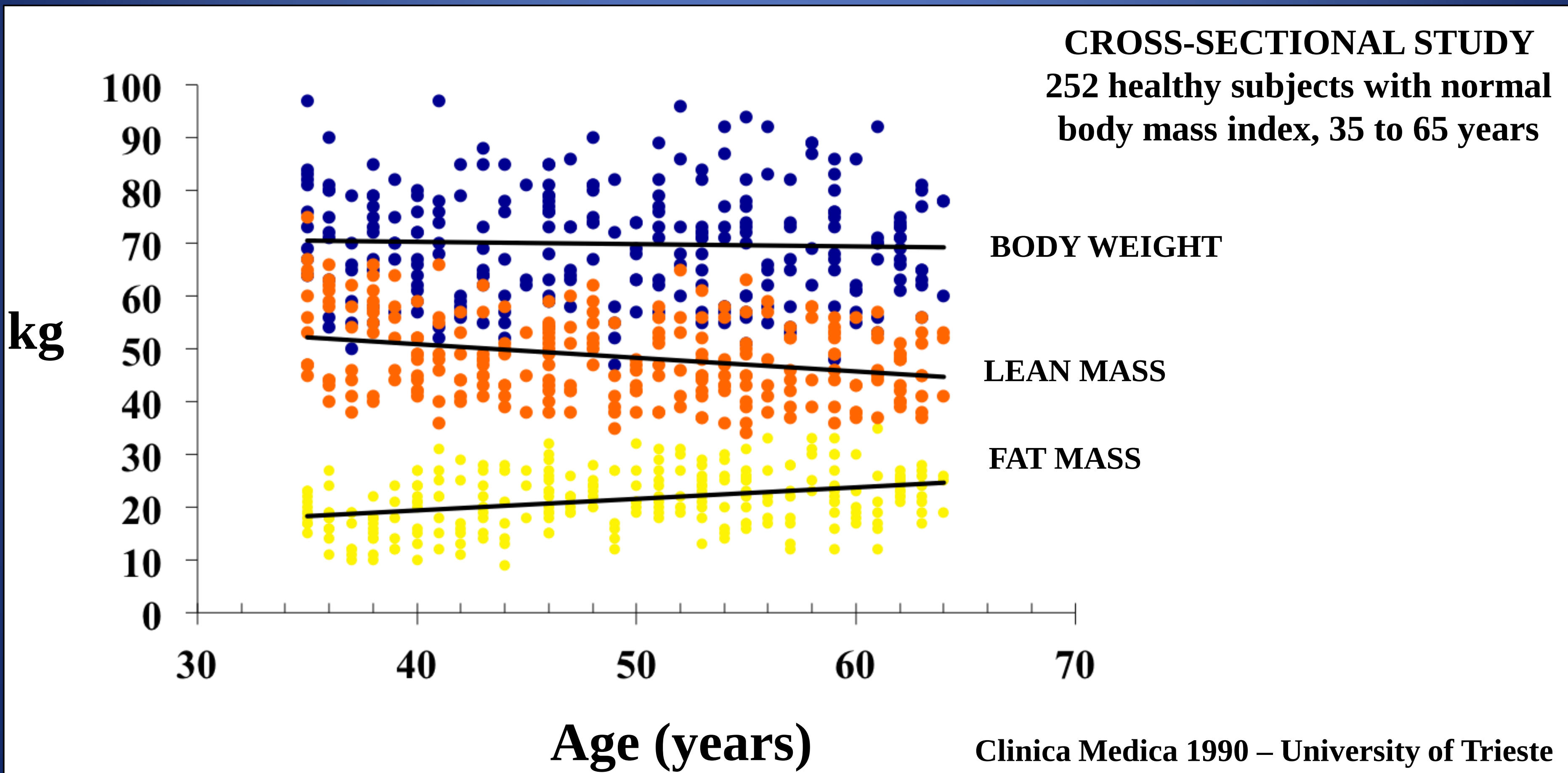
EFFECTS OF AMINO ACID INFUSION ON SKELETAL MUSCLE PROTEIN BALANCE IN SEVERELY BURNED PATIENTS



*, P<0.05 vs. postabsorptive state #, P<0.05 vs. healthy volunteers

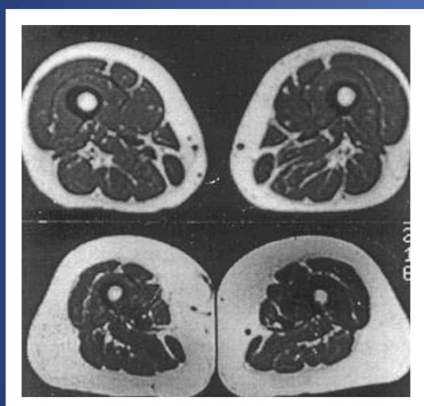
INTRODUCTION

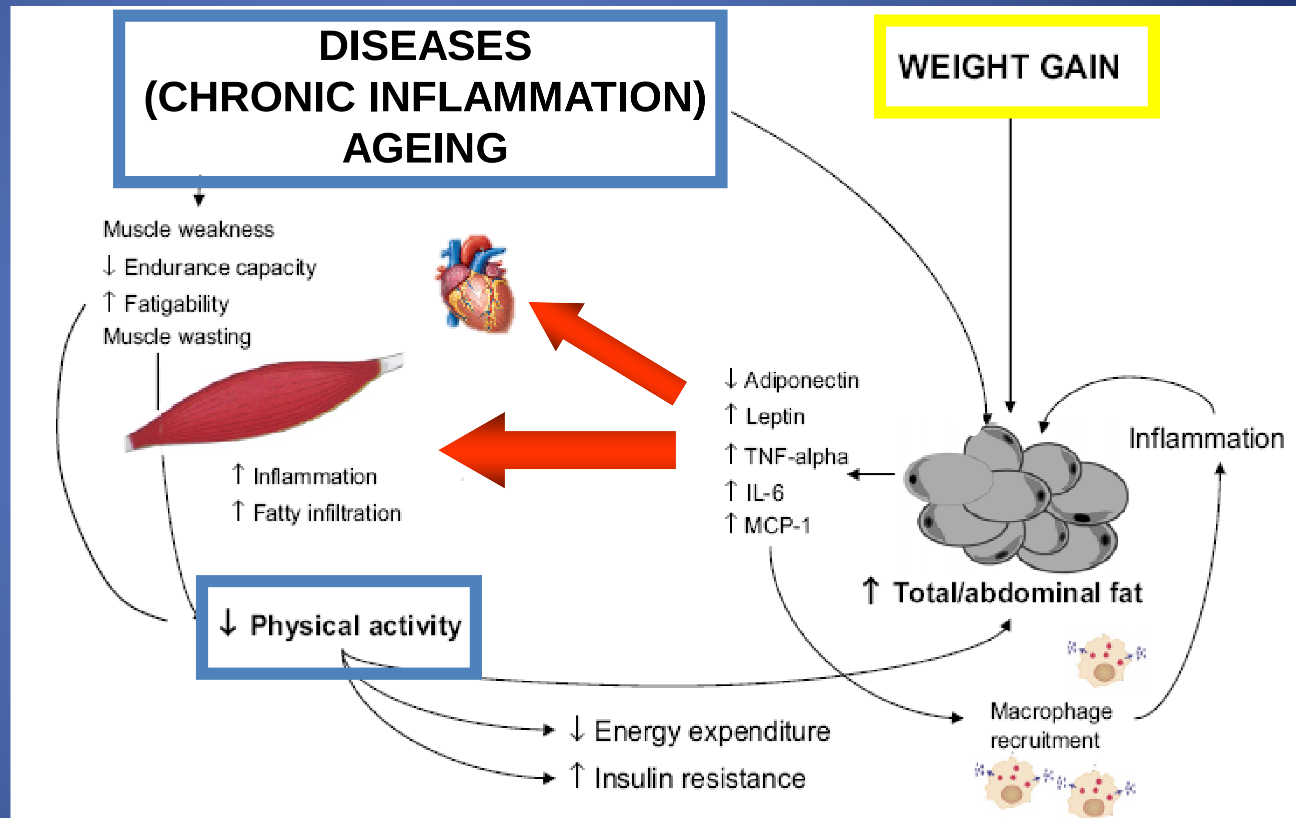
SARCOPENIA: Body weight and composition in aging



INTRODUCTION

SARCOPENIA: Role of fat mass and inflammation



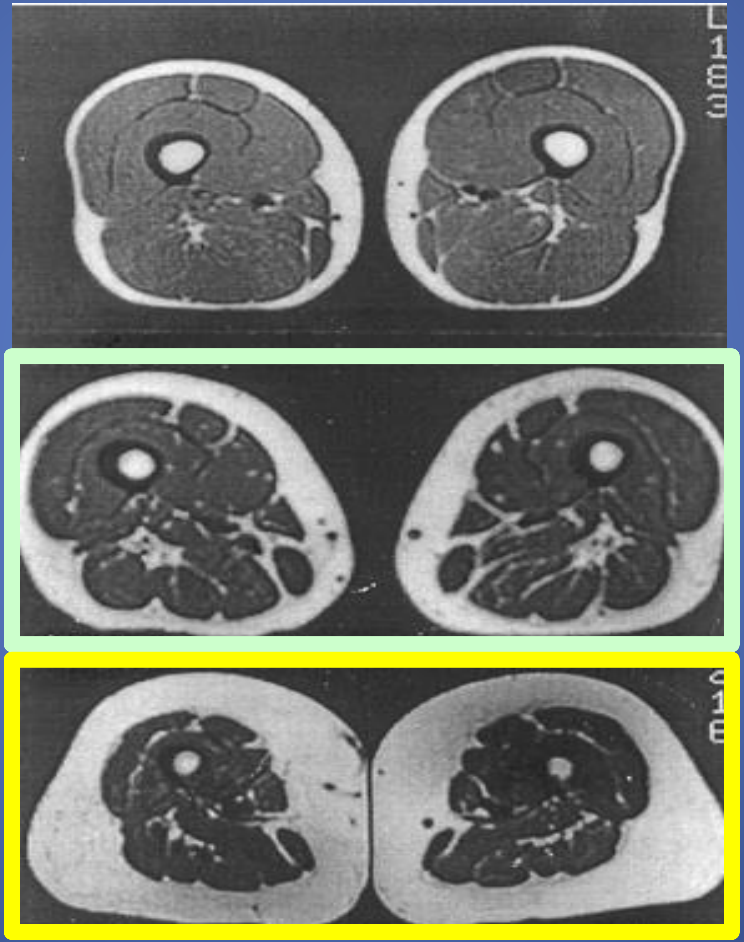


Zamboni et al., Nutrition, Metabolism & Cardiovascular Diseases 2008

Inter-relationships between adipose tissue and muscle. A mechanism leading to sarcopenic obesity.

INTRODUCTION

SARCOPENIA



SARCOPENIC OBESITY

COMPOSIZIONE CORPOREA

OBESITÀ SARCOPENICA

Sindrome caratterizzata da progressiva e generalizzata alterazione della composizione corporea, con:

- **eccesso di tessuto adiposo (obesità)**
- **ridotti massa e funzionalità muscolari (sarcopenia)**

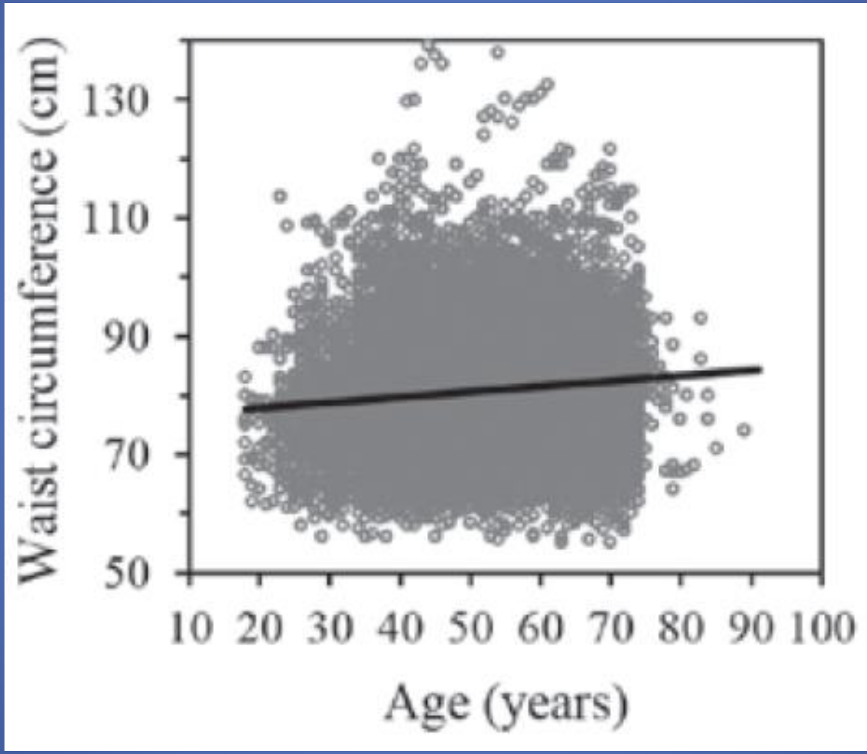
Prevalenza maggiore in anziani e persone affette da malattie croniche

Interferisce negativamente con

- **capacità fisica**
- **metabolismo**
- **funzione cardiovascolare**

con conseguente peggioramento della qualità della vita, aumento della morbidità e della mortalità.

Correlation between waist circumference and age



Correlations were examined in longitudinal data for waist circumference in all subjects (21,358). The line represents a least-squares plot of the data. P=4.34x10-60, R2=0.0124, waist circumference (cm)=76.0696+0.0893x;

BIOMEDICAL REPORTS 3: 767-777, 2015

Società moderna

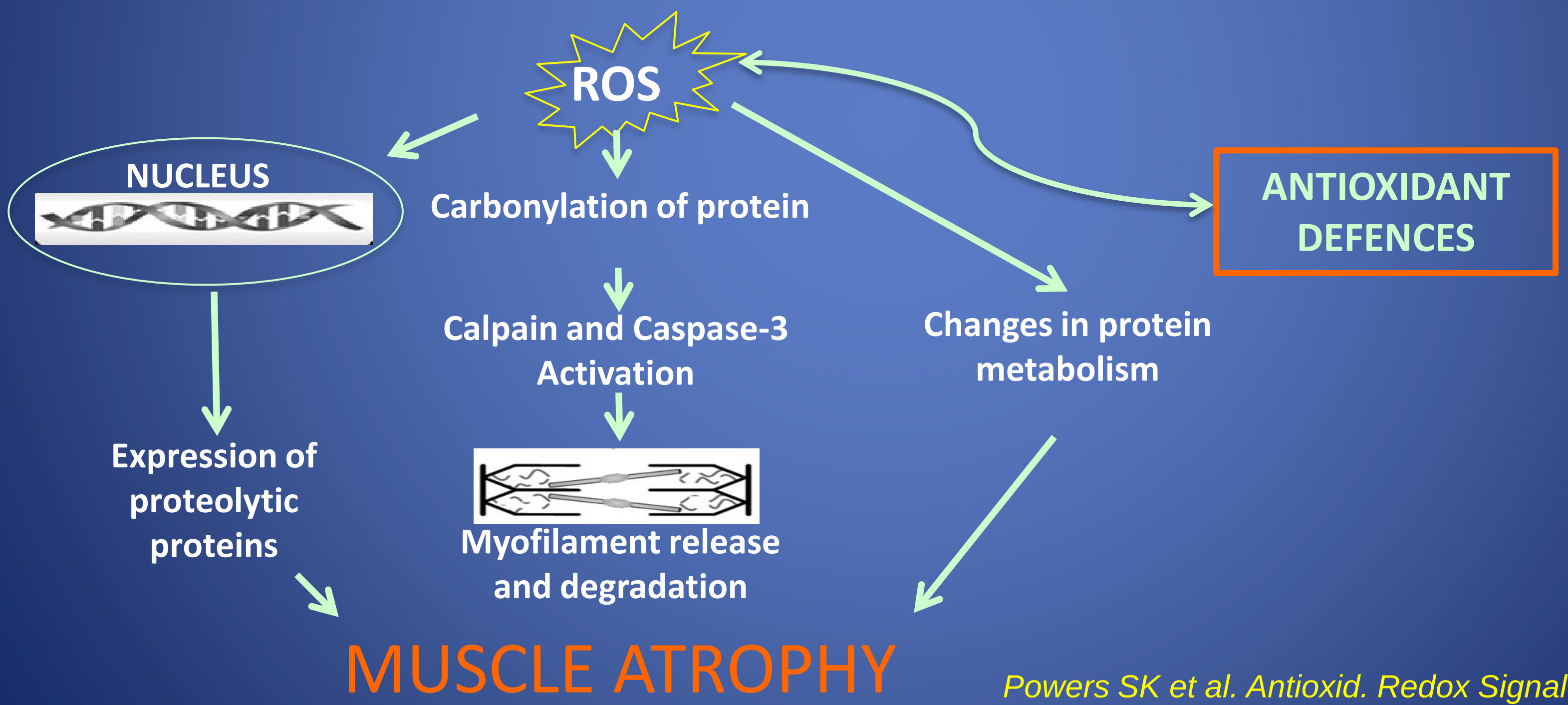
Johanna Quaas, 86 years old

Pengzue Su ,87-year old

SARCOPENIA: Oxidative stress

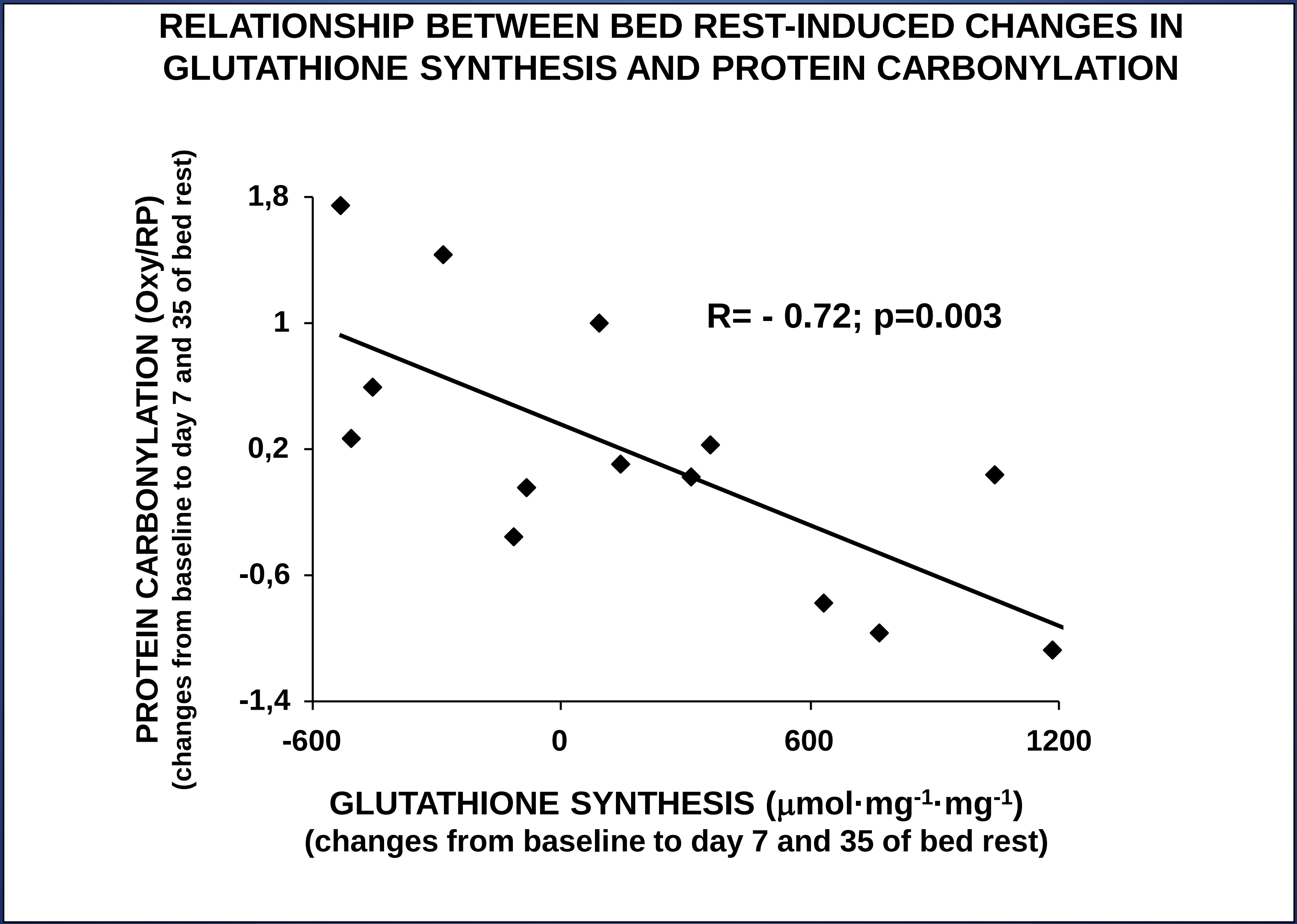
"An imbalance between oxidants and antioxidants in favor of the oxidants, potentially leading to damage, is termed *oxidative stress*".

Sies H. Exp Physiol. 1997



Powers SK et al. Antioxid. Redox Signal. 2011 - modified

Glutathione synthetic capacity directly modulates oxidative stress



CHRONIC DISEASES AND MUSCLE WAISTING

COPD

CHRONIC INACTIVITY

Exacerbations

Systemic inflammation
Oxidative stress

Anabolic/Catabolic disequilibrium

HYPOXIA

COPD Skeletal Muscle Disease

Man WDC et al. Clinical Science (2009) – Adapted

Recommended Dietary Allowance (RDA) for protein

~0.83 g/kg/d

European Food Safety Agency, 2012
Food and Nutrition Board, 2002

Net balance of body proteins

Difference between *nitrogen intake* and *total nitrogen loss*

Nitrogen Balance technique has limitations →

Systematic errors:
overestimated intake
underestimated losses
(Millward DJ. J Nutr. 1998)

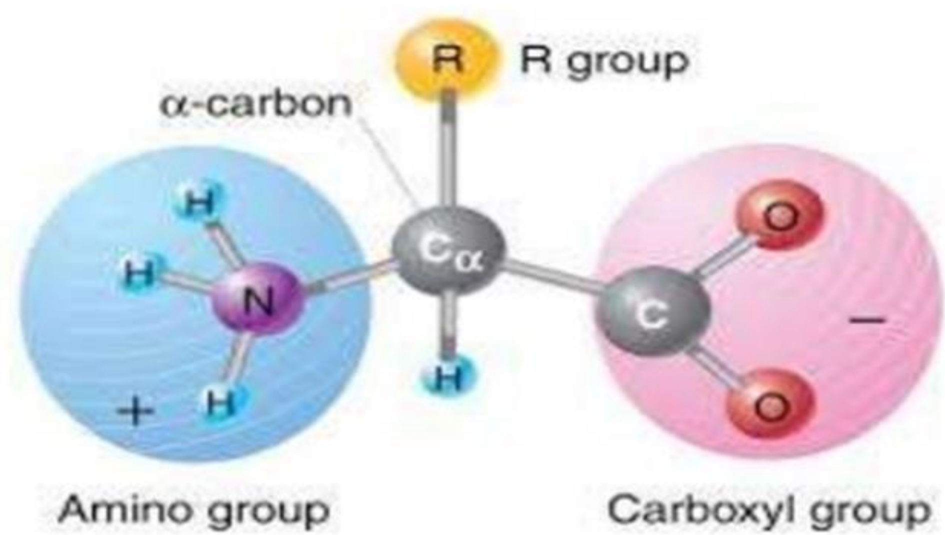
Conceptual limitation:
metabolic adaptation to nitrogen intakes
(Young VR. J Nutr. 1986)

RDA → No differences between gender and age
(Conley TB et al. J Nutr Biochem. 2013)

PROTEINE

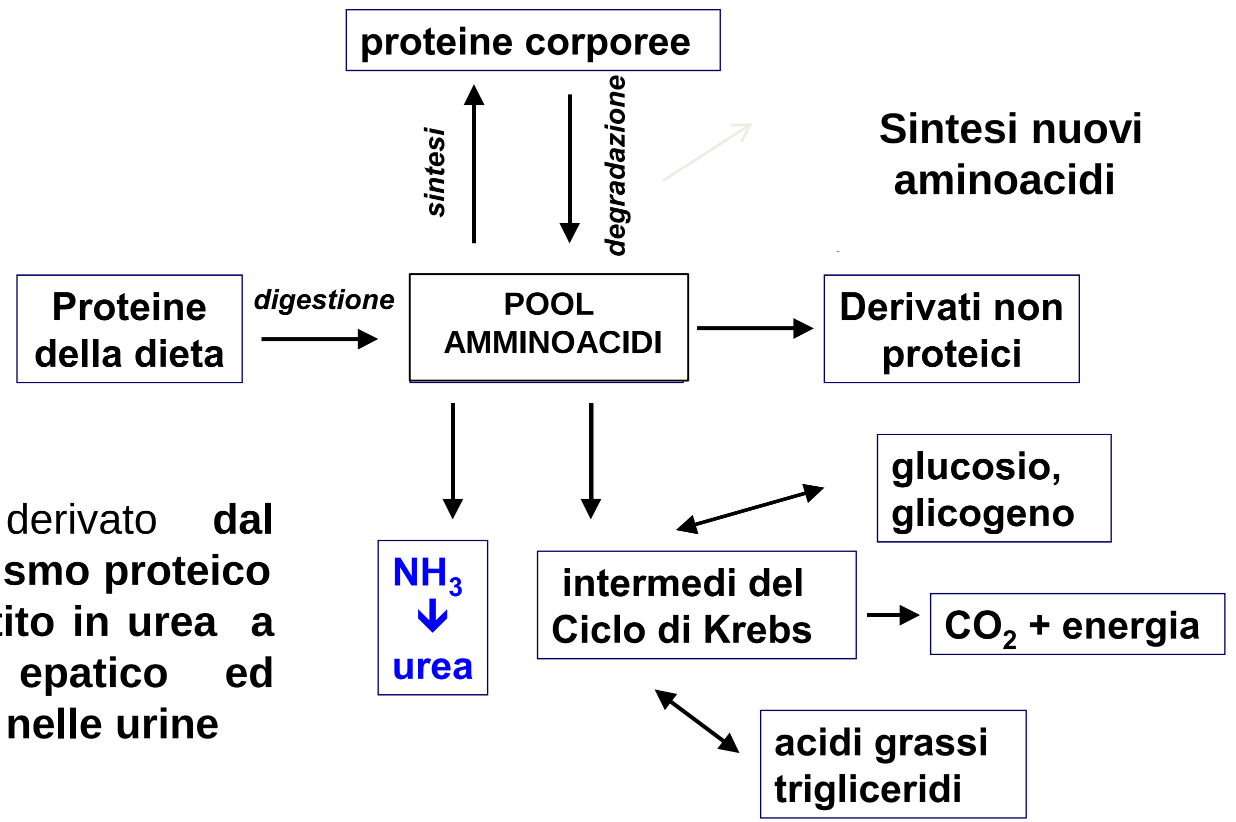
Macronutrienti con significato **plastico, funzionale ed energetico**

Le **unità di base** che compongono le molecole sono gli **amminoacidi** caratterizzati da un **gruppo amminico (-NH^{+3}) da un gruppo carbossilico (-COOH)** e da un **gruppo -R laterale**, legati a un atomo centrale di carbonio.



Gli amminoacidi vengono classificati In funzione delle proprietà chimiche del gruppo -R come acidi, basici, idrofili (o *polari*) e idrofobi (o *apolari*).

METABOLISMO DELLE PROTEINE

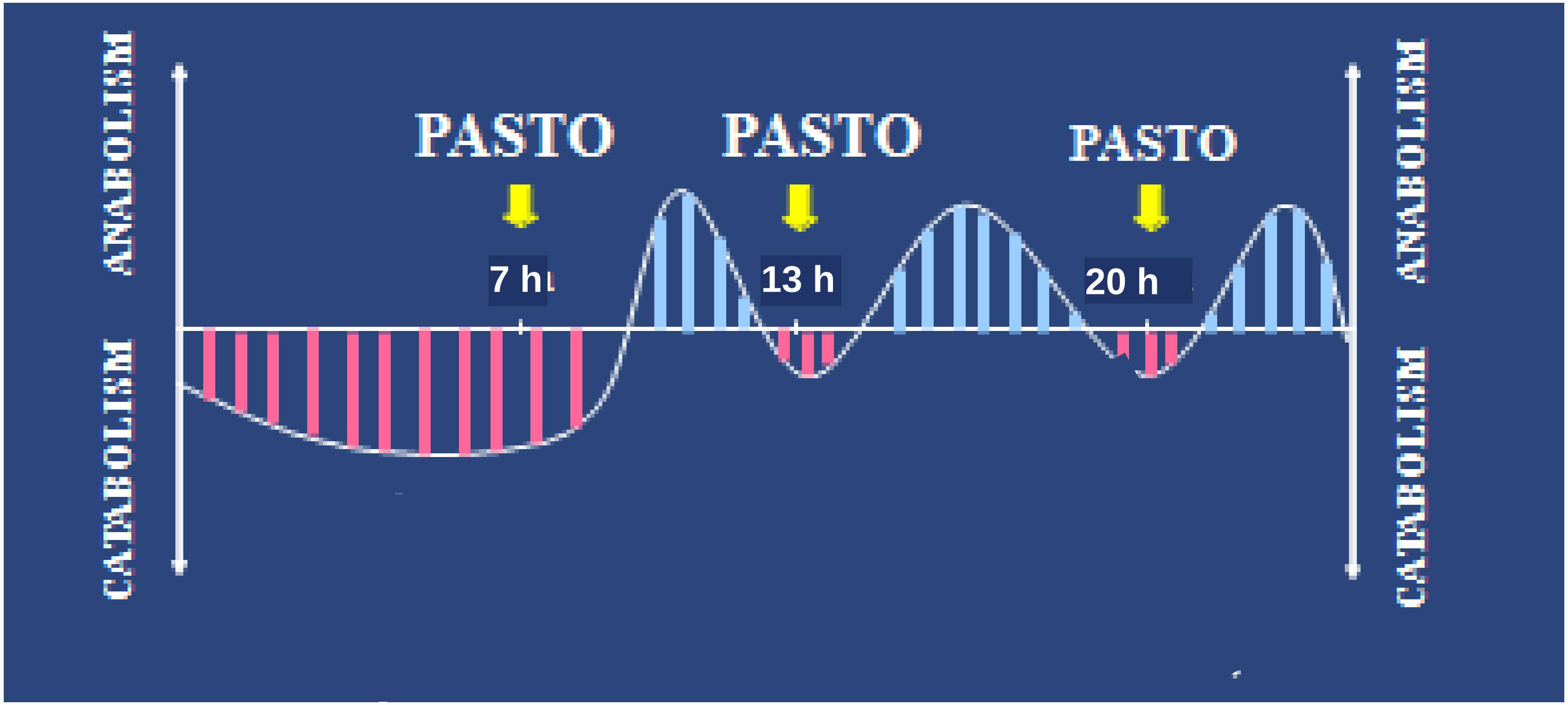


Azoto derivato **dal catabolismo proteico Convertito in urea a livello epatico ed escreto nelle urine**

Il pool di amminoacidi presente nel sangue è la risultante dei diversi fattori dall'introito alimentare al metabolismo proteico

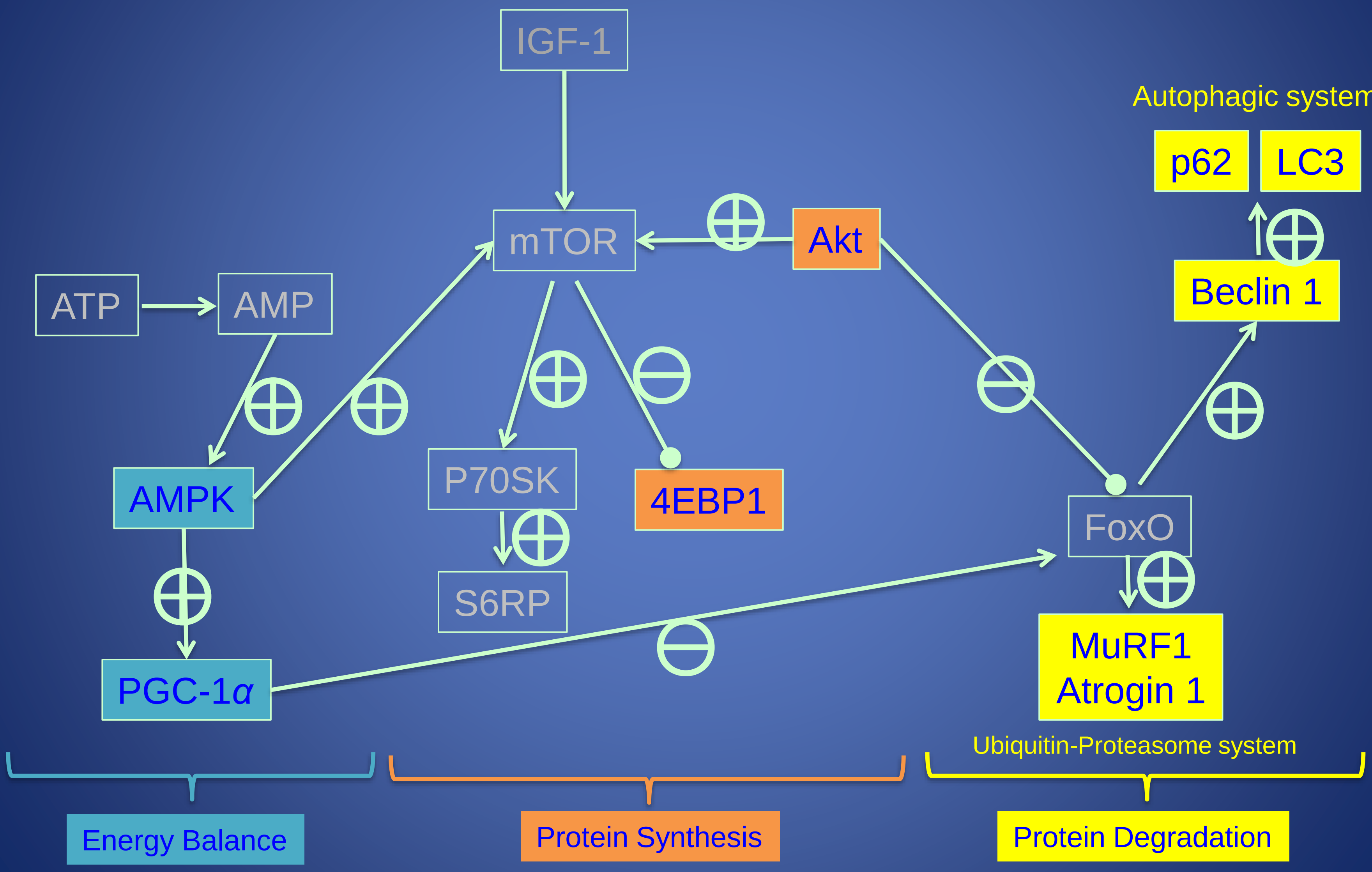
SINTESI DELLE PROTEINE

Stimolata soprattutto dagli amminoacidi introdotti con i pasti in particolare amminoacidi ramificati, (soprattutto leucina con attivazione del complesso proteico TORC 1, mammalian target of rapamycin complex) che funge da sensore dell'apporto di nutrienti

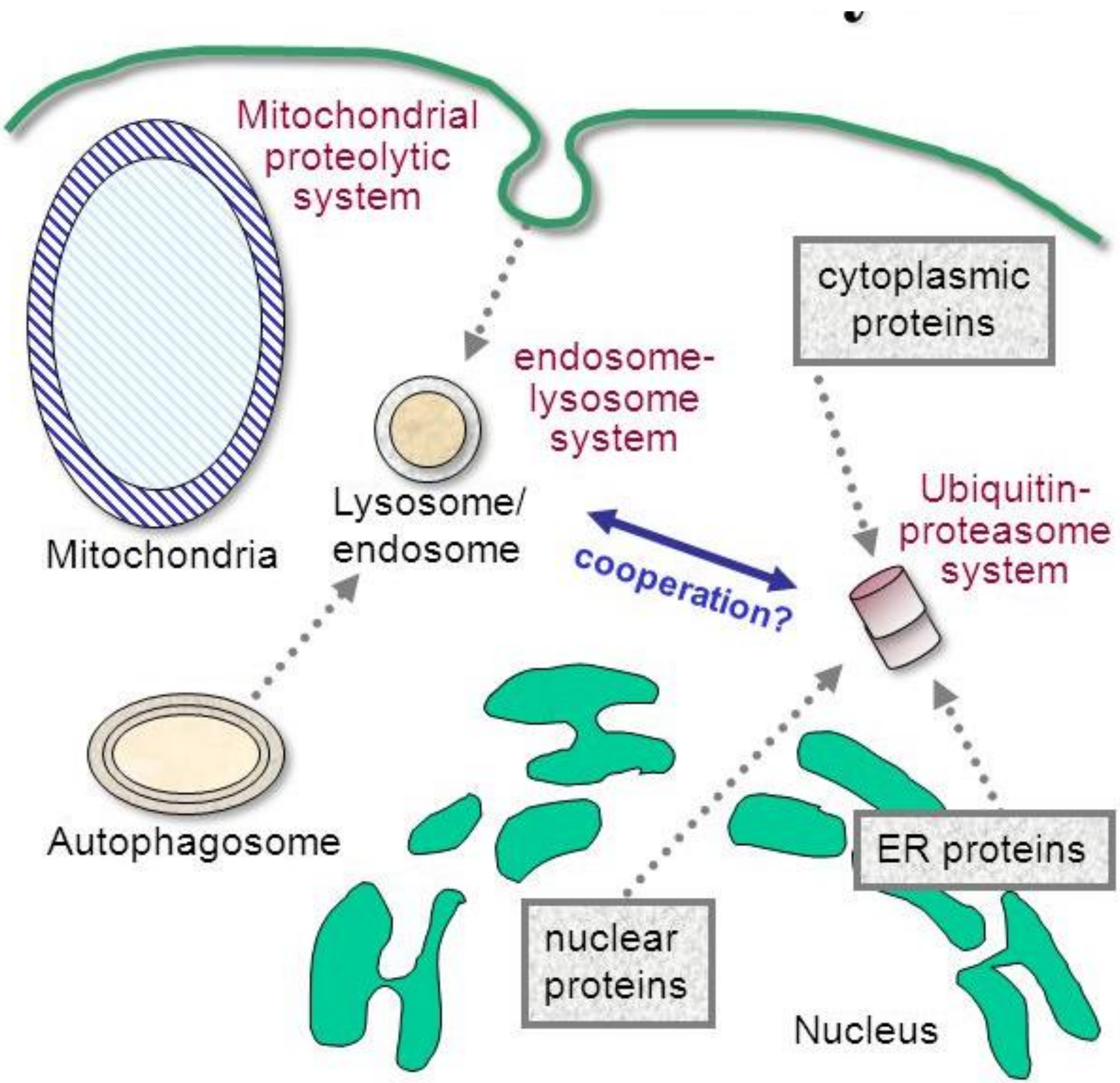


Le sintesi proteiche richiedono quindi disponibilità di substrati amminoacidici

METABOLIC INDICES IN SKELETAL MUSCLE BIOPSIES



VIE PROTEOLITICHE DELLE PROTEINE
Sistema endosoma/lisososma e Ubiquitina/proteosoma



- endosome-lysosome pathway degrades extracellular and cell-surface proteins
- ubiquitin-proteasome pathway degrades proteins from the cytoplasm, nucleus and ER

TURNOVER PROTEICO

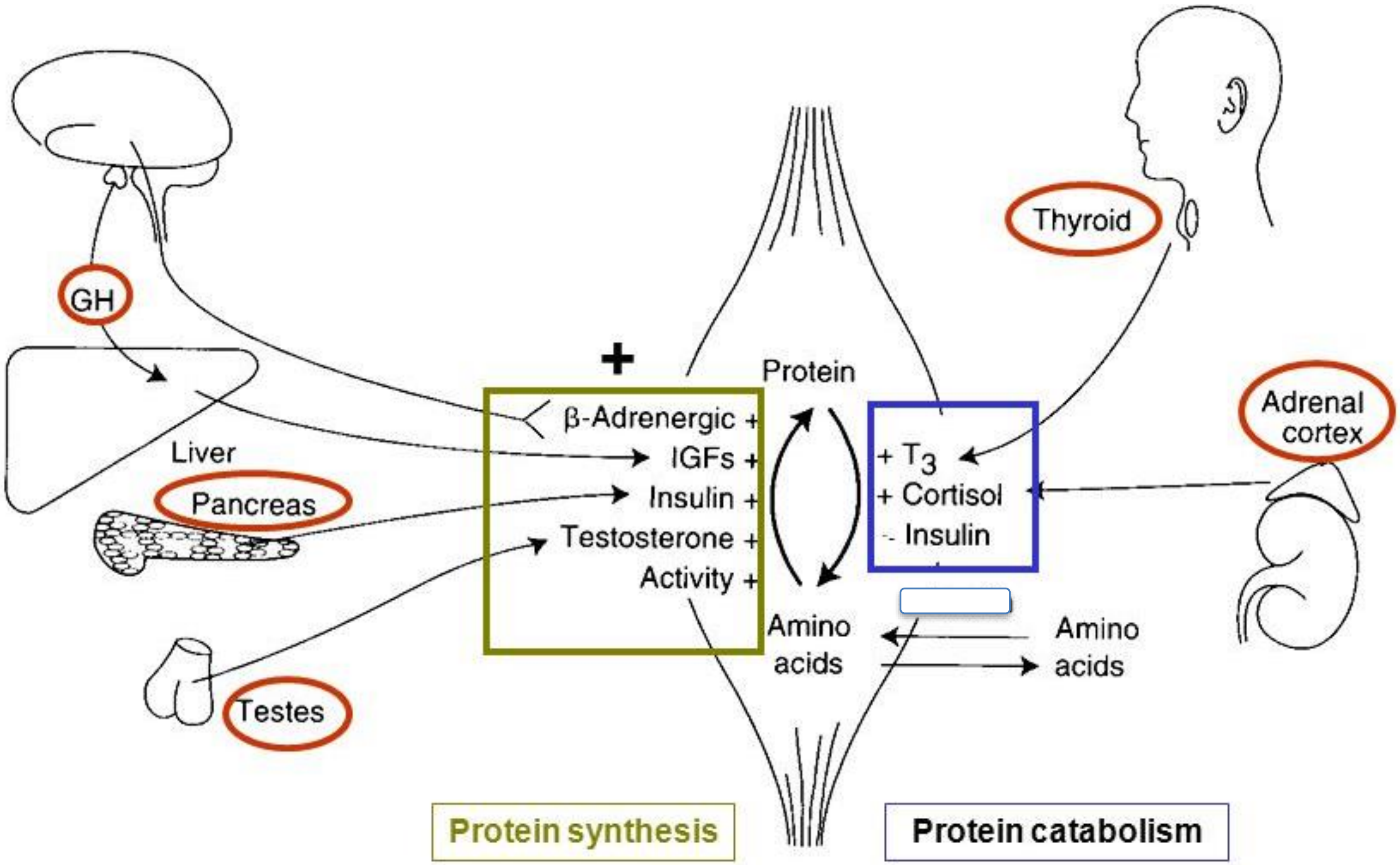
La continua demolizione e sintesi è fondamentale per

- degradare e rimpiazzare proteine danneggiate
- modificare la quantità relativa di differenti proteine in base alle necessità nutrizionali e fisiologiche
- rapido adattamento metabolico

La regolazione del turnover proteico è influenzata da:

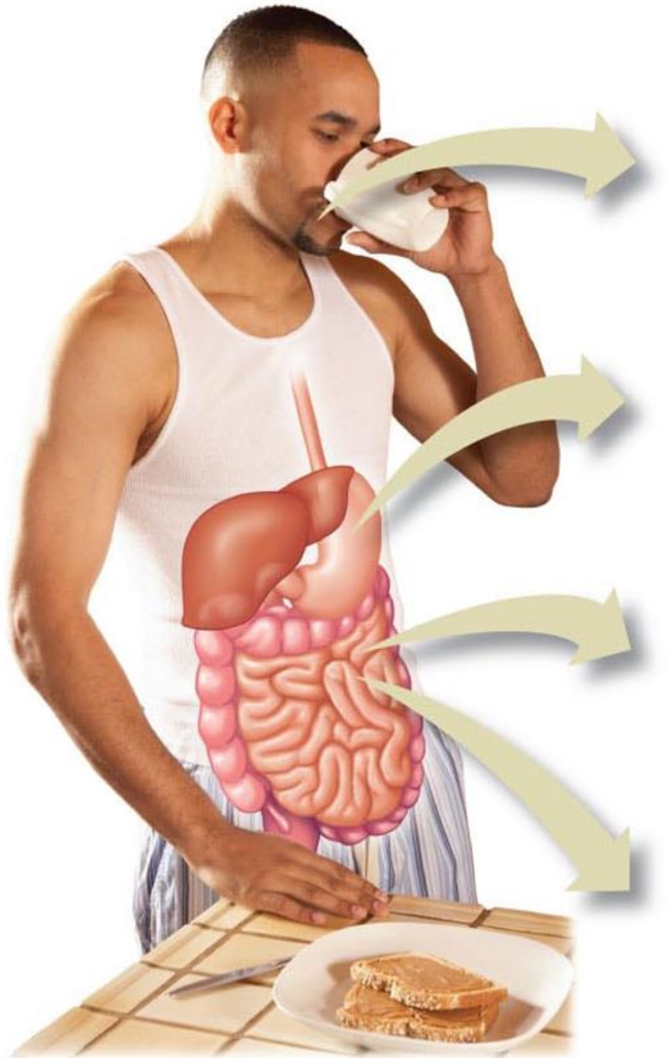
- **stato nutrizionale** (energetico e proteico)
- **da alcuni ormoni** (insulina, glucocorticoidi, ormoni tiroidei, ormone della crescita, citochine)

REGOLAZIONE ORMONALE DELLE SINTESI E DEL CATABOLIMO DELLE PROTEINE



From Metabolic Regulation by KN Fryan

DIGESTIONE E ASSORBIMENTO DELLE PROTEINE



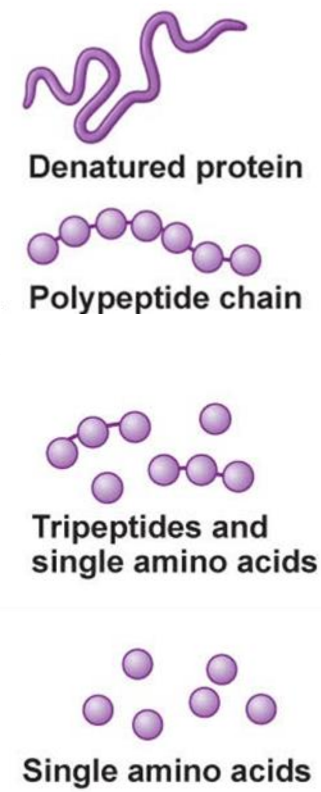
STOMACO

L’acido idrocloridrico denatura le proteine e attiva il **pepsinogeno in pepsina**, enzima che frammenta le catene polipeptidiche in polipeptidi di più piccole dimensioni

INTESTINO TENUE

Gli **enzimi pancreatici** secreti nel lume intestinale scindono ulteriormente i legami peptidici dando origine a dipeptidi, tripeptidi e singoli amminoacidi.

Le **tripeptidasi e dipeptidasi** di origine intestinale portano a termine la digestione dei frammenti peptidici a singoli amminoacidi che vengono assorbiti.



CLASSIFICAZIONE CHIMICA DEGLI AMMINOACIDI

CATENE LATERALI

Neutre apolari: alanina, fenilalanina, glicina, leucina, isoleucina, metionina, prolina triptofano , valina

Neutre polari: asparagina, glutammina, serina, treonina cisteina, tirosina

Carica acida: aspartico, glutammico

Carica basica: arginina , istidina, lisina

AMINOACIDI ESSENZIALI E NON ESSENZIALI

ESSENZIALI

- ❖ Sono amminoacidi che l’organismo umano non è in grado di sintetizzare e che perciò devono essere introdotti con la dieta

- ❖ **Sono essenziali:** lisina, leucina, isoleucina, metionina, fenilalanina, treonina, triptofano, valina e istidina.

- ❖ Il fabbisogno dell’istidina si riduce in età adulta, mentre è più elevato nei bambini e nelle donne in gravidanza

AMINOACIDI ESSENZIALI E NON ESSENZIALI

NON ESSENZIALI

Sono amminoacidi che l'organismo è in grado di sintetizzare. Vanno comunque integrati con la dieta con un apporto bilanciato in quanto il pool di aminoacidi non è totalmente riutilizzabile (fabbisogno di azoto)

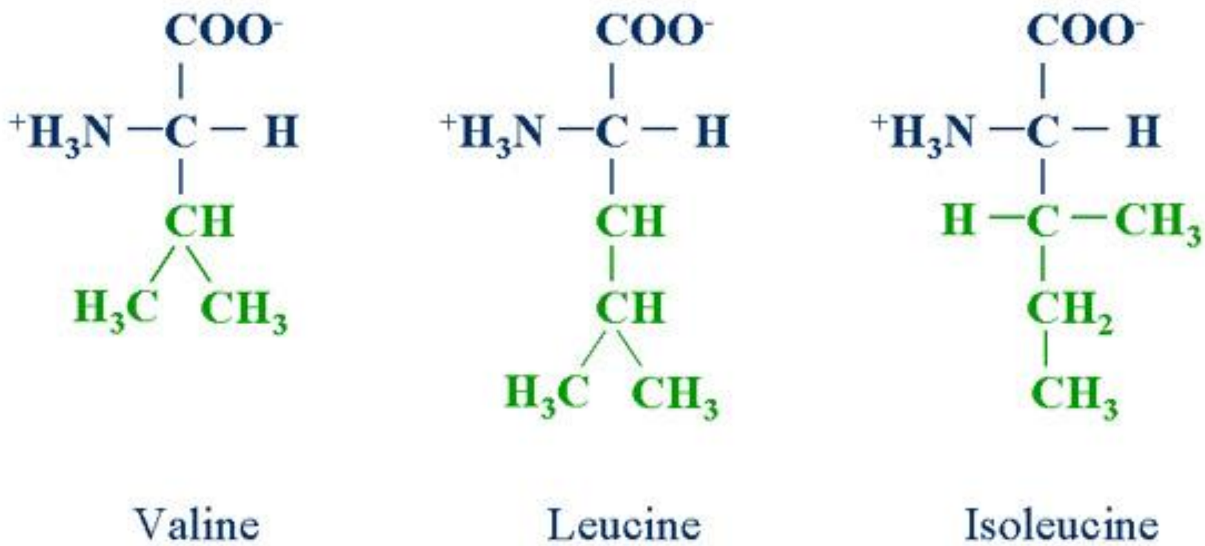
SEMI-ESSENZIALI

- Possono derivare da amminoacidi essenziali precursori
- Tirosina sintetizzata da fenilalanina
- Cisteina sintetizzata da metionina
- Tuttavia il loro apporto ha un'azione di risparmio sui precursori

- **CONDIZIONATAMENTE ESSENZIALI**

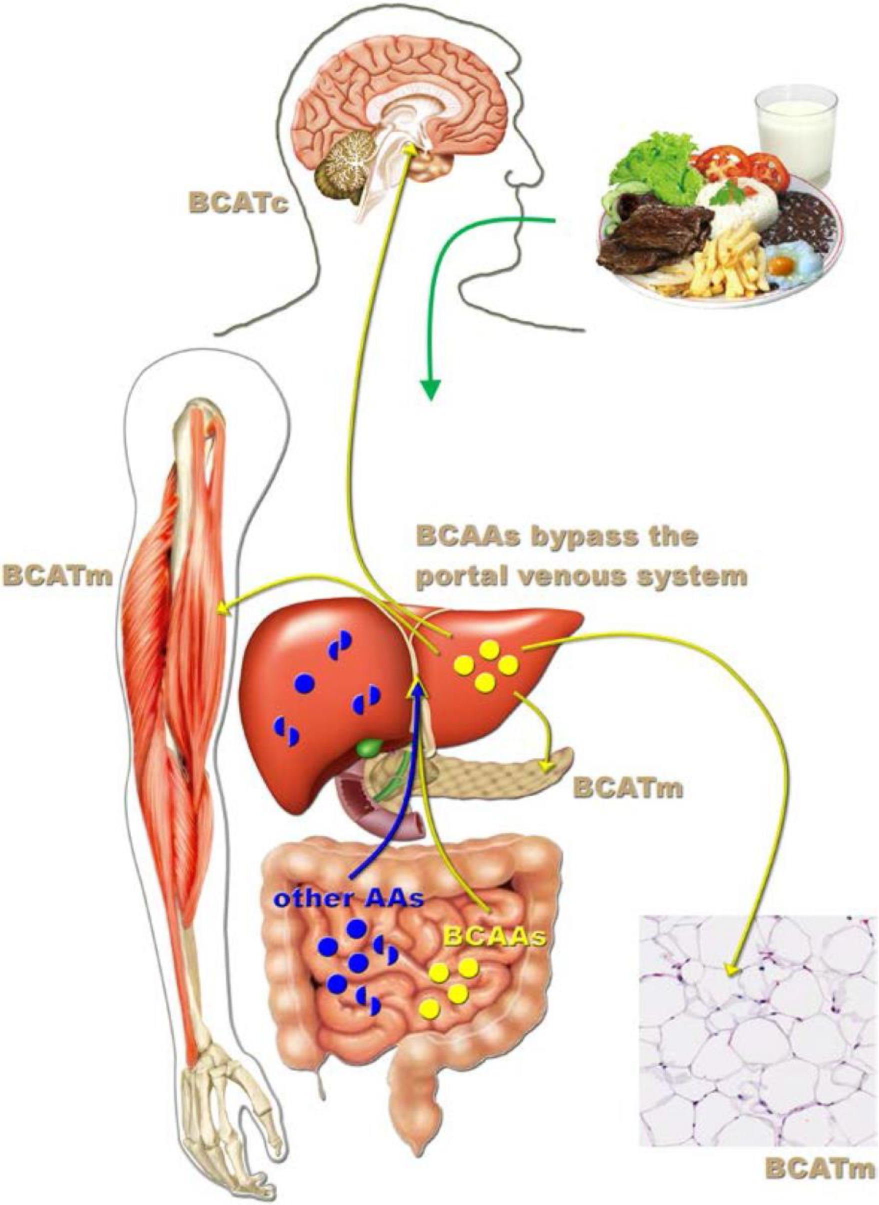
Diventano essenziali in condizioni patologiche

AMMINOACIDI RAMIFICATI
BCAA, Branched chain amino acids



- **promuovono le sintesi proteiche** e
- **regolano il metabolismo del glucosio** (insulin-like effect)

METABOLISMO DEGLI AMMINOACIDI



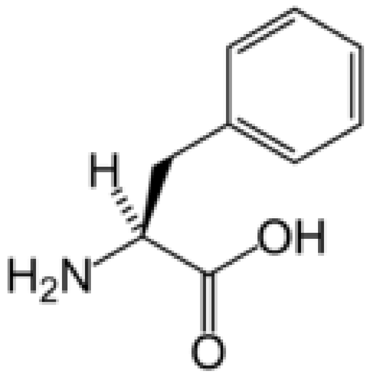
❖ Dopo un pasto proteico e la digestione proteica gli amminoacidi assorbiti raggiungono il fegato attraverso la vena porta

❖ Qui vengono transaminati prima di raggiungere la circolazione sistemica o essere utilizzata come fonte alternativa di energia

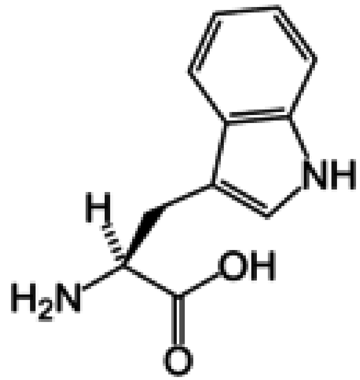
❖I BCAA invece, raggiunto il fegato lo bypassano. Dopo un pasto la concentrazione ematica degli BCAA aumenta in modo significativo e raggiunge altri tessuti (muscoli scheletrici, pancreas, tessuto adiposo, cervello) dove vengono metabolizzati da Branched-chain amino acid transaminase (BCAT).

Pedroso J, Nutrients 2015, 7, 3914-3937;

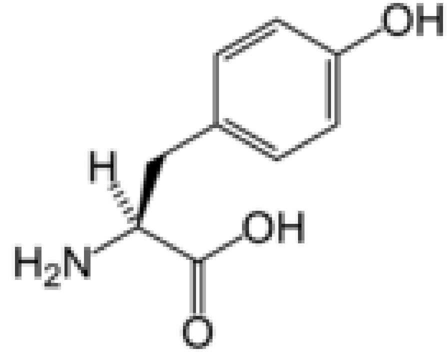
AMMINOACIDI AROMATICI



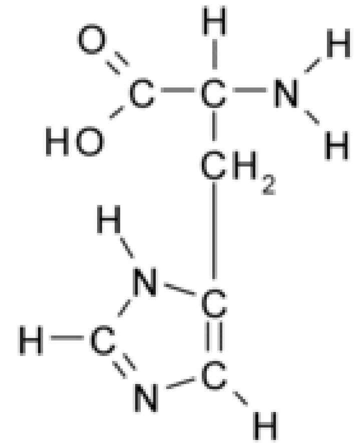
Fenilalanina



Triptofano



Tirosina

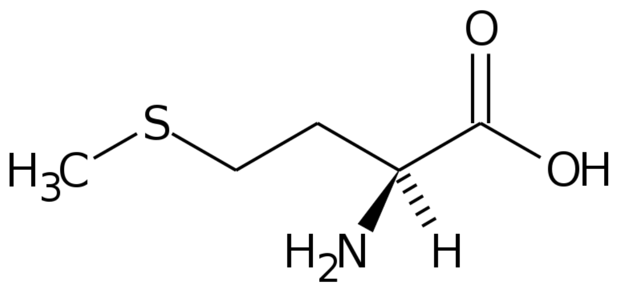


Istidina

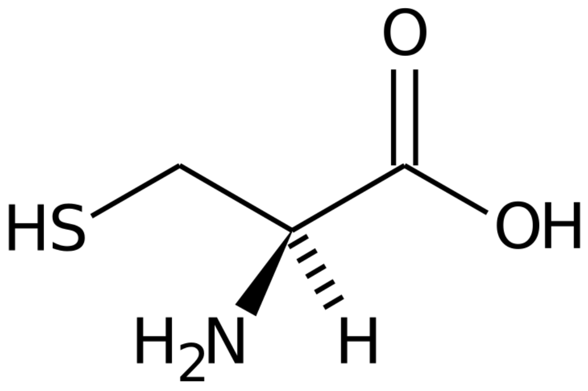
ALCUNI DERIVATI

❖Fenilalanina → Tirosina →→ Dopamina → Norepinefrina → Epinefrina
❖Fenilalanina → Tirosina → Tiroxina
❖Triptofano → 5-idrossitriptofano → Serotonina

AMMINOACIDI SOLFORATI



Metionina



Cisteina

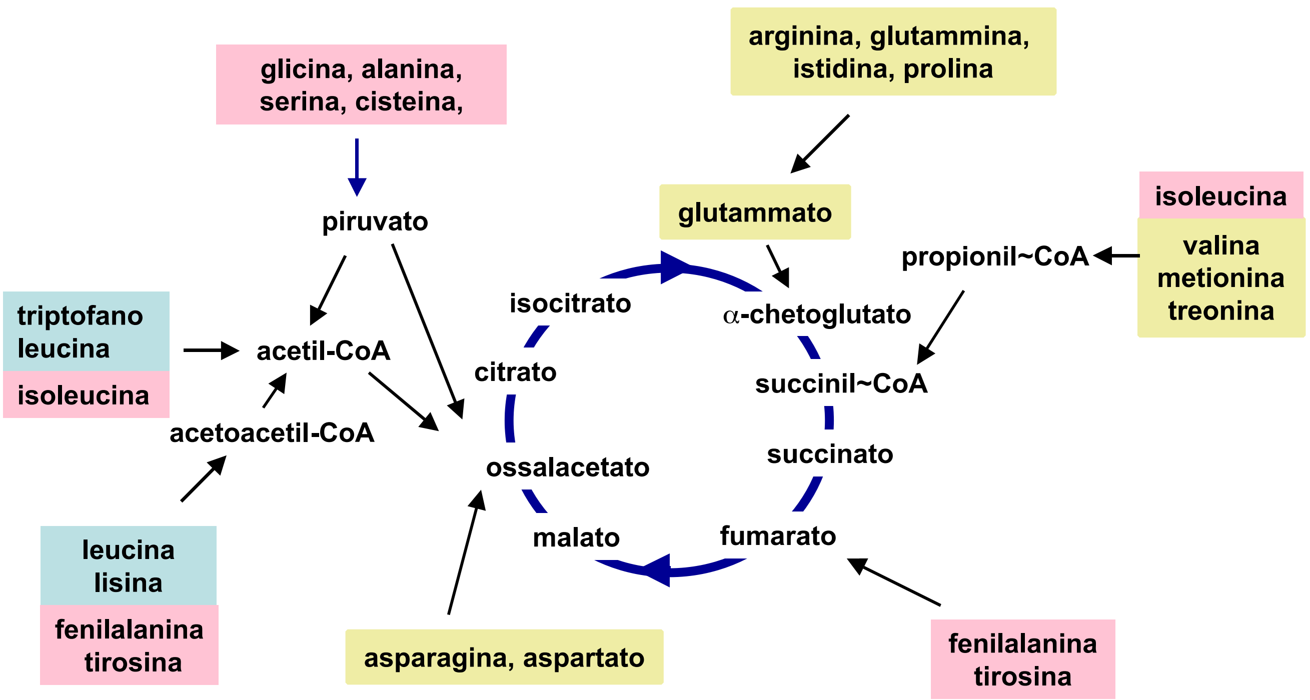
METIONINA
Sintesi della cisteina e quindi del Glutatione
Carnitina, Fosfolipidi, donatore di metili

AMMINOACIDI CHETOGENICI E GLUCOGENICI

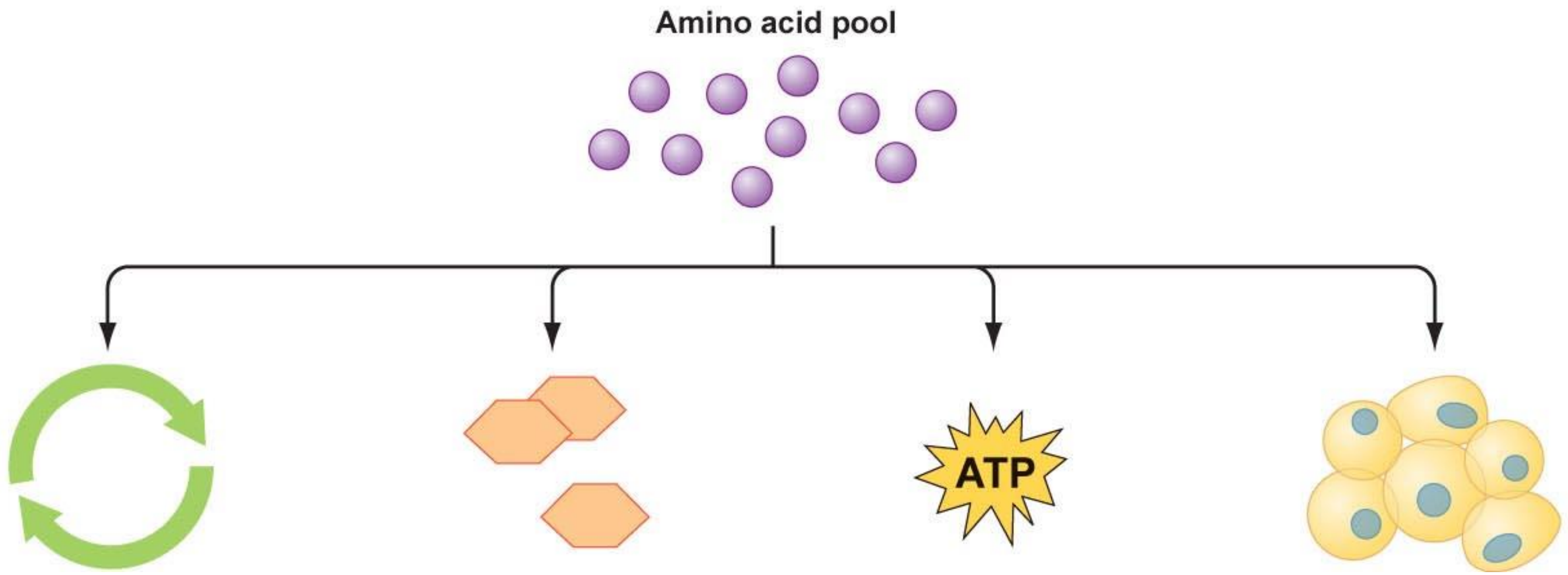
in giallo
a.a ⇒ glucosio

in celeste
a.a. ⇒ corpi chetonici

in rosa
a.a. ⇒ glucosio e corpi chetonici



DESTINO METABOLICO DEGLI AMMINOACIDI



TURNOVER PROTEICO

Le proteine vanno incontro a continui processi di anabolismo e catabolismo.
Inoltre gli amminoacidi entrano nella sintesi di diversi prodotti derivati

Trasporto di azoto (glutammina, alanina)
Regolazione sintesi
AA ramificati, leucina
Ormoni

NEOGLUCOGENESI

In condizioni di introito proteico superiore ai fabbisogni gli amminoacidi possono contribuire alla neoglucogenesi

PRODUZIONE ENERGIA

Gli amminoacidi possono essere utilizzati per la produzione di energia,
specie in condizioni di carenza di altri substrati energetici

SINTESI ACIDI GRASSI

In condizioni di apporto proteico superiore ai fabbisogni gli amminoacidi possono essere convertiti in acidi grassi, accumulati come trigliceridi nel tessuto adiposo

DESTINO METABOLICO DI AMMINOACIDI PRECURSORI DI COMPOSTI AZOTATI

amminoacidi precursori	*composti derivati*
glicina *(+ succinil CoA)*	**Eme**
glutammina, glicina, acido aspartico	**Nucleotidi**
lisina, metionina	**Carnitina**
arginina, glicina, metionina	**Creatina**
istidina, triptofano, tirosina, glutammato *ormoni, neurotrasmettitori, ammine di interesse farmacologico*	**Ammine biogene**
tirosina	**Tiroxina, adrenalina**
cisteina (*sali biliari, neuromodulatore*)	**Taurina**
glutammina *(amminozuccheri)*	**Glucosammina**
arginina *(vasodilatatore, inibisce aggregazione piastrinica)*	**Ossido nitrico (NO)**
triptofano (*1mg vit equivale a 60 mg a.a.*)	**Niacina**
glutammico, cisteina, glicina	**Glutatione**

DESTINO METABOLICO
DI ALCUNI AMMINOACIDI

- **Componenti di peptidi** glutatione (GSH) γGlu-Cys-Gly
- **Intermedi metabolici** ornitina
- **Fonte energetica** a.a. glucogenici, a.a. chetogenici
- **Regolatori del turnover proteico** leucina, glutammina
- **Trasporto di azoto** glutammina, alanina

PRINCIPALI FUNZIONI DELLE PROTEINE

- Attività enzimatica
- Recettori - attività di signaling
- Strutturali – es. collagene, cheratina, proteine muscolari
- Attività motoria, equilibrio (proteine muscolari)
- Immunità, tra cui anticorpi
- Ormoni tra cui Insulina, glucagone, leptina, ecc.
- Neuropeptidi
- Trasporto - albumina, tranferrina, emoglobina, lipoproteine , ecc.
- Osmolarità plasmatica, regolazione bilancio idrico
- Funzione energetica
- Riserva azotata. **Di fatto NON ESISTONO PROTEINE DI RISERVA** ed ogni perdita proteica si associa a perdita di funzione (da impercettibile e rilevante)

PROTEIN INTAKE

quantity

&

quality

protein quantity

Recommended Dietary Allowance (RDA) for protein

~0.83 g/kg/d

European Food Safety Agency, 2012
Food and Nutrition Board, 2002

RDA → No differences between gender and age
(Conley TB et al. J Nutr Biochem. 2013)

Optimal protein intake in the elderly

Robert R. Wolfe [a,*], Sharon L. Miller [b], Kevin B. Miller [c]

"The RDA was based on the results of the available studies that estimated the *minimum protein intake* necessary to avoid a progressive loss of lean body mass as determined by nitrogen balance and may, therefore, not be adequate in many conditions"

Clinical Nutrition (2008) **27**, 675–684

Optimal protein intake in the elderly

Robert R. Wolfe [a,*], Sharon L. Miller [b], Kevin B. Miller [c]

There is an evidence that **the RDA for elderly** may be **greater than 0.8 g/kg/day** to **improve muscle mass, strength and function** as well as to improve immune status, wound healing, blood pressure and bone health

Clinical Nutrition (2008) **27**, 675–684

"Protein intakes above the RDA value have *no benefit* and may pose *long-term health risks*."

Conley TB et al. J Nutr Biochem.

Higher protein intake has been shown to be useful in subjects with:

- *Ageing* *(accepted)*
- *COPD* *(controversial)*
- *Obesity* *(controversial)*
- *Type 2 diabetes* *(controversial)*
- *Heart disease* *(controversial)*

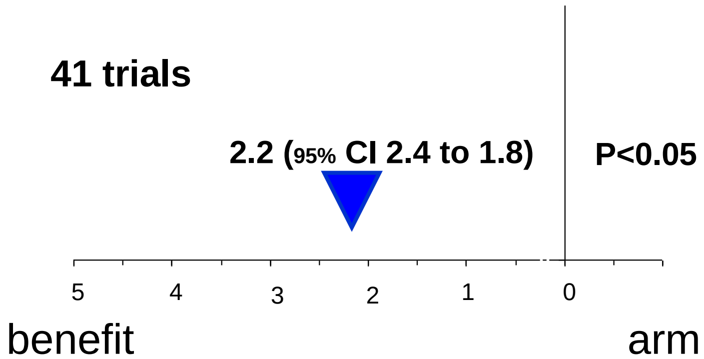
SARCOPENIA

Layman DK *Nutrition & Metabolism*, 2009

Protein and energy supplementation in elderly people at risk from malnutrition

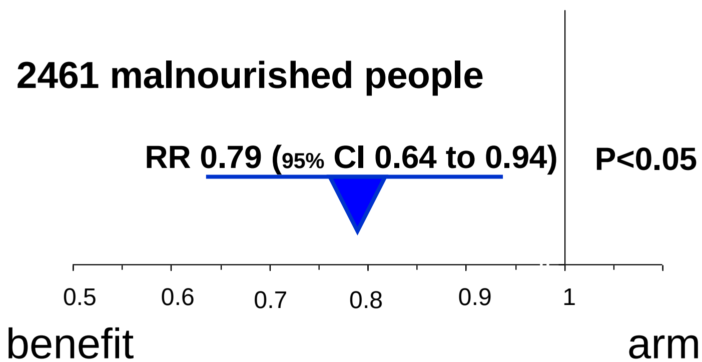
Cochrane Database Syst Rev 2009

% WEIGHT CHANGE

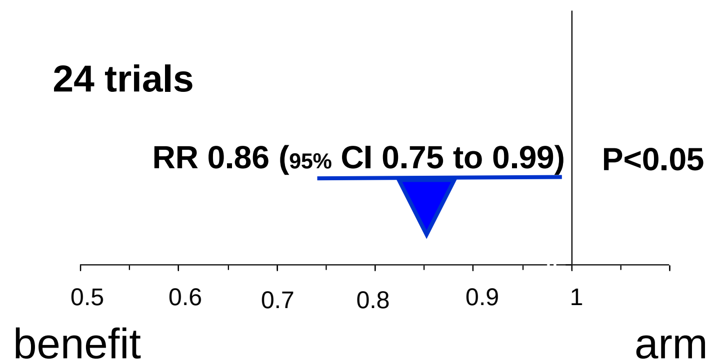


62 trials
10,187 participants
commercial “sip-feeds”
intervention < 18 months

MORTALITY



COMPLICATIONS



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]

[a] *Geriatric Centre Oldenburg, Oldenburg, Germany*
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CHRONIC DISEASES

PROT-AGE recommendations for protein levels in geriatric patients with specific acute or chronic diseases

- The amount of additional dietary protein or supplemental protein needed depends on the disease, its severity, the patient's nutritional status prior to disease, as well as the disease impact on the patient's nutritional status.
- Most older adults who have an acute or chronic disease need more dietary protein (ie, 1.2–1.5 g/kg BW/d); people with severe illness or injury or with marked malnutrition may need as much as 2.0 g/kg BW/d.
- Older people with severe kidney disease (ie, estimated glomerular filtration rate [GFR] < 30 mL/min/1.73m^2) who are not on dialysis are an exception to the high-protein rule; these individuals need to limit protein intake.

JAMDA 14 (2013) 542–559

424 subjects with Cardiovascular Disease were enrolled at the "Cardiovascular Centre" of the Ospedale Maggiore (Trieste, Italy).

	Male (n=237)	Female (n=187)	Total (n=424)
AGE	68±12	69±14	68±13
BMI	26 [24-30]	25 [22-28]	26 [23-29]
Abdominal circumerence	98 [92-108]	90 [80-97]	95 [88-103]
CVD	73%	61%	68%
CV Events	30%	18%	25%

Protein intake according to level of physical activity

	METS = 0 **(n=238 - 61,6%)**	METS > 0 (n=148 – 38,4%)	p-value
GFR	64±24	71±21	0,665
Proteine g/kg/die	**0,52 [0,42-0,63]**	**0,55 [0,43-0,67]**	**0,035**
Eventi CV	25,6%	24,3%	0,774
Patologie CV	71,8%	62,2%	0,047
Rischio CV molto alto	54,6%	56,1%	0,779

- Only the 8% of the population reach the recommended protein intake (1 - 1,2 g/kg/die)
- Higher percentage of inactive subjects (61,6%)
- Lower protein intake in the inactive subjects
- High risk of SARCOPENIA

Tence M., Di Girolamo F.G., Biolo G. 2015

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HEALTHY AGEING

PROT-AGE recommendations for dietary protein intake in *healthy* older adults

- To maintain and regain muscle, older people need more dietary protein than do younger people; older people should consume an average daily intake in the range of 1.0 to 1.2 g/kg BW/d.
- The per-meal anabolic threshold of dietary protein/amino acid intake is higher in older individuals (ie, 25 to 30 g protein per meal, containing about 2.5 to 2.8 g leucine) in comparison with young adults.
- Protein source, timing of intake, and amino acid supplementation may be considered when making recommendations for dietary protein intake by older adults.
- More research studies with better methodologies are desired to fine tune protein needs in older adults.

JAMDA 14 (2013) 542–559

PROT-AGE recommendations for older people with kidney disease

Nondialysis CKD

- **Severe CKD, GFR <30**[*]: Limit protein intake to 0.8 g/kg BW[†]/d
- **Moderate CKD, 30 <GFR <60:** Protein >0.8 g/kg BW[†]/d is safe, but GFR should be monitored 2x/year
- **Mild CKD, GFR >60:** Increase protein intake per patient needs

Hemodialysis

>1.2 g/kg BW[†]/d or, if achievable, 1.5 g/kg BW[†]/d[‡]

Peritoneal Dialysis

>1.2 g/kg BW[†]/d or, if achievable, 1.5 g/kg BW[†]/d[‡]

JAMDA 14 (2013) 542–559

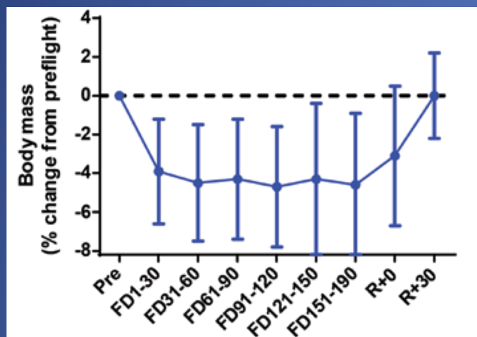
BW, body weight; CKD, chronic kidney disease; GFR, glomerular filtration rate.

[*]GFR is measured in mL/min/1.73 m^2.

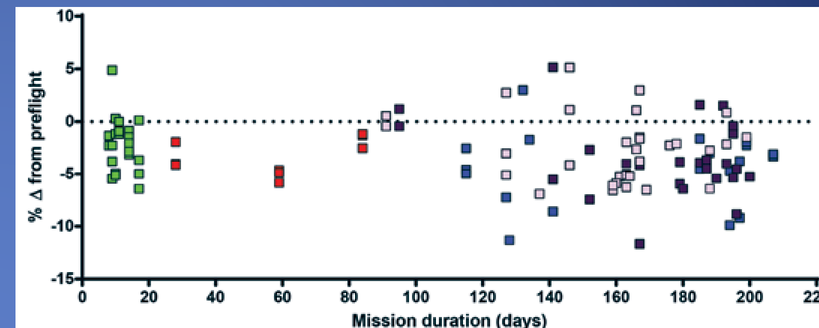
[†]Recommendations are based on ideal body weight. Regular follow-up supports compliance.

[‡]Prospective studies targeting these high protein intakes in older hemodialysis/peritoneal dialysis patients are not available.

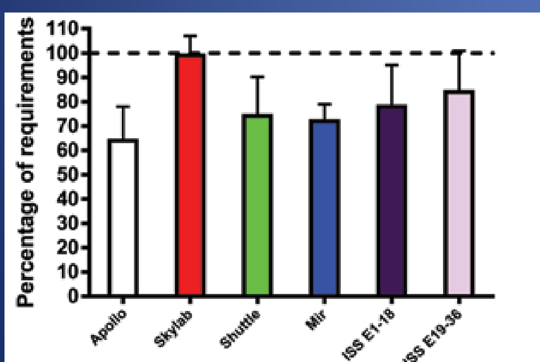
Data from previous space flight missions

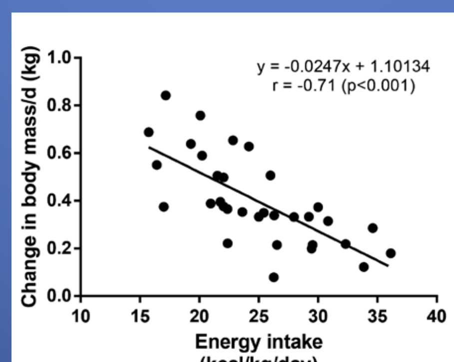


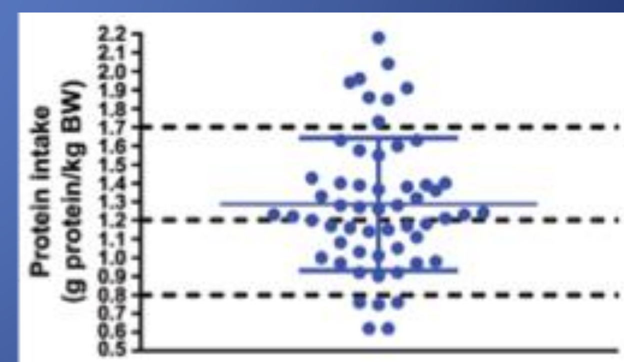
Body mass losses of 1-5% of preflight body mass have been a typical finding in the history of spaceflight



Changes in body weight on the day of landing relative to before flight.







US and Russian space programs

the Space Shuttle (N=25), Skylab (N=9), Mir (N=19), ISS Expeditions 1-18 (N=26), Expeditions 19-36 (N=31).

MISURAZIONI DI POPOLAZIONE

PANGEA
TELESNA AKTIVNOST IN PREHRANA ZA KAKOVOSTNO STARANJE
ATTIVITÀ FISICA E NUTRIZIONE PER UN INVECCHIAMENTO DI QUALITÀ

- Capodistria ✔☐
- Lubiana ✔☐
- Kranj ✔☐
- Udine ✔☐
- Trieste ✔
- Ferrara ✔

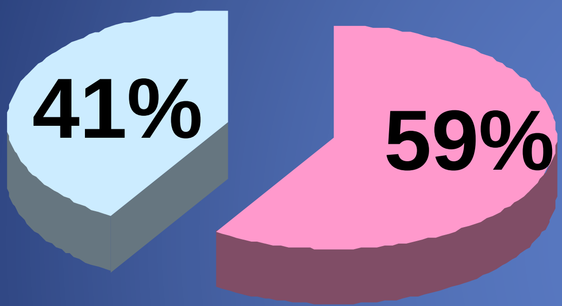
CRITERI PER L' ADESIONE

-ETÀ (non inferiore a 60 anni)
-CAPACITÀ DI CAMMINO PER 2 KM

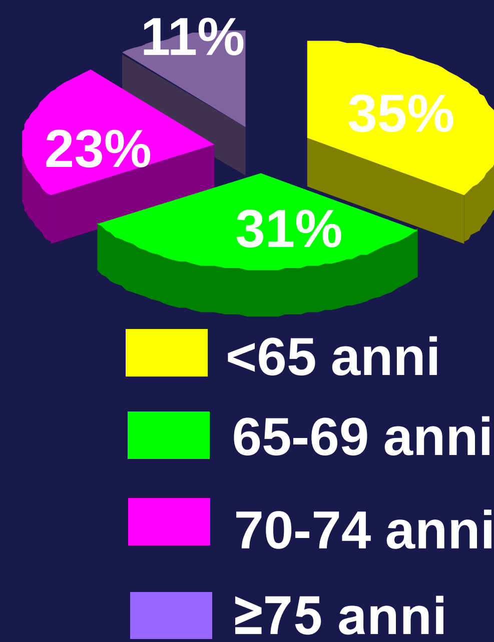
SOGGETTI SELEZIONATI

Femmine (range età: 60-78 anni)

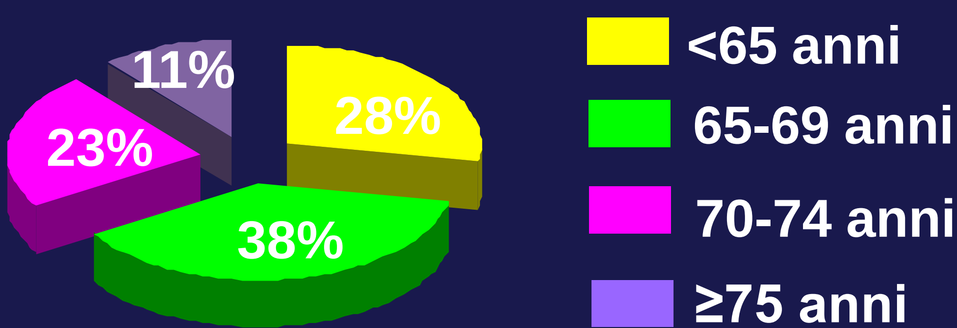
Maschi (range età: 60-77 anni)



ETÀ



ETÀ



STUDIO DI POPOLAZIONE

COMPLEX

Questionnaire
Urine
Blood
Anthropometrics, bioimpedance
Ultrasound visceral fat measurement
ECG
Cardiovascular capabilities
Flexibility
Maximum force and balance
Gait
Reaction time, attention, memory, logic capabilities

circa 3h

BASIC

Short questionnaire
Anthropometrics, bioimpedance
Immediate annalisys of capillary blood
2 km walking test
dinamometrcs
10 m walking (3 repetitions)
flexibility – bent on a bench

circa 1,5h

ABITUDINI ALIMENTARI

24 HOUR RECALL (x2) e
QUESTIONARI DI FREQUENZA DI CONSUMO

DATA DI NASCITA________
GENERE - UOMO □ DONNA □

PASTI	ORA	LUOGO	CIBI E BEVANDE: TIPO, QUANTITÀ, CONDIMENTI
Colazione			
Merenda mattina e spuntini			
Pranzo			
Merenda pomeriggio e spuntini			
Cena			
Dopocena			

ATLANTE FOTOGRAFICO DELLE PORZIONI E DEI PESI

		
Latte 200 ml	Cornflakes 30 g	Zucchero Cucchiaino = 5 grammi Cucchiaio da tè = 10 grammi Bustina = 5 grammi
		
Pane 60 g	100 g	Olio: cucchiaio da minestra

QUESTIONARIO ALIMENTARE DI FREQUENZA DEI CONSUMI

DATA

NOME E COGNOME...CODICE...

Il questionario valuta quanto spesso i cibi elencati sono stati assunti nel corso dell'ultimo anno
(per frutta e verdura fare riferimento alla stagione, ad es: Quando è stagione di ciliegie, quanto spesso le consuma?)

GRUPPO LATTE E LATTICINI	Più volte al giorno	1x giorno	5-6x settimana	2-4x settimana	1x settimana	1-3x mese	MAI
A - Latte (al naturale, con caffè, orzo, al cioccolato, al cacao, ecc.)	1	2	3	4	5	6	7
B - Yogurt, latte acido, kefir	1	2	3	4	5	6	7
C - Formaggio, ricotta, formaggini	1	2	3	4	5	6	7
D - Panna, panna acida	1	2	3	4	5	6	7
E - Budini al latte, gelato al latte	1	2	3	4	5	6	7
F - *Frico*	1	2	3	4	5	6	7
G - Grana, parmigiano o stravecchio sui primi piatti	1	2	3	4	5	6	7

CONDIMENTI E GRASSI	Più volte al giorno	1x giorno	5-6x settimana	2-4x settimana	1x settimana	1-3x mese	MAI
A - Burro	1	2	3	4	5	6	7
B - Margarina	1	2	3	4	5	6	7
C - Lardo, ciccioli	1	2	3	4	5	6	7
D - Maionese	1	2	3	4	5	6	7
E - Olio di semi	1	2	3	4	5	6	7
F - Olio di oliva	1	2	3	4	5	6	7

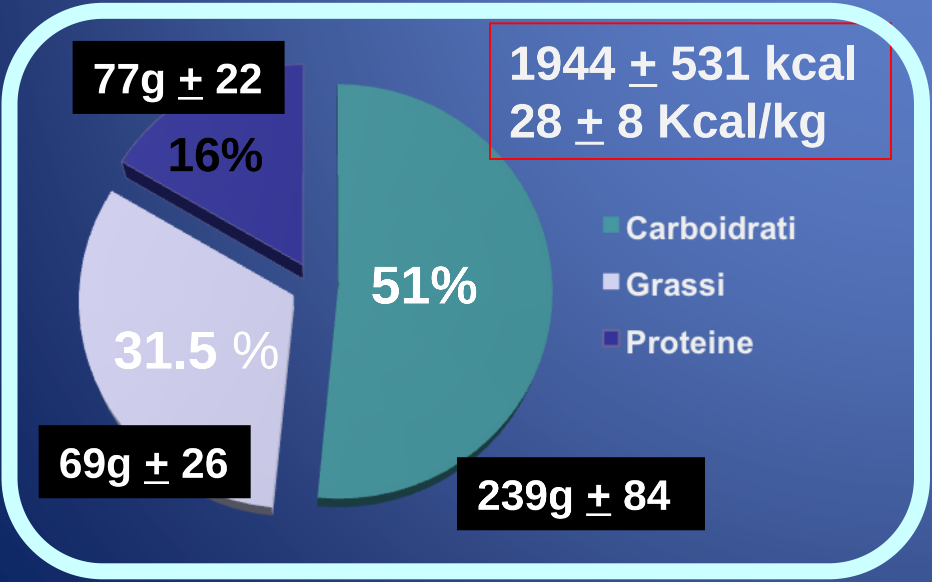
FRUTTA	Più volte al giorno	1x giorno	5-6x settimana	2-4x settimana	1x settimana	1-3x mese	MAI
A - Mele, pere	1	2	3	4	5	6	7
B - Pesche, albicocche, prugne	1	2	3	4	5	6	7
C - Uva	1	2	3	4	5	6	7
D - Banane	1	2	3	4	5	6	7
E - Arance, mandarini	1	2	3	4	5	6	7
F - Fragole, , mirtilli, ciliegie (*in stagione*)	1	2	3	4	5	6	7
G - Anguria , melone (*in stagione*)	1	2	3	4	5	6	7
H - Kiwi	1	2	3	4	5	6	7
I - Frutta secca zuccherina, tipo prugne, albicocche,ecc.	1	2	3	4	5	6	7
J - Frutta cotta o composta	1	2	3	4	5	6	7
K- Frutta secca oleosa	1	2	3	4	5	6	7
L - *Cachi*	1	2	3	4	5	6	7

VERDURE	Più volte al giorno	1x giorno	5-6x settimana	2-4x settimana	1x settimana	1-3x mese	MAI
A - Fagioli	1	2	3	4	5	6	7
B - Fagiolini	1	2	3	4	5	6	7
C - Piselli	1	2	3	4	5	6	7
D - Cavolfiori, broccoli	1	2	3	4	5	6	7
E - Carote, cavolo rapa	1	2	3	4	5	6	7
F - Spinaci, biete	1	2	3	4	5	6	7
G - Mais	1	2	3	4	5	6	7
H - Patate	1	2	3	4	5	6	7
I - Pomodori, peperoni	1	2	3	4	5	6	7
J - Crauti, brovada (rape)	1	2	3	4	5	6	7
K - Cavolo capuccio,verza	1	2	3	4	5	6	7
L - Zucchine, cetrioli, melanzane	1	2	3	4	5	6	7
M - Insalata, radicchio (tutti i tipi)	1	2	3	4	5	6	7
N - Barbabietola rossa	1	2	3	4	5	6	7

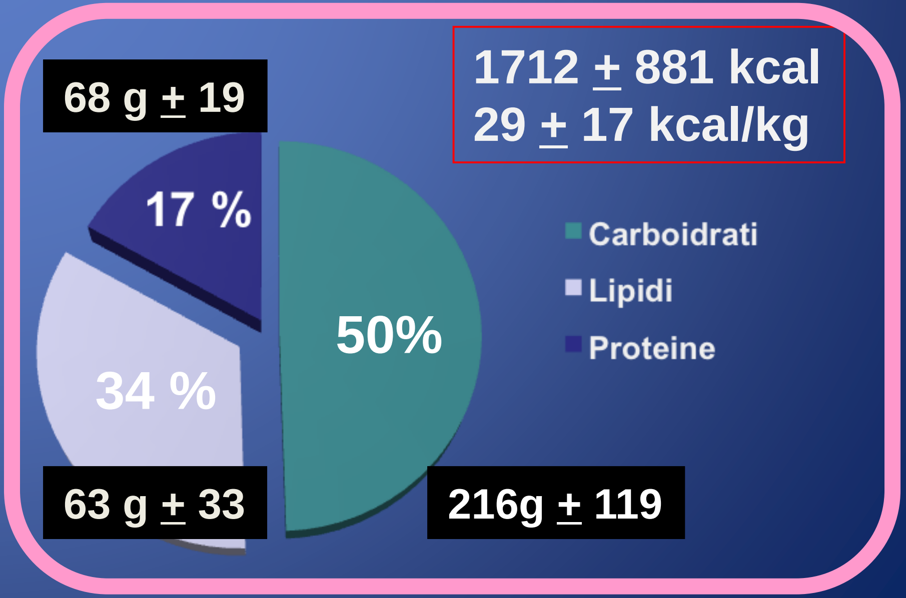
CALORIE TOTALI e NUTRIENTI (%)

EFSA European Food Safety Authority (2010) **IOM**	
CARBOIDRATI	**45-65%** (≥130 g/giorno)
PROTEINE	**10-35%**
GRASSI	**20-35 %**

UOMINI



DONNE



Recommended Dietary Allowance (RDA) for protein

~0.83 g/kg/d

European Food Safety Agency, 2012
Food and Nutrition Board, 2002

RDA → No differences between gender and age
(Conley TB et al. J Nutr Biochem. 2013)

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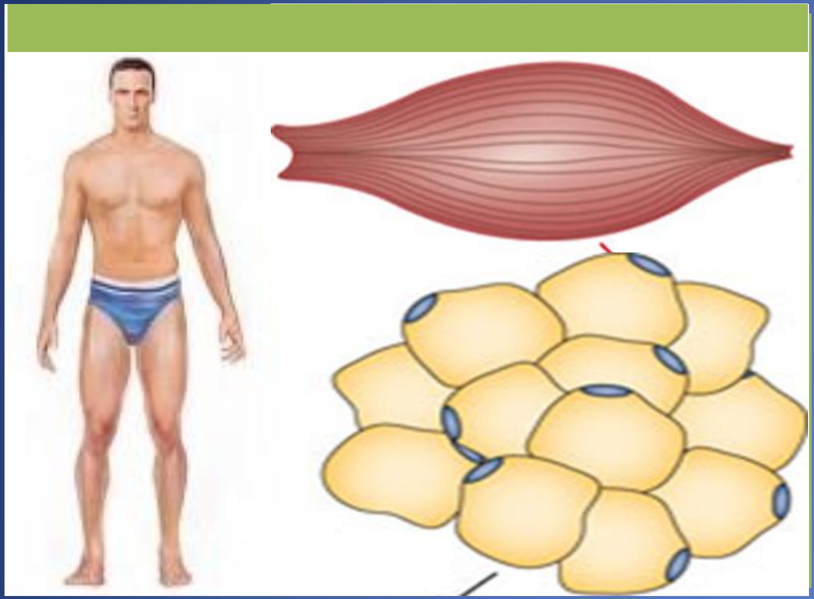
- Protein source, timing of intake, and amino acid supplementation may be considered when making recommendations for dietary protein intake by older adults.
- More research studies with better methodologies are desired to fine tune protein needs in older adults.

JAMDA 14 (2013) 542–559

PROTEINE (g/kg PESO IDEALE)



RACCOMANDAZIONI

EFSA	0.83 g/kg
LARN	0.9 g/kg
PROT-AGE	1-1.2 g/kg

Anziani attivi: 1.2 g /kg minimo

Proteine g/kg	UOMINI (%)	DONNE (%)
< 0.8 g/kg$_{PI}$ insufficiente	6	11
0.8 – 1.0 g/kg$_{PI}$ EFSA - LARN	32	18
1.0 – 1.2 g/kg$_{PI}$ PROT-AGE	28	33
>1.2 – g/kg$_{PI}$ soggetti attivi	34	34
FONTI ANIMALI/VEGETALI (%)	60 / 40	60 / 40

MEDIA g/kg

Uomini 1.13 ± 0.32
Donne 1.18 ± 0.34

SORGENTI DI PROTEINE ANIMALI

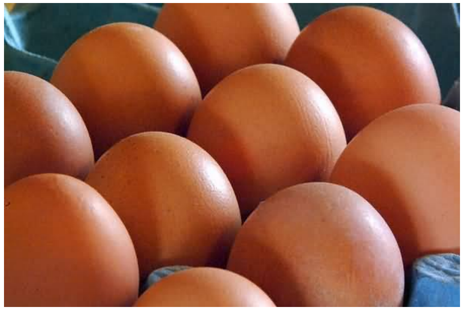
Carne, salumi, pesce, latte e derivati (latticini) uova/100 g peso netto e a crudo

Carne o pesce 100 g = 15-20 g

Uova per 50 g = 6,2g

Un uovo pesa mediamente 55g

guscio 5 g, albume 35 g, tuorlo 15g



Formaggio grana padano 100 g = 39 g

Latte, vaccino intero 100 ml = 3,4 g

Da:Tabelle composizione alimenti.

CREA Centro di ricerca Alimenti e Nutrizione, aggiornamento 2019

SORGENTI DI PROTEINE ANIMALI

Cereali, legumi, noci/100 g peso netto

100 g = 8 g

100 g a crudo =11-13

Fagioli borlotti freschi

100 g dopo cottura = 5,7 g Secchi dopo cottura

100 g = 15 g
30 g (circa 7 noci) a netto = 4,5 g

Da:Tabelle composizione alimenti.
CREA. Centro di ricerca Alimenti e Nutrizione, aggiornamento 2019

CONTENUTO PROTEICO DI ALCUNI TRA I PIÙ COMUNI ALIMENTI ANIMALI E VEGETALI (g/100 g DI PARTE EDIBILE)

Caciocavallo	circa 38	Biscotti di soia	11,5
Soia secca	37	Fette biscottate	11
Parmigiano	33,5	Pasta di semola	11
Bresaola	32	Polpo	11
Arachidi tostate	29	Noci fresche	10,5
Pecorino siciliano	29	Pappa reale	10
Caciotta di pecora	circa 28	Pane	9
Provolone	28	Biscotti secchi	8
Fave secche	27	Pane integrale	7,5
Prosciutto crudo	27	Riso integrale	7,5
Scamorza	25	Cioccolato al latte	7
Fontina	24,5	Cornflakes	7
Fesa di tacchino	circa 24	Riso brillato	7
Fagioli secchi	23	Panettone	6
Petto di pollo	circa 23	Asparagi di bosco	5
Mandorle secche	22	Funghi porcini	4
Lombata/costata di vitellone	circa 21,5	Mais	4
Tonno fresco	21,5	Cocco fresco	3,5
Agnello	21	Fichi secchi	3,5
Bistecca di maiale	21	Latte/yogurt parzialmente scremato	3,5
Ceci secchi	21	Asparagi coltivati	3
Filetti di orata	21	Broccoletti	3
Pagello	21	Castagne fresche	3
Vitello	21	Cavolfiore	3
Sarda	21	Spinaci freschi	3
Fior di latte	17	Patate	2
Spigola	17	Banane	1
Noci secche	14	Bieta	1
Bovino in gelatina	circa 13	Fichi freschi	1
Pasta all'uovo secca	13	Peperoni	1
Piselli freschi	13	Pomodori in insalata	1
Savoiardi	12	Zucchine	1
Tortellini freschi	12	Miele	0,6
Uovo intero	12	Mela	0,3

Da: INN, 2000.

Da:Tabelle composizione alimenti Istituto Nazionale Nutrizione, 2000

PROTEINE COMPLETE

- Le proteine complete contengono **quantità, qualità e proporzionalità di amminoacidi essenziali adeguati** a garantire le **sintesi proteiche ottimali** nell’organismo.
- Sono **complete** le proteine di origine **animale**, a parte le proteine del collagene
- Sono definite pertanto ad **alto valore biologico** (vedasi infra)

PROTEINE INCOMPLETE

- Le proteine **incomplete** contengono **quantità insufficienti di alcuni amminoacidi essenziali** ovvero gli amminoacidi non sono presenti nelle giuste proporzione a garantire **sintesi proteiche ottimali** nell’organismo

- Definite pertanto proteine a **medio-basso valore biologico** (vedasi infra)

- **AMMINOACIDO LIMITANTE amminoacido a più bassa concentrazione presente in una proteina** rispetto all'equilibrio o la proporzione di amminoacidi presa come riferimento, ad es, proteine dell'uovo intero. **Sono incomplete le singole proteine di origine vegetale**

AMMINOACIDI LIMITANTI
in alcuni prodotti vegetali



CEREALI
Lisina, Treonina , Isoleucina

LEGUMI
Metionina e Triptofano

NOCI: Leucina, Isoleucina

FREQUENZA DI CONSUMO DI ALIMENTI PROTEICI

	2-4 sett.	MAI
M:	31 %	14 %
F:	24 %	10 %

	2-4 sett.	MAI
M:	38 %	6 %
F:	24 %	7 %

	2-4 sett.	MAI
M:	40 %	5 %
F:	45 %	5 %

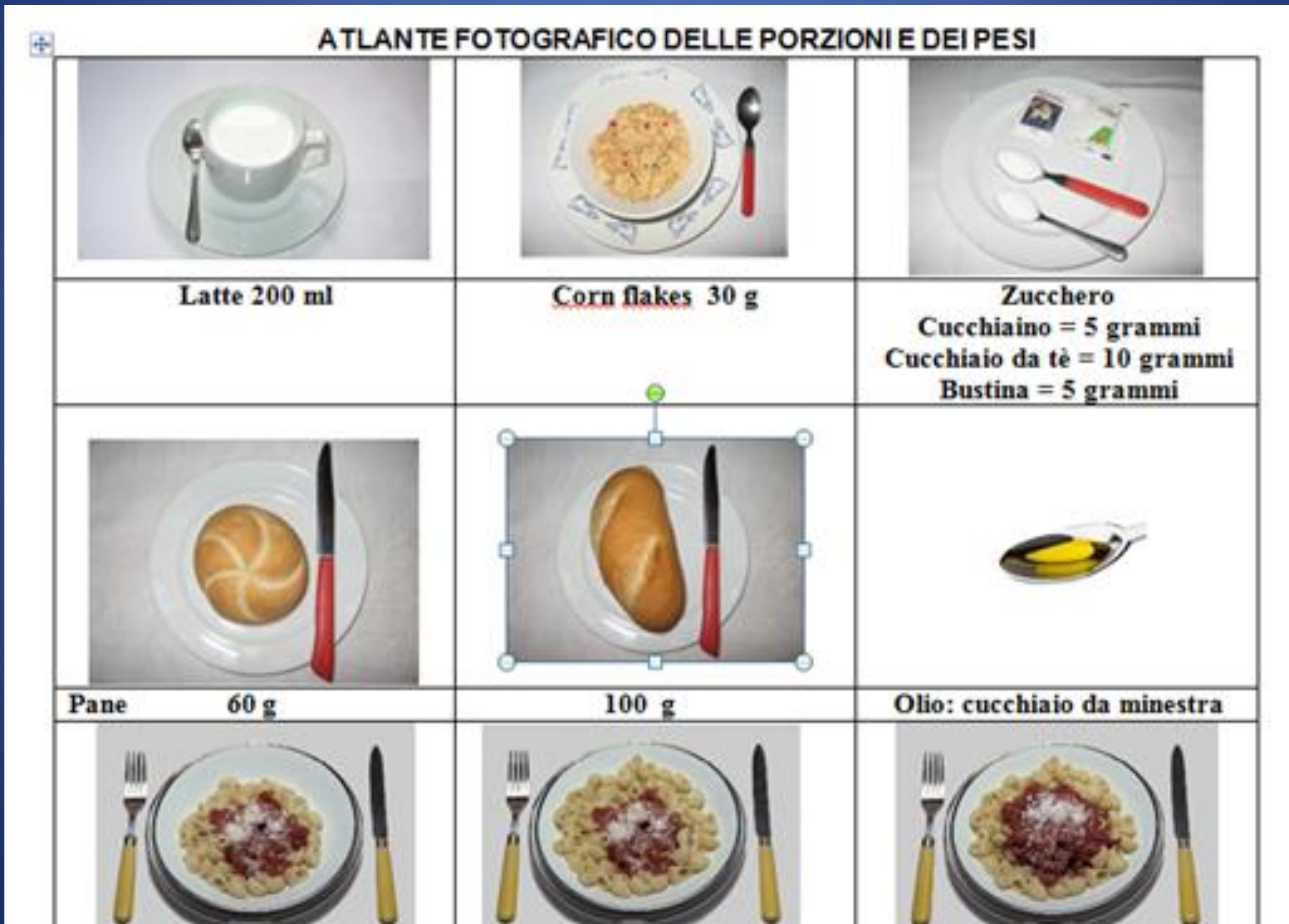
	2-4 sett.	MAI
M:	17 %	26 %
F:	9 %	29 %

	2-4 sett.	MAI
M:	45 %	0 %
F:	49 %	0 %

	2-4 sett.	MAI
M:	40 %	6 %
F:	44 %	3 %

	2-4 sett.	MAI
M:	22 %	11 %
F:	20 %	11 %

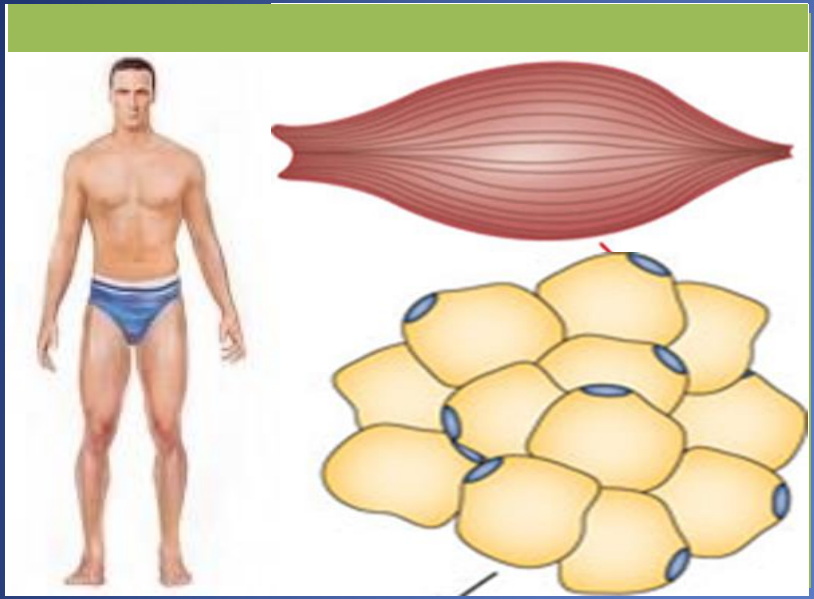
24 HOUR RECALL e
QUESTIONARI DI FREQUENZA DI CONSUMO (x2)



ATLANTE FOTOGRAFICO DELLE PORZIONI E DEI PESI

Latte 200 ml	Corn flakes 30 g	Zucchero Cucchiaino = 5 grammi Cucchiaio da tè = 10 grammi Bustina = 5 grammi
Pane 60 g	100 g	Olio: cucchiaio da minestra

PROTEINE (g/kg PESO IDEALE)



RACCOMANDAZIONI

EFSA **0.83 g/kg**
LARN **0.9 g/kg**
PROT-AGE **1-1.2 g/kg**

Anziani attivi: 1.2 g /kg minimo

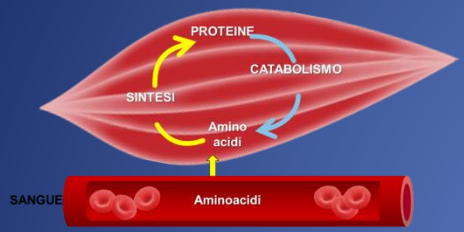
MEDIA g/kg

Uomini 1.13 ± 0.32
Donne 1.18 ± 0.34

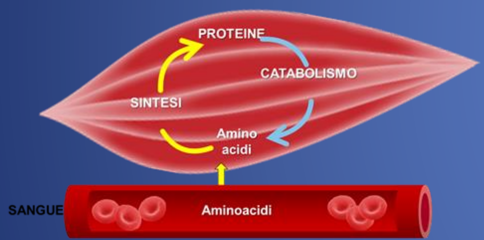
Proteine g/kg	Uomini %	Donne %
< 1	38	30
1-1.2	28	33
> 1.2	34	37

LE PROTEINE AI PASTI

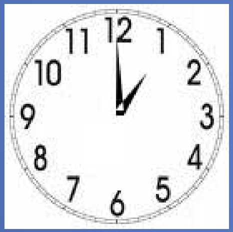
PROT-AGE: 25-30 g proteine ai tre principali pasti della giornata

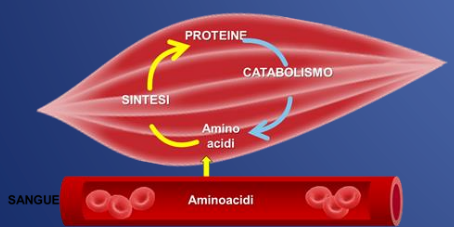


COLAZIONE

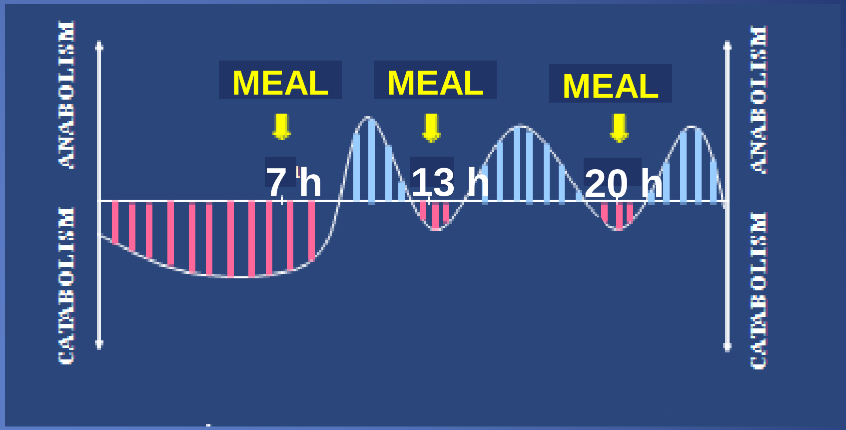


PRANZO





CENA



	Uomini	Donne
Media proteine nei 3 pasti (g)	25.6	22.0
soggetti < 25 g/pasto (%)	40	77

>70 years do not assume the current RDA of proteins (0.8 g/kg/day).

The phenomenon depends upon several factors:

- **ODONTOSTOMATOLOGICAL PROBLEMS** → alteration of the masticatory function → influence in the choice of foods;
- **DELAYED GASTRIC EMPTYING**, associated with a reduced gallbladder contractility and higher serum levels of the hormone cholecystokinin (CCK) and neuropeptide Y (PYY) (facilitating a ***long-lasting satiety***);
- **HIGHER BLOOD CONCENTRATION OF LEPTIN** in the elderly (showing that the anorexigenic signal prevails over the orexigenic one);

protein quality

- **amino acid composition**
- **absorption kinetics**

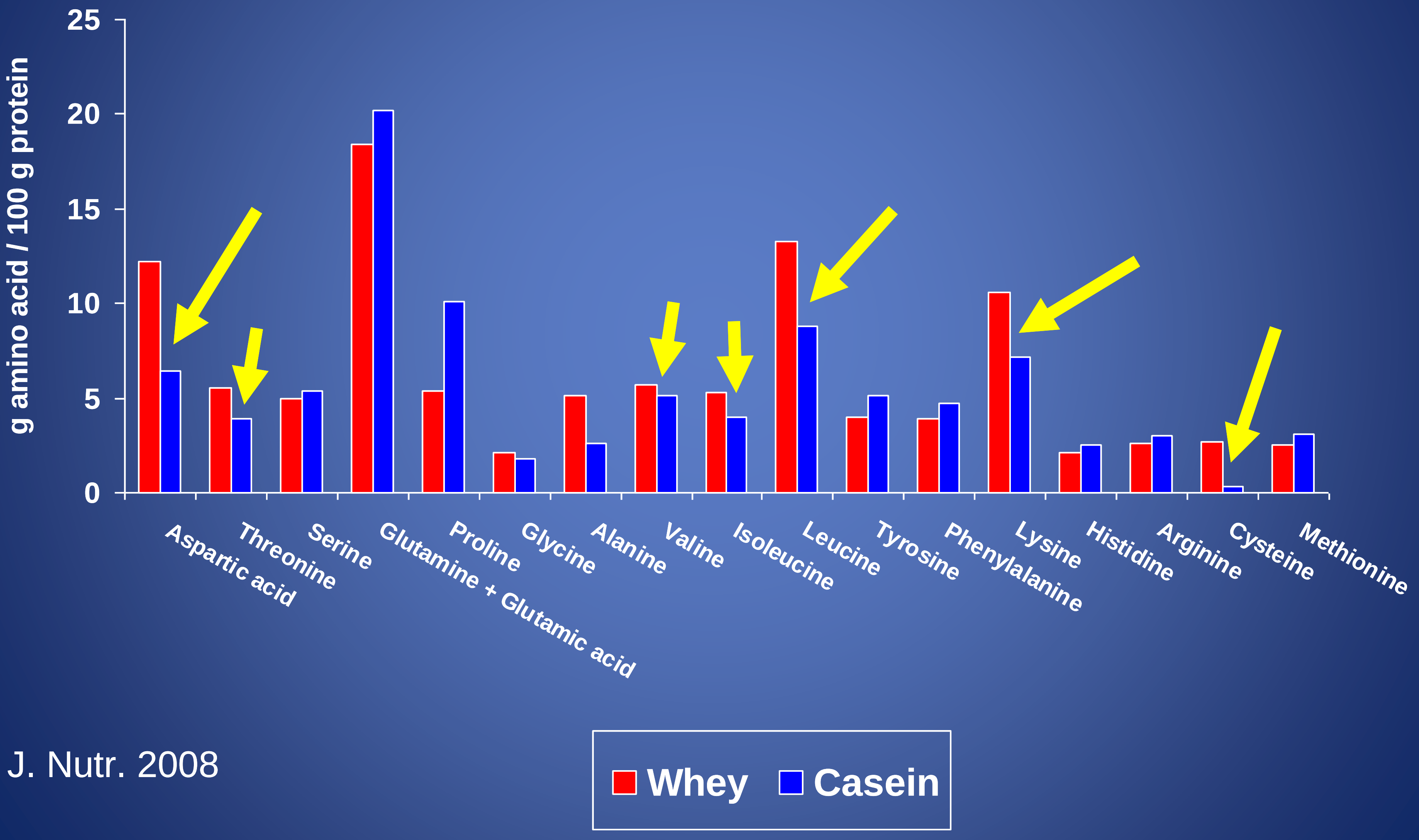
Concentration of major milk proteins

Protein	Concentration (g/l) Cow	Human
Total caseins	26.0	2.7
α-Casein	13.0	
β-Casein	9.3	
κ-Casein	3.3	
Total whey protein	6.3	67.3
β-Lactoglobulin	3.2	
α-Lactalbumin	1.2	1.9
Immunoglobulins (A, M, and G)	0.7	1.3
Serum albumin	0.4	0.4
Lactoferrin	0.1	1.5
Lactoperoxidase	0.03	
Lysozyme	0.0004	0.1
Miscellaneous	0.8	1.1
Proteose-peptone	1.2	
Glycomacropeptide	1.2	

Milk Biologically Active Componentsas Nutraceuticals: Review

***Critical Reviews in Food Science and Nutrition*, 45:645–656 (2005)**

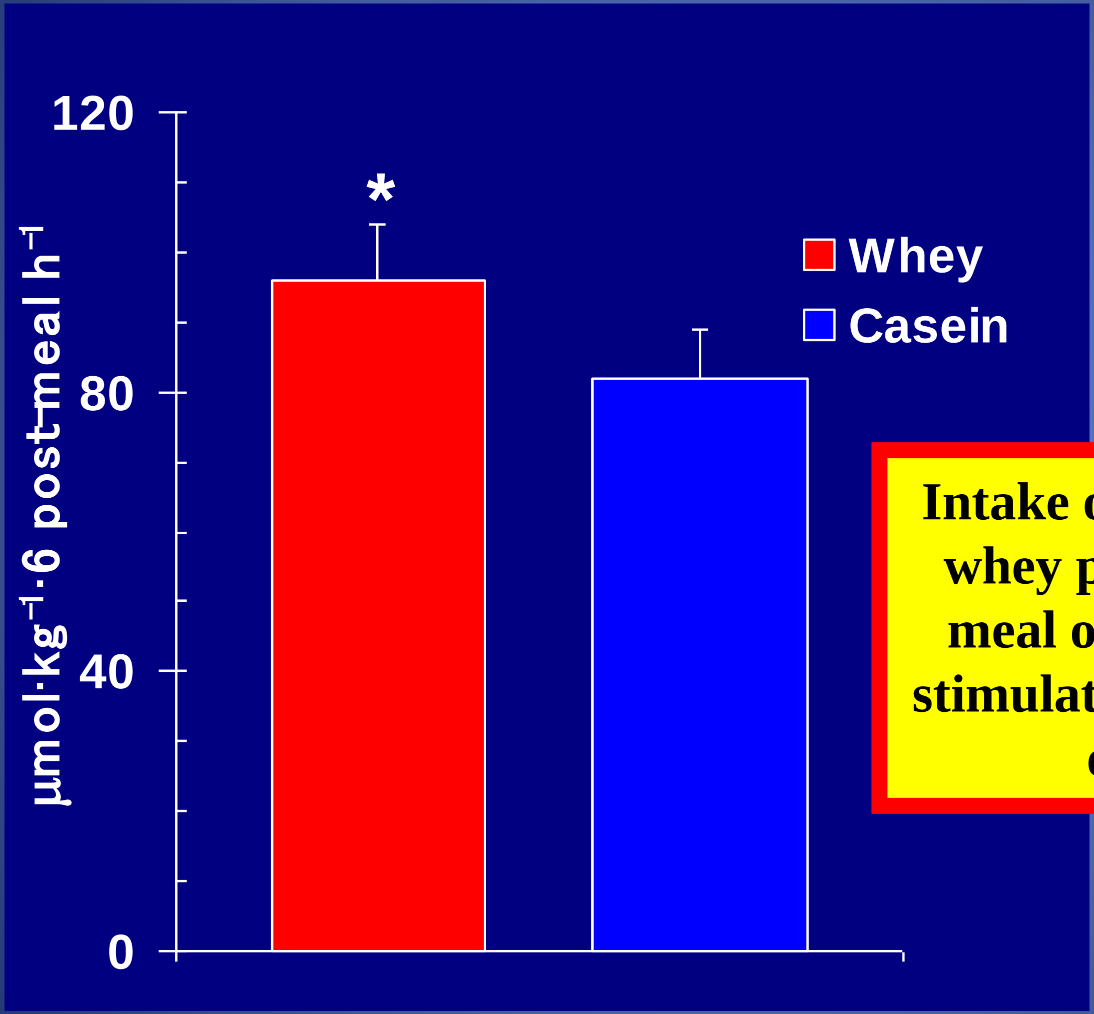
Amino acid composition of whey and casein



J. Nutr. 2008

WHEY PROTEIN INGESTION ENHANCES POSTPRANDIAL ANABOLISM DURING SHORT-TERM BED REST IN YOUNG MEN

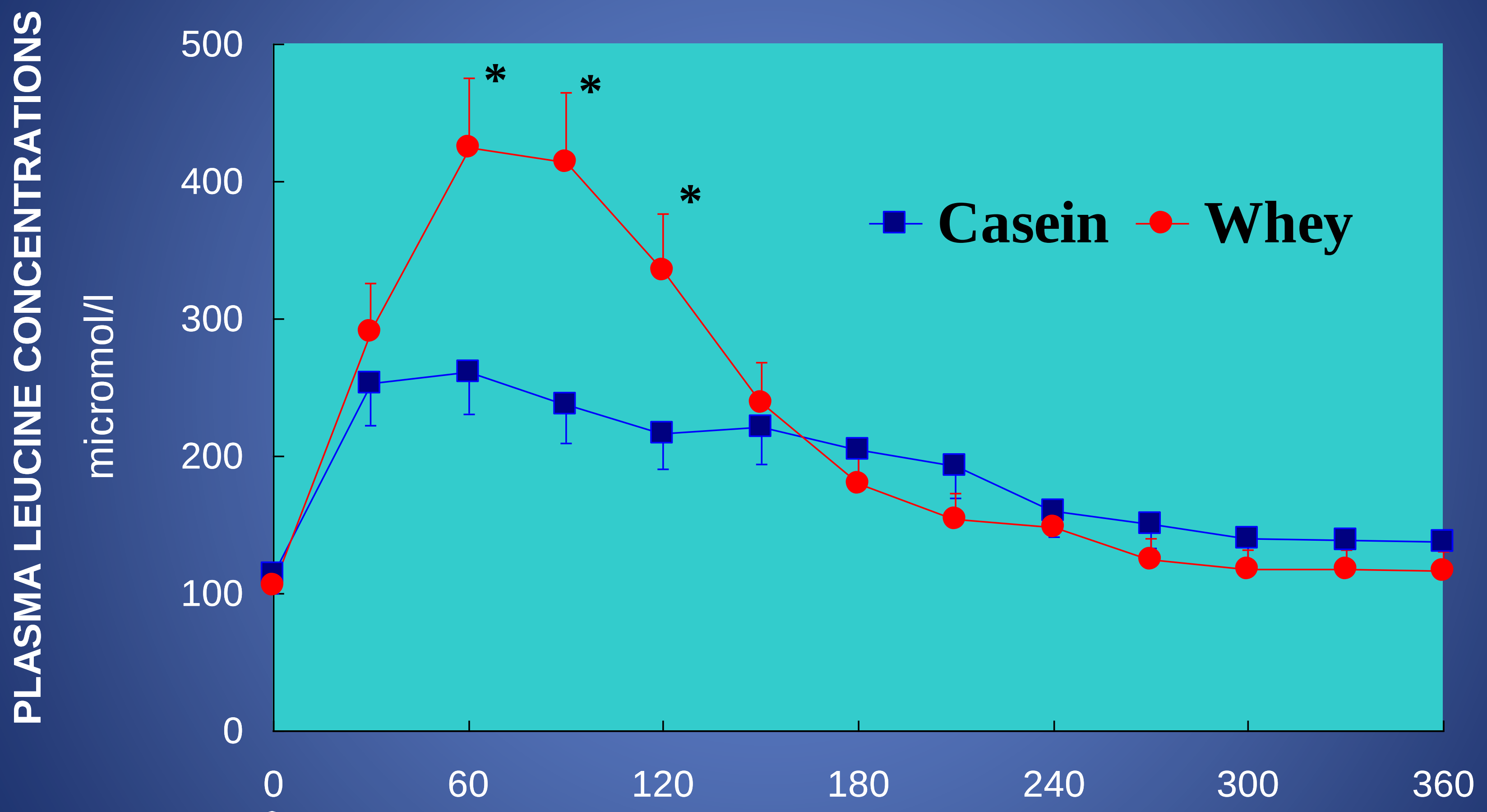
Antonione et al., J Nutr 2008



Intake of the rapidly absorbed whey protein within a mixed meal optimizes postprandial stimulation of protein synthesis during bed rest.

Effects of whey and casein meals on whole body phenylalanine utilization for protein synthesis during bed rest

CASEIN AND WHEY ABSORPTION KINETICS



Test Meal
0.4 g/kg whey or casein
0.27 g/kg sucrose

J Nutr 2008

VALUTAZIONE DELL’EFFICACIA DELLE PROTEINE ALIMENTARI NELLE SINTESI PROTEICHE

QUALITA’ PROTEICA

Vengono utilizzati diversi metodi:

1. Misurazione dell’**aumento di peso di animali** che sono **in crescita** (metodo indaginoso)
2. Misurazioni che valutano il **contenuto corporeo di azoto** estrapolato dall’assorbimento e/o dalla digestione della proteina valutata (metodo indaginoso)
3. Misurazioni che fanno riferimento alla **composizione quali-quantitativa degli amminoacidi presenti nella proteina valutata**. Sono più semplici e oggi più utilizzate. Adottate anche dalla FAO, WHO

VALUTAZIONE DELLA QUALITA' DELLE PROTEINE CON MISURAZIONE DELLA CRESCITA IN ANIMALI

PROTEIN EFFICIENCY RATIO

$$PER = \frac{\text{Gain in Body Mass (g)}}{\text{Protein Intake (g)}}$$

Aumento di peso di un animale in crescita in relazione all'apporto proteico.
Confronto con proteina di riferimento ad es. ovoalbumina somministrata a gruppo animali di controllo

Valori > 2,5-2,7 indicativi di una buona efficacia

- ❖Uova 3,8; carne di manzo 2,9;
- ❖Proteine siero di latte 3,2; Caseina 2,5
- ❖Proteine soia 2,2

PROTEINE
contenuto in azoto

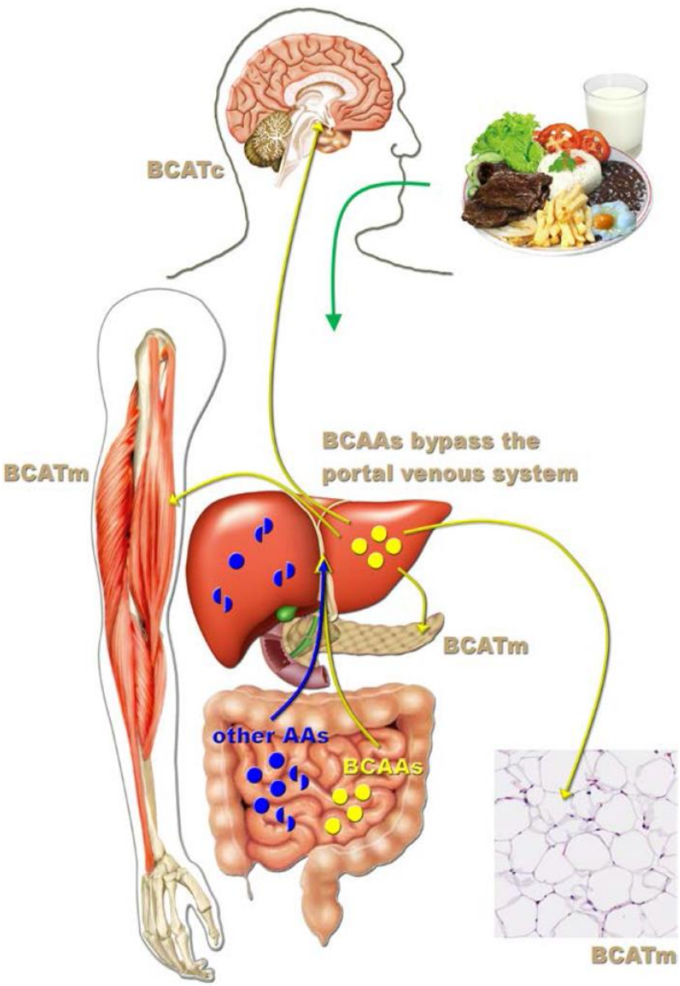
In media le proteine contengono il 16% di azoto

100 g di proteine / 16 g = 6,25 g

Quantità di proteine in grammi partendo dai grammi di azoto (conversione quantità di azoto in proteine)
= **azoto x 6,25**

Quantità di azoto partendo dai grammi di proteine (conversione quantità di proteine in quantità di azoto
= **proteine : 6,25**

VALUTAZIONE DELLA QUALITA’ DELLE PROTEINE CON MISURAZIONE DEL CONTENUTO CORPOREO DI AZOTO



PARAMETRI UTILIZZATI

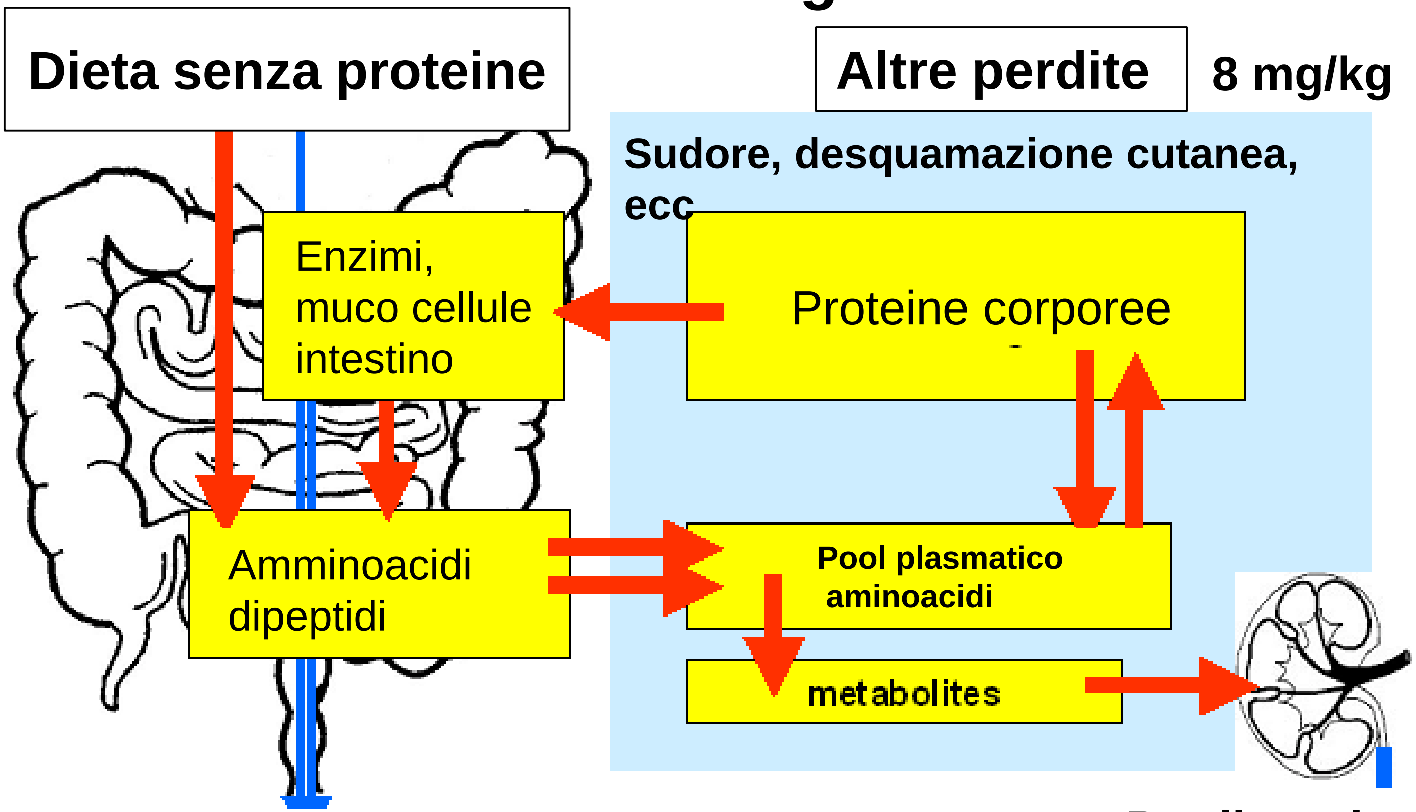
❖**(I) =** Introito di azoto U(N)

❖**Azoto digerito (D) =** Introito – perdite fecali – perdite fecali a dieta aproteica/introito (sull’ingerito)

❖**Azoto assorbito =** Introito – perdite fecali – perdite fecali a dieta aproteica

❖**Azoto ritenuto =** I – perdite fecali – perdite fecali a dieta aproteica - perdite Urinarie –perdite urinarie a dieta aproteica

FABBISOGNO PROTEICO MINIMO
Metodologia



Perdite fecali

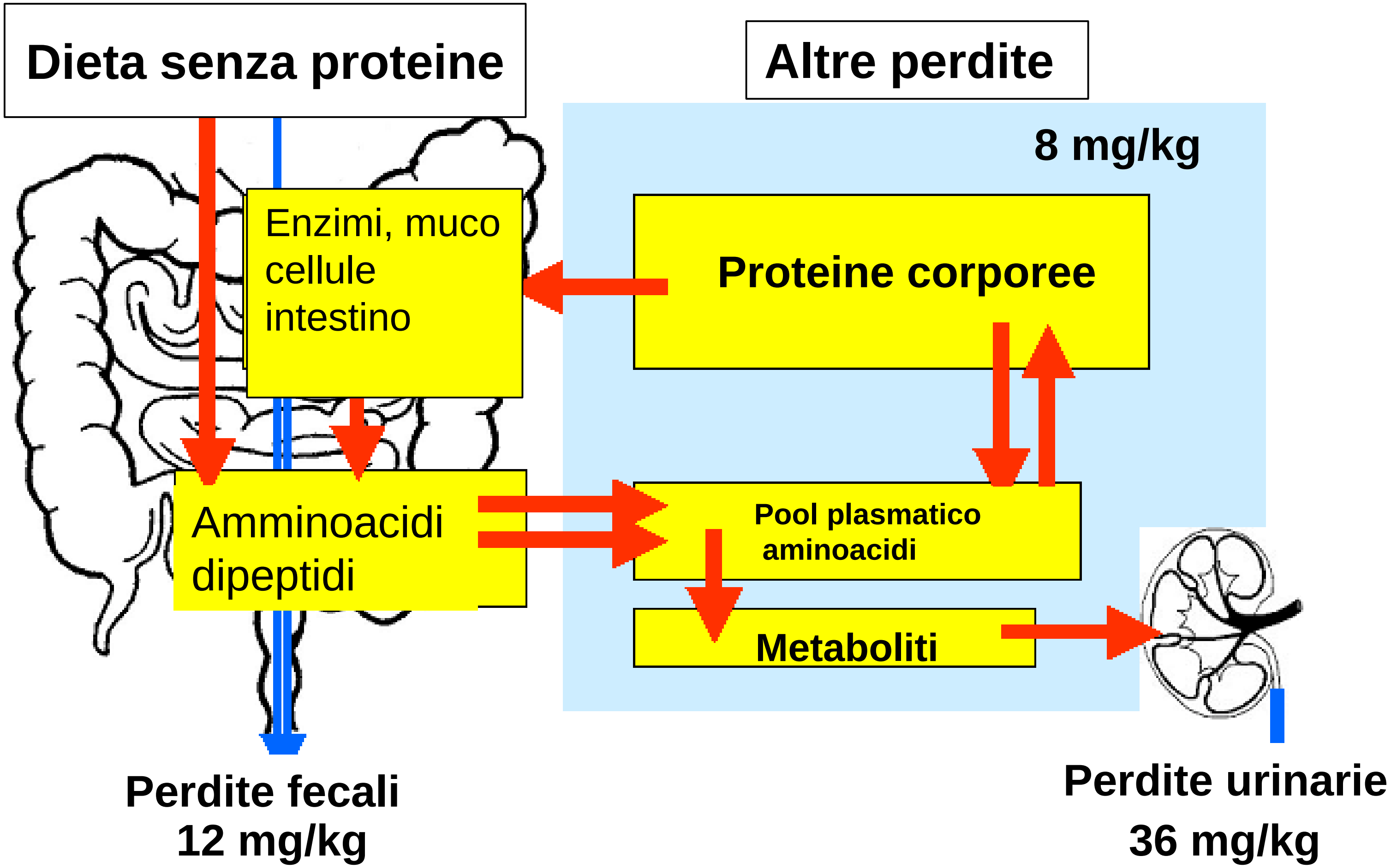
Cellule sfaldate, muco, biomassa batterica

Perdite urinarie

Urea + NUN, azoto non ureico (creatinina, acido urico da catabolismo basi puriniche provenienti dal ricambio tissutale)

E' stato **definito** tramite valutazione delle **perdite azotate obbligate** in soggetti giovani a dieta priva di proteine per una settimana in associazione ad un apporto di calorie da carboidrati e grassi sufficiente a mantenere il bilancio di energia, senza attivazione di neoglucogenesi

FABBISOGNO PROTEICO MINIMO RISULTATI



- **Totale 56 mg/kg di azoto/giorno**
- In un soggetto di 70 kg (peso ideale) = 56 x 70= 3,9 g di azoto.
- 3,9 x 6,25, = **24,4 g di proteine,** ovvero 0,35 g di proteine/kg peso ideale

VALUTAZIONE
DELLA QUALITA' DELLE PROTEINE

VALORE BIOLOGICO (VB): proporzione dell'azoto (della proteina) assorbito che viene ritenuto e utilizzato per la crescita e il mantenimento corporeo al netto di perdite urinarie e fecali.

- Dipende dalla **composizione in amminoacidi** e dalla presenza di **aminoacidi limitanti.**
- **Non tiene** conto della **digeribilità delle proteine.**

$$\mathbf{BV} = \frac{\text{Nalim} - \text{Nfeci} - \text{Nurine}}{\text{Nalim} - \text{Nfeci}}$$

N ritenuto / N assorbito

$$\mathbf{BV} = \frac{I - (F - Fk) - (U - Uk)}{I - (F - Fk)} \times 100$$

(% dell'azoto utilizzato)

N= azoto, I = Introito di azoto; F = perdite fecali di azoto dopo ingestione della proteina testata, Fk perdite fecali di azoto a dieta non proteica
U = perdite urinarie di azoto dopo ingestione della proteina testata, Uk perdite urinarie di azoto a dieta non proteica

DIGERIBILITA' delle PROTEINE

Rapporto tra proteina introdotta meno perdite fecali e quota di proteina ingerita

$$\text{Digeribilità, D} = \frac{I - (F - F_k)}{I} \times 100$$

Rapporto tra assorbito e introdotto

I = Introito di azoto;
F perdite fecali di azoto dopo ingestione della proteina testata
Fk perdite fecali di azoto a dieta non proteica

VALUTAZIONE
DELLA QUALITA' DELLE PROTEINE

UTLIZZAZIONE PROTEICA NETTA (NET PROTEIN UTILIZATION, NPU)

Si ottiene moltiplicando il **valore biologico** (N ritenuto su N assorbito) **per la digeribilità** (assorbito su introdotto della proteina testata)

$$\mathbf{VB \times D} = \frac{I - (F - Fk) - (U - Uk)}{I - (F - Fk)} \times \frac{I - (F - Fk)}{I} =$$

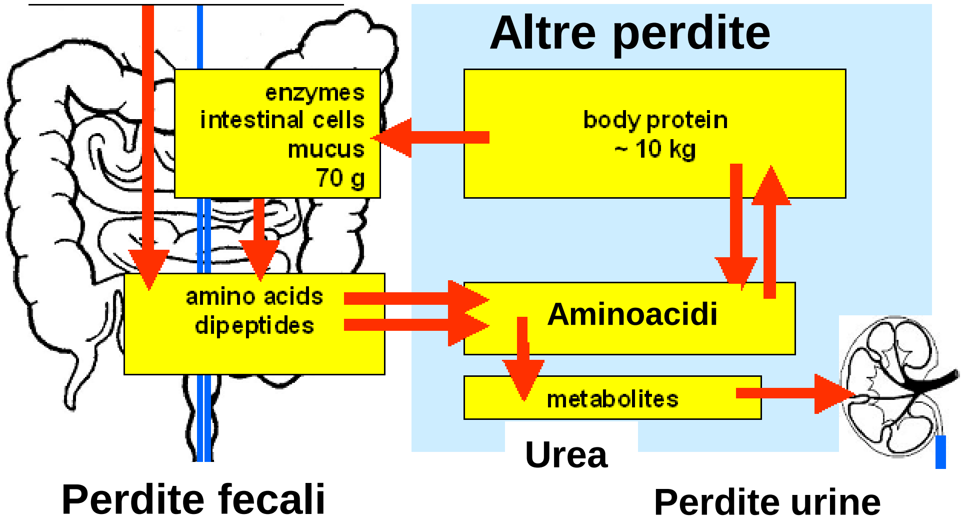
$$\mathbf{NPU} = \frac{I - (F - Fk) - (U - Uk)}{I}$$

Valuta **N ritenuto su N introdotto**

N = azoto VB = valore biologico , = Introito di azoto; F perdite fecali di azoto dopo ingestione della proteina testata,
Fk perdite fecali di azoto a dieta non proteica; U= perdite urinarie dopo ingestione proteina testata e Uk perdite urinarie di azoto a dieta non proteica

FABBISOGNO PROTEICO CON PROTEINE A DIVERSO NPU, NET PROTEIN UTILIZATION (BV x digeribilità)

NPU	Fabbisogno proteico g/kg
94 % uova	0,66
80% pesce	0,74
67 % vitello	0,84
61% soia	0,98
40% frumento	1,20



Gli studi con Bilancio dell'azoto = proteine introdotte, g azoto die / 6,25) − [UUN azoto ureico urinario g/die + UNUN, Urinary Non Urea Nitrogen, (dato da acido urico e creatinina escreti nelle urine) + 2-4 g equiparati alla somma di perdite di azoto fecali + altre perdite) **hanno rilevato che la neutralità del bilancio richiede quote di apporto proteico diverse, in relazione al NPU della proteina testata**

Per ottenere bilancio azoto neutro servono più proteine derivate da prodotti vegetali rispetto a prodotti di origine animale

VALUTAZIONE DELLA QUALITA' DELLE PROTEINE TRAMITE DOSAGGIO AMMINOACIDICO

DIGERIBILITÀ DELLE PROTEINE CORRETTA PER L'AMMINOACIDO LIMITANTE
Protein Digestibility-Corrected Amino Acid Score (PDCAAS)

$$\frac{I - (F - Fk)}{I} \times \frac{\text{AA limitante mg/g proteina testata}}{\text{Stesso AA mg/g proteina di riferimento}}$$

Digeribilità proteina testata

- **PDCAAS** è basato sul fabbisogno di amminoacidi nell'uomo, sia sulla capacità di digerire le proteine ingerite
- Secondo la FAO e WHO, **uno score = 1** indica che **la proteina soddisfa il fabbisogno di tutti gli amminoacidi essenziali**
- Tuttavia il **PDCAAS non considera il surplus di amminoacidi essenziali presenti in alcune proteine** che possono compensare i più bassi livelli presenti in altre

VALUTAZIONE DELLA QUALITA' DELLE PROTEINE CON DIVERSE METODOLOGIE

Table 1. Protein quality rankings.

Protein Type	Protein Efficiency Ratio	Biological Value	Net Protein Utilization	Protein Digestibility Corrected Amino Acid Score
Beef	2.9	80	73	0.92
Black Beans	0		0	0.75
Casein	2.5	77	76	1.00
Egg	3.9	100	94	1.00
Milk	2.5	91	82	1.00
Peanuts	1.8			0.52
Soy protein	2.2	74	61	1.00
Wheat gluten	0.8	64	67	0.25
Whey protein	3.2	104	92	1.00

Adapted from: U.S Dairy Export Council, Reference Manual for U.S. Whey Products 2nd Edition, 1999 and Sarwar, 1997.

Hoffman JR. Journal of Sports Science and Medicine (2004) 3, 118-130

PDCAAS

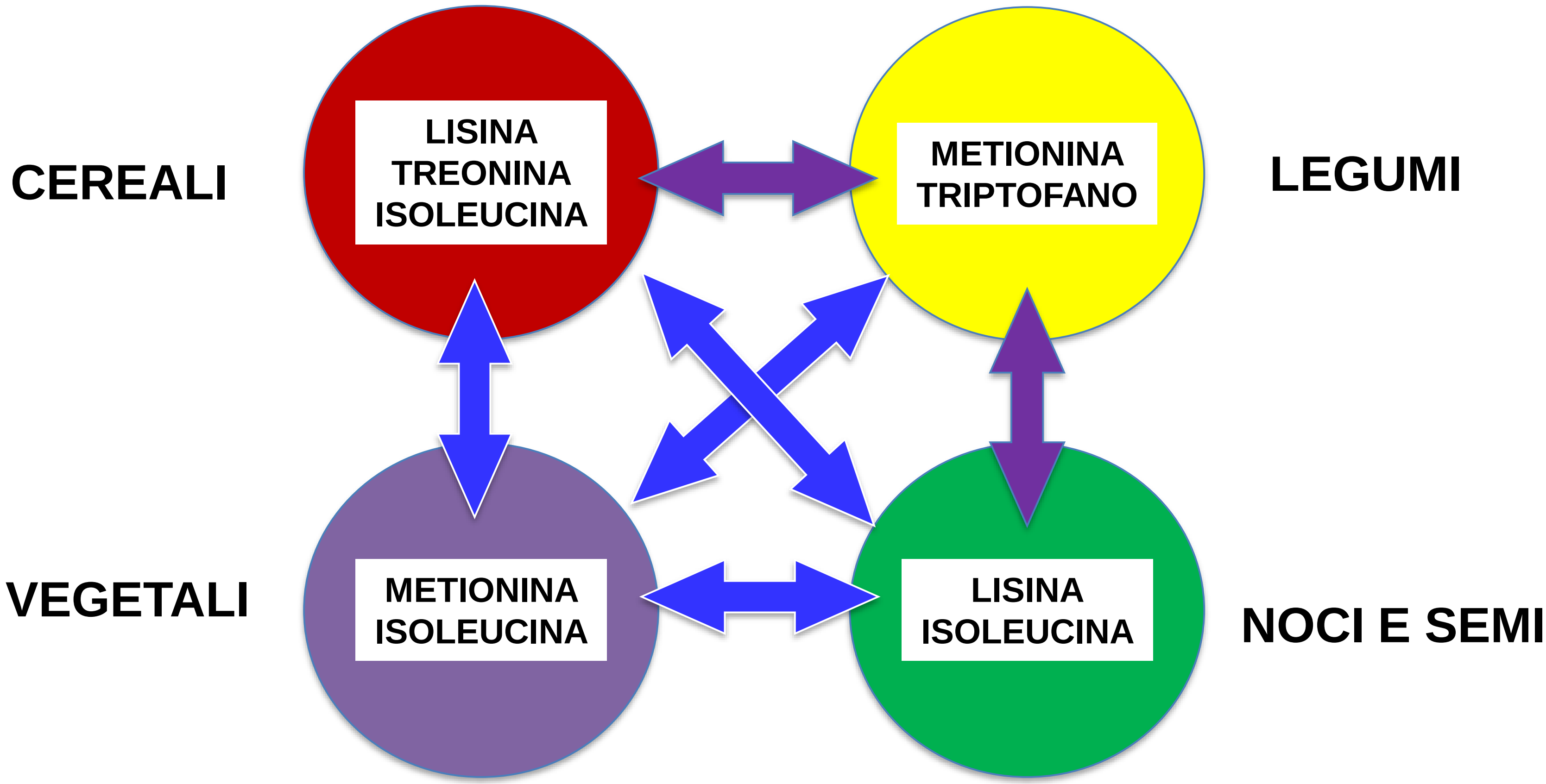
Score di diversi cibi

1	Latte di mucca
1	Uova
1	Caseina
1	Proteine della soia
1	Pupe di bachi da seta
1	Whey (proteine siero di latte)
0.92	Carne di manzo
0.893	Proteine di piselli concentrate
0.78	Ceci
0.75	Fagioli neri

0.70	Legumi media
0.687	Grilli
0.64	Frutta fresca
0.59	Cereali e derivati
0.52	Arachidi
0.50	Riso
0.48	Frutta secca oleosa, noci
0.525	Crusca di frumento
0.42	Frumento
0.25	Glutine di frumento

PROTEINE COMPLEMENTARI

Proteine alimentari la cui **associazione** in un pasto **rende l'apporto proteico completo** per compensazione delle reciproche carenze parziali di amminoacidi (riportate all'interno dei cerchi)



PDCAAS E COMPLEMENTARIETA’ DEGLI ALIMENTI

Combinando diversi cibi è possibile **massimizzare lo score del PDCAAS** in quanto i **diversi componenti completano** a vicenda **le quote di amminoacidi essenziali**. La complementarietà può essere ottenuta **abbinando proteine vegetali con proteine animali oppure con l’associazione di proteine vegetali di diversa tipologia**

Piselli cotti 0,597 + Riso 0,50

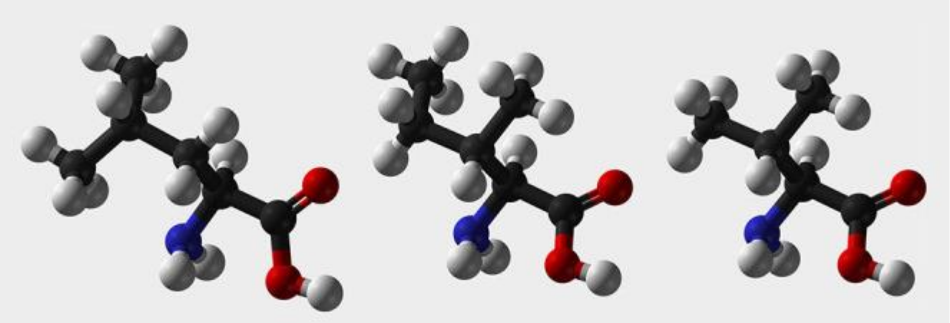
1,097	Riso e piselli
1	Cereali, noci e semi
1	Legumi, noci e semi
0,92	Riso e latte

PDAAS. Protein digestibility corrected AA score

Amino Acids

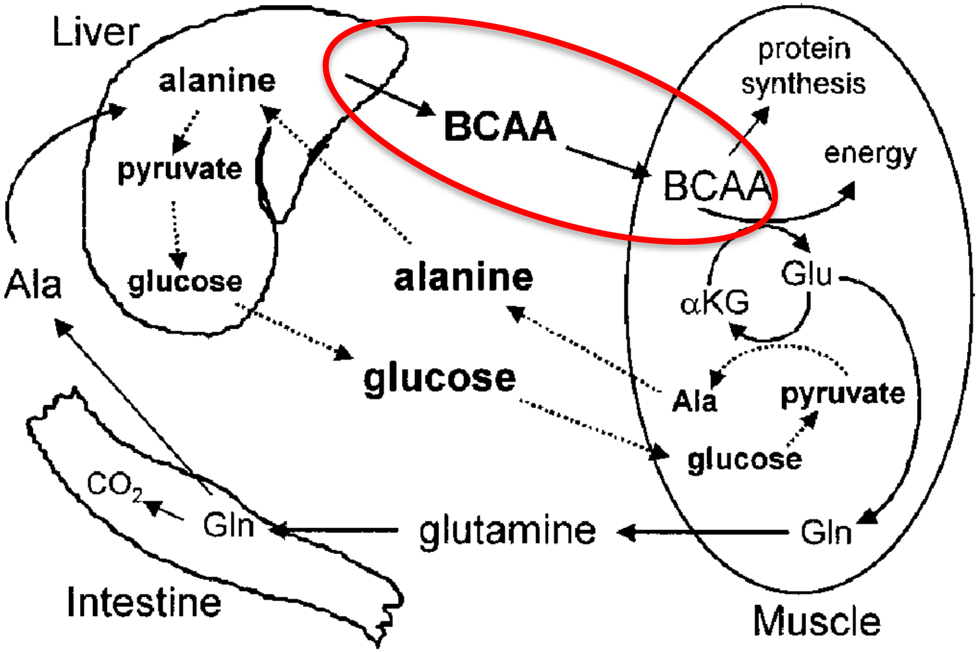
BRANCHED CHAIN AMINO ACIDS (BCAA)

- Essential amino acids

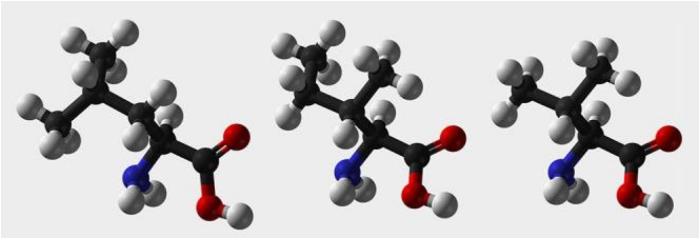


Valine Leucine Isoleucin

- BCAAs in humans elevates the phosphorylation and the activation of p70S6 kinase and 4E-BP1 in skeletal muscle

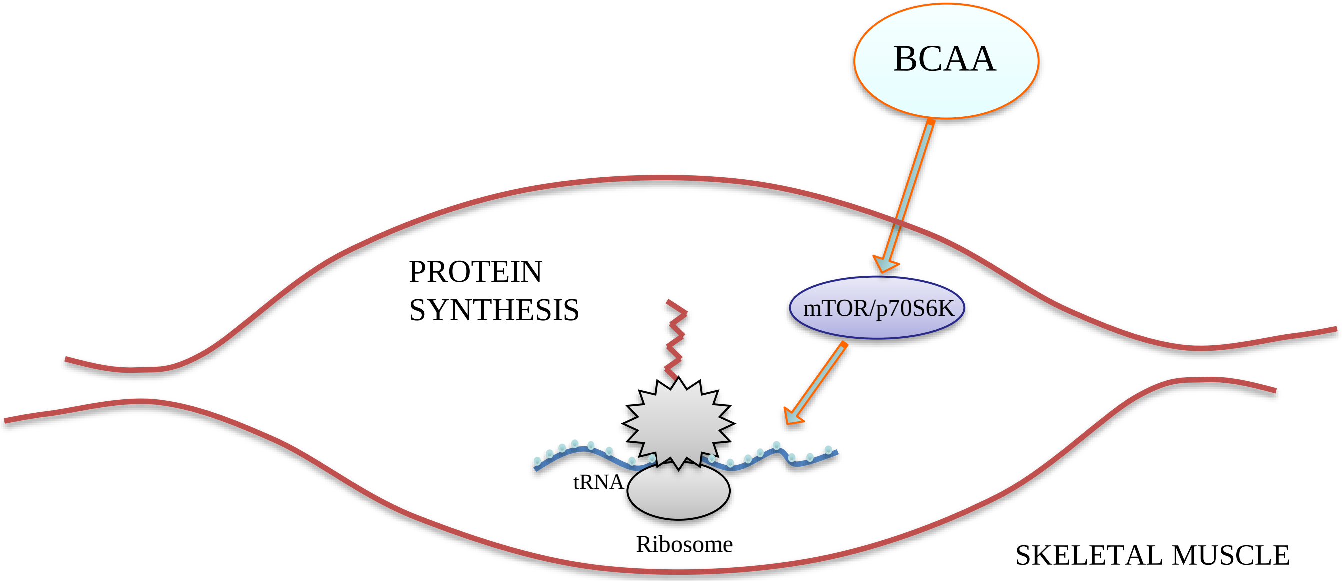


BRANCHED CHAIN AMINO ACIDS (BCAA)

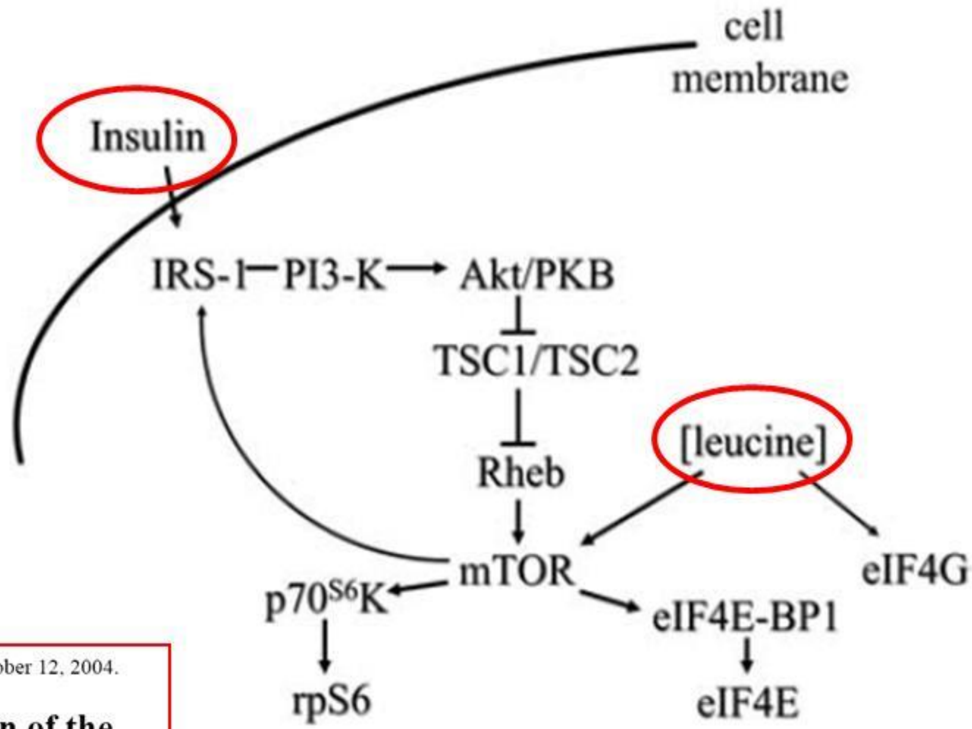


Valine Leucine Isoleucin

- BCAAs in humans elevates the phosphorylation and the activation of p70S6 kinase and 4E-BP1, downstream components of the mTOR signaling pathway, which controls RNA translation and synthesis of proteins, and which is recognized as the central node to support muscle hypertrophy



Leucine enhances the insulin stimulatory effect on mTOR under conditions of hormonal resistance



Layman & Walker 2006

The FASEB Journal express article 10.1096/fj.03-1409fje. Published online October 12, 2004.

Amino acids and leucine allow insulin activation of the PKB/mTOR pathway in normal adipocytes treated with wortmannin and in adipocytes from *db/db* mice

Charlotte Hinault,* Isabelle Mothe-Satney,* Nadine Gautier,* John C. Lawrence, Jr.,† and Emmanuel Van Obberghen *

Am J Physiol Endocrinol Metab 291: E381–E387, 2006.
First published February 28, 2006; doi:10.1152/ajpendo.00488.2005.

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]

Departments of [1]Surgery and Shriners Hospitals for Children-Galveston, [3]Internal Medicine, and [4]Anesthesiology, University of Texas Medical Branch, Galveston, Texas; and [2]AminoScience Laboratories, Ajinomoto Company, Incorporated, Kawasaki, Japan

MUSCLE PROTEIN SYNTHESIS

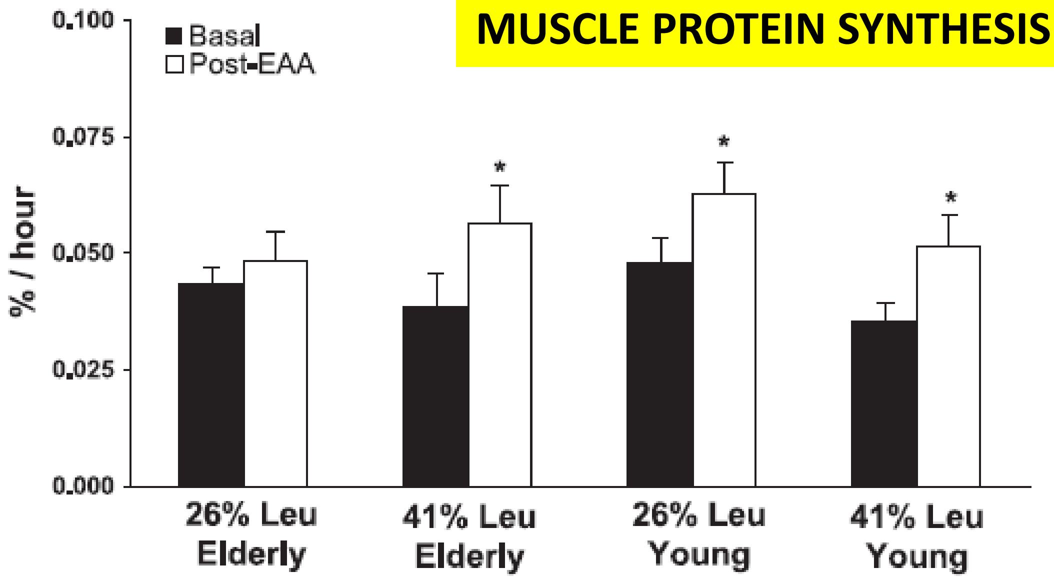


Fig. 5. Fractional synthetic rate (%/h) of mixed muscle protein in the basal state (Basal) and after the ingestion of 6.7 g of EAA (Post-EAA) containing either 1.7 (26% Leu) or 2.8 (41% Leu) g of leucine. *Significantly different from the corresponding basal value ($P < 0.05$).

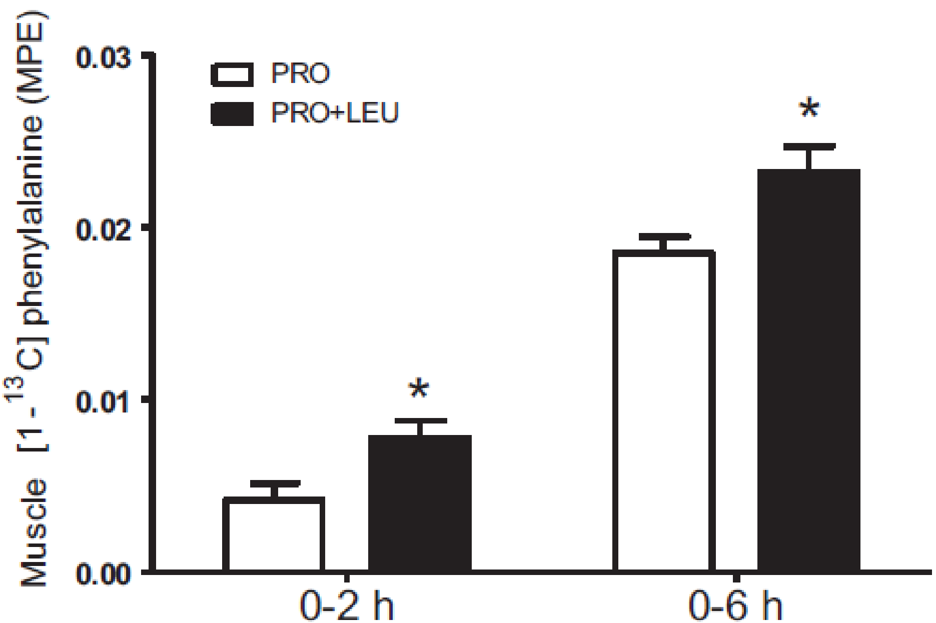
Leucine co-ingestion improves post-prandial muscle protein accretion in elderly men

Benjamin T. Wall, Henrike M. Hamer, Anneke de Lange, Alexandra Kiskini, Bart B.L. Groen, Joan M.G. Senden, Annemie P. Gijsen, Lex B. Verdijk, Luc J.C. van Loon*

Department of Human Movement Sciences, NUTRIM School for Nutrition, Toxicology and Metabolism, Maastricht University Medical Centre, PO Box 616, Maastricht, 6200 MD, The Netherlands

Clinical Nutrition 32 (2013) 412–419

Methods: Twenty-four elderly men (74.3 ± 1.0 y) were randomly assigned to ingest 20 g intrinsically L-[1-^{13}C]phenylalanine-labeled casein protein with (PRO + LEU) or without (PRO) 2.5 g crystalline leucine.



Mean (±SEM) delta protein-bound L-[1-^{13}C]phenylalanine enrichments (MPE) during a 2 and 6 h incorporation period following the ingestion of 20 g intrinsically L-[1-^{13}C]phenylalanine-labeled casein with (PRO + LEU; $n = 12$) or without (PRO; $n = 12$) 2.5 g crystalline leucine in healthy, elderly men. Data were analyzed with an unpaired, two-tailed Student's t-test. *$P < 0.05$ compared with corresponding time point in the PRO group.

Long-term leucine supplementation does not increase muscle mass or strength in healthy elderly men[1–3]

Suzanne Verhoeven, Kristof Vanschoonbeek, Lex B Verdijk, René Koopman, Will KWH Wodzig, Paul Dendale, and Luc JC van Loon

Am J Clin Nutr 2009;89:1468–75.

Leucine or placebo (2.5 g) was administered with each main meal during a 3-mo intervention period.

Body composition[1]

	Placebo ($n = 14$)		Leucine ($n = 15$)	
	Before	After	Before	After
Lean mass (kg)	55.8 ± 0.9	56.2 ± 1.1	54.6 ± 1.0	55.0 ± 1.5
Fat mass (kg)	19.8 ± 1.7	19.2 ± 2.0	20.0 ± 1.4	20.0 ± 1.3
Body fat (%)	24.5 ± 1.7	23.9 ± 1.9	25.3 ± 1.2	25.4 ± 1.2
Leg lean mass (kg)	17.6 ± 0.4	18.0 ± 0.4	17.1 ± 0.5	17.6 ± 0.4
Leg fat (%)	18.9 ± 1.5	19.4 ± 1.6	19.6 ± 1.2	19.8 ± 1.2
CSA (cm^2)	71 ± 3	71 ± 3	71 ± 2	71 ± 2
Leg volume (L)	7.5 ± 1.9	7.5 ± 1.7	8.1 ± 3.0	7.8 ± 4.1

[1] All values are means ± SEMs. CSA, cross-sectional area. Data were analyzed by using repeated-measures ANOVA. No significant differences were observed between groups or over time.

Results: No changes in skeletal muscle mass or strength were observed over time in either the leucine- or placebo-supplemented group. No improvements in indexes of whole-body insulin sensitivity (oral glucose insulin sensitivity index and the homeostasis model assessment of insulin resistance), blood glycated hemoglobin content, or the plasma lipid profile were observed.

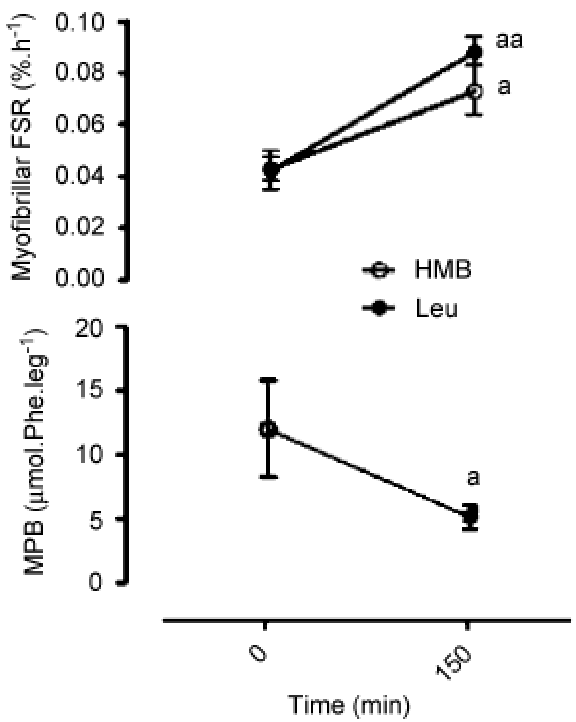
Glycemic control[1]

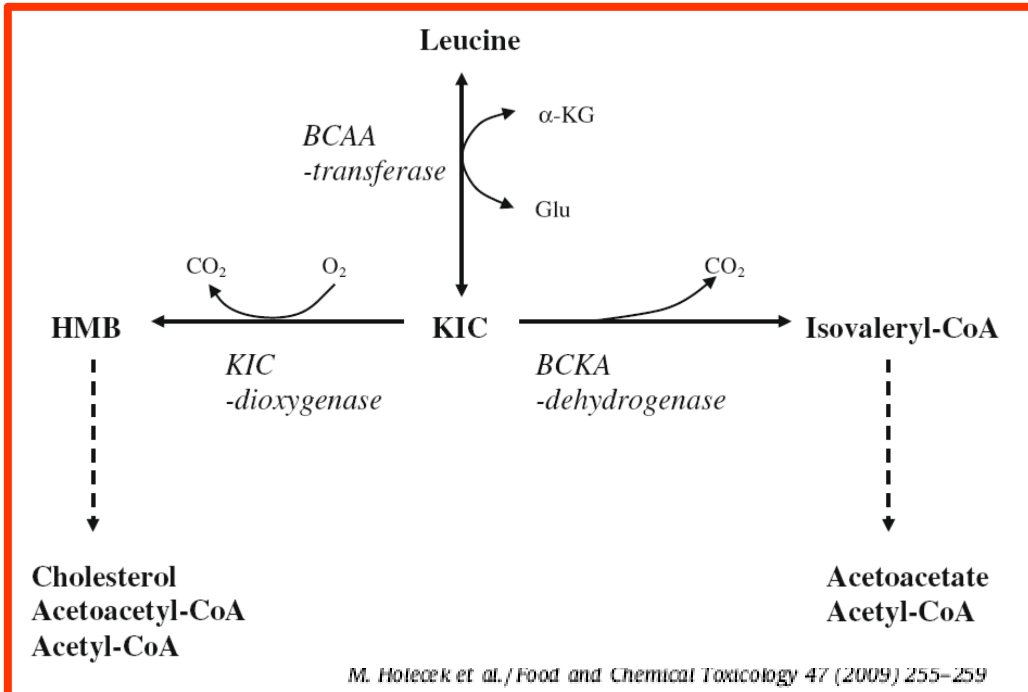
	Placebo ($n = 14$)					Leucine ($n = 15$)				
	0	2	4	8	12	0	2	4	8	12
Plasma glucose (mmol/L)	5.54 ± 0.11	5.63 ± 0.13	5.62 ± 0.12	5.75 ± 0.13	5.49 ± 0.10	5.69 ± 0.18	5.77 ± 0.18	5.86 ± 0.15	5.85 ± 0.17	5.66 ± 0.16
Plasma insulin (mU/L)	6.04 ± 0.76	6.08 ± 0.82	4.66 ± 0.54	6.37 ± 1.04	6.15 ± 1.25	6.73 ± 0.68	8.22 ± 0.91	9.03 ± 1.45	8.34 ± 1.44	7.37 ± 1.17
Hb A_{1c} (%)	5.8 ± 0.1	5.6 ± 0.1	5.6 ± 0.1	5.6 ± 0.1	5.8 ± 0.1	5.9 ± 0.1	5.8 ± 0.1	5.8 ± 0.1	5.8 ± 0.1	5.9 ± 0.1
HOMA-IR	1.51 ± 0.21	1.55 ± 0.23	1.19 ± 0.16	1.66 ± 0.29	1.54 ± 0.33	1.74 ± 0.21	2.12 ± 0.26	2.38 ± 0.4	2.19 ± 0.39	1.89 ± 0.32
$Glucose_{120\ min}$ OGTT	7.16 ± 0.67	—	—	—	5.44 ± 0.49	6.76 ± 0.5	—	—	—	6.76 ± 0.65
OGIS ($mL \cdot min^{-1} \cdot m^{-2}$)	876 ± 40	—	—	—	939 ± 40	924 ± 44	—	—	—	906 ± 42

[1] All values are means ± SEMs. HOMA-IR, homeostasis model assessment of insulin resistance; OGIS, oral glucose insulin sensitivity; OGTT, oral-glucose-tolerance test; Hb A_{1c}, glycated hemoglobin. Data were analyzed by using repeated-measures ANOVA. No significant differences were observed between groups or over time.

Effects of leucine and its metabolite β-hydroxy-β-methylbutyrate on human skeletal muscle protein metabolism

J Physiol 591.11 (2013) pp 2911–2923





Consumption of small amounts (∼2–3 g) of either Leu or its metabolite HMB resulted in the acute increase of MPS to a degree comparable to that seen after a mixed meal, with HMB also suppressing MPB.

Effect of β-hydroxy-β-methylbutyrate (HMB) on lean body mass during 10 days of bed rest in older adults

Nicolaas E.P. Deutz [a,*], Suzette L. Pereira [b], Nicholas P. Hays [a], Jeffery S. Oliver [b], Neile K. Edens [b], Chris M. Evans [a], Robert R. Wolfe [a]

[a] *Center for Translational Research in Aging & Longevity, Donald W. Reynolds Institute on Aging, University of Arkansas for Medical Sciences, Little Rock, AR, USA*
[b] *Abbott Nutrition, Columbus, OH, USA*

Clinical Nutrition 32 (2013) 704–712

Design: A randomized, controlled, double-blinded, parallel-group design study was carried out in 24 healthy (SPPB ≥ 9) older adult subjects (20 women, 4 men), confined to complete bed rest for ten days, followed by resistance training rehabilitation for eight weeks. Subjects in the experimental group were treated with HMB (calcium salt, 1.5 g twice daily – total 3 g/day). Control subjects were treated with an inactive placebo powder. Treatments were provided starting 5 days prior to bed rest till the end rehabilitation phase. DXA was used to measure body composition.

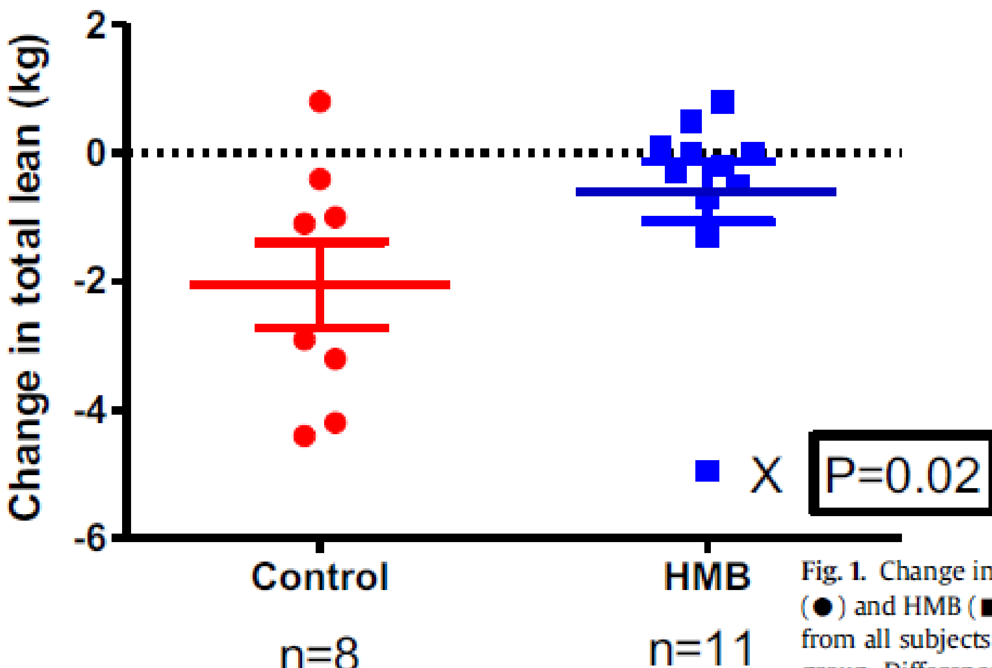


Fig. 1. Change in total lean mass in individual subjects over 10-day bed rest in Control (●) and HMB (■). Line with error bars represent mean ± SEM for each group. Values from all subjects (Control $n = 8$; HMB $n = 11$). X indicates potential outlier from HMB group. Difference between treatment groups was non-significant ($p = 0.16$, ANOVA). When data are analyzed from all Control subjects ($n = 8$) and HMB subjects excluding potential outlier, thus a total of 10 subjects, the difference between treatment groups is significant ($p = 0.02$, ANOVA).

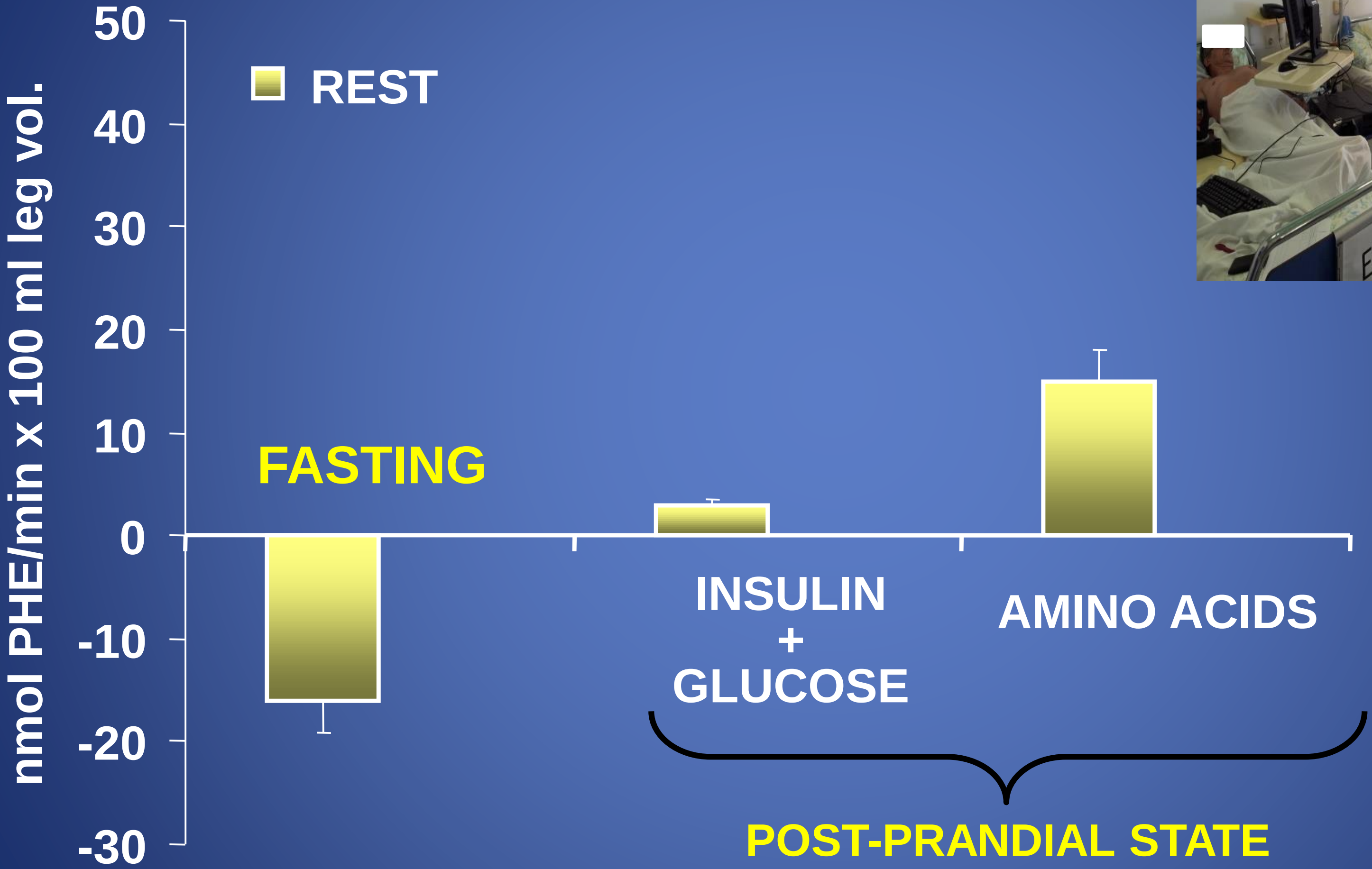
Author	Clinical setting	Subjects	Daily dose	Duration	Changes in body composition/function				Additional effects	Overall efficacy
					BM	FFM	FM	Strength		
Hsieh et al. (2010)	Old age-related wasting	79 bed-ridden elderly receiving tube feeding (43 M, 36 F)	2 g HMB (nasogastric feeding tube)	2 or 4 wk (39 subjects continued the study for another 14 days)	=(2 wk or 4 wk)	NA	NA	NA	Waist circumference: (+) (2, or 4 weeks) Red blood cells: −(2 week) Hemoglobin: −(2 weeks) BUN: −(2 weeks) UUN: −(2 or 4 weeks) Calf circumference: + (4 weeks) Plasma uric acid: −(4 weeks)	Y
Vukovich et al. (2001a, b)	Old age-related wasting	31 old adults (15 M, 16 F)	3 g HMB	8 wk (during training)	=	(+)	−	(+)	Plasma HMB: +	Y
Baier et al. (2009)	Old age-related wasting	77 elderly subjects (38 M, 39 F)	2 g or 3 g HMB (if >68 kg)/5 or 7.5 g ARG (if >68 kg)/1.5 or 2.25 g LYS (if >68 kg)/0.1 g ascorbic acid	1 year	+	+	=	=	BCM: + TBW: + ICW: + ECW: = Functionality: = Protein synthesis: + Protein breakdown: + Protein turnover: + Dietary intake: = Psychological well-being: = Quality of life: = Blood chemistry/hematology: =	Y
Flakoll et al. (2004)	Old age-related wasting	50 elderly subjects (50 F)	2 g HMB/5 g ARG/1.5 g LYS/0.5 g ascorbic acid	12 wk	=	(+)	=	+	"Get-up-and-go" functionality test: + Average limb circumferences: + Abdomen and hip circumferences: (−) UUN: − Proteolysis: = Net protein gain: = Protein synthesis: + Plasma arginine: (+) Dietary intake: = Plasma hormones/amino acids: =	Y
Fuller et al. (2011a, b)	Old age-related wasting	77 elderly subjects (38 M, 39 F)	2 g HMB/5 g ARG/1.5 g LYS (1.5 × dosage if weighing >68 kg)	1 year	NA	+	NA	+		Y
Williams et al. (2002)	Collagen deposition	35 healthy elderly subjects (8 M, 27 F)	3 g HMB/14 g ARG/14 g GLN	2 wk	NA	NA	NA	NA	Plasma arginine: + Plasma ornithine: + Collagen accumulation: + OHP content: + Total protein deposition: = α-AN: =	Y

Beta-hydroxy-beta-methylbutyrate supplementation in health and disease: a systematic review of randomized trials

Alessio Molfino · Gianfranco Gioia · Filippo Rossi Fanelli · Maurizio Muscaritoli

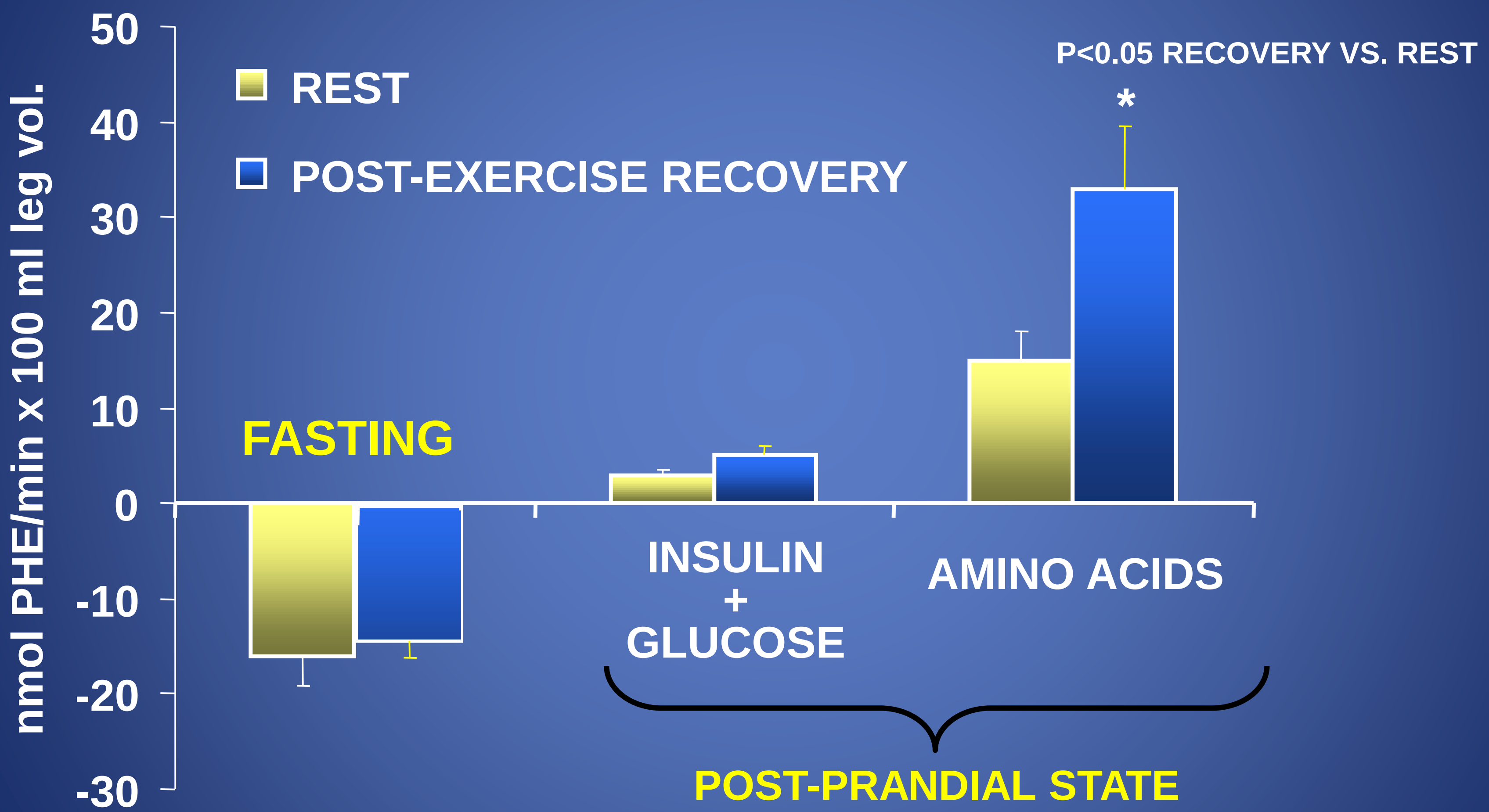
Amino Acids 2013
DOI 10.1007/s00726-013-1592-z

Regulation of muscle protein balance in the fasting and postprandial states



AJPENDO 1995, AJPENDO 1997, Diabetes 1999

Regulation of muscle protein balace in the fasting and postprandial states at rest and after exercise

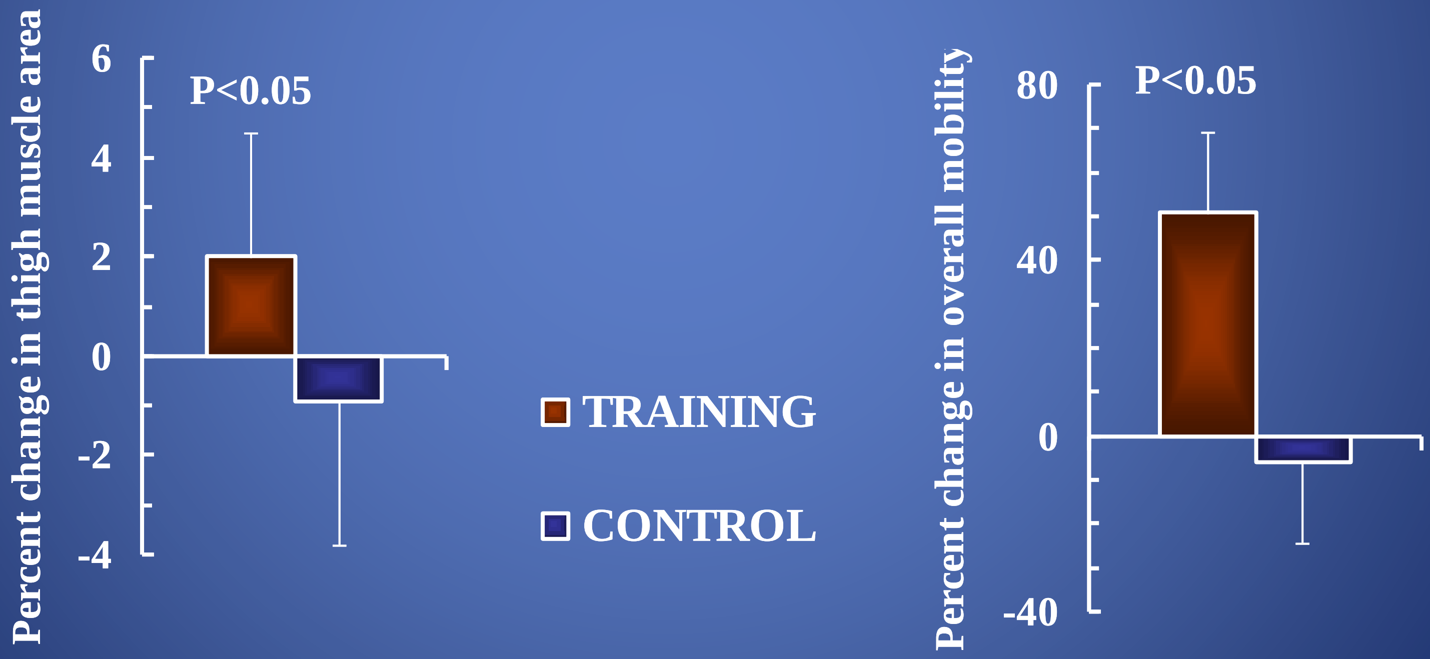


AJPENDO 1995, AJPENDO 1997, Diabetes 1999

Exercise Training for Physical Frailty in Very Elderly People

Fiatarone et al., New Engl J Med 1994

Randomized, placebo-controlled trial. 100 frail nursing home residents. Progressive resistance exercise training over a 10-week period.



J Physiol 587.1 (2009) pp 211–217

RAPID REPORT

Age-related differences in the dose–response relationship of muscle protein synthesis to resistance exercise in young and old men

Vinod Kumar[1], Anna Selby[1], Debbie Rankin[1], Rekha Patel[1], Philip Atherton[1], Wulf Hildebrandt[1], John Williams[2], Kenneth Smith[1], Olivier Seynnes[3], Natalie Hiscock[4] and Michael J. Rennie[1]

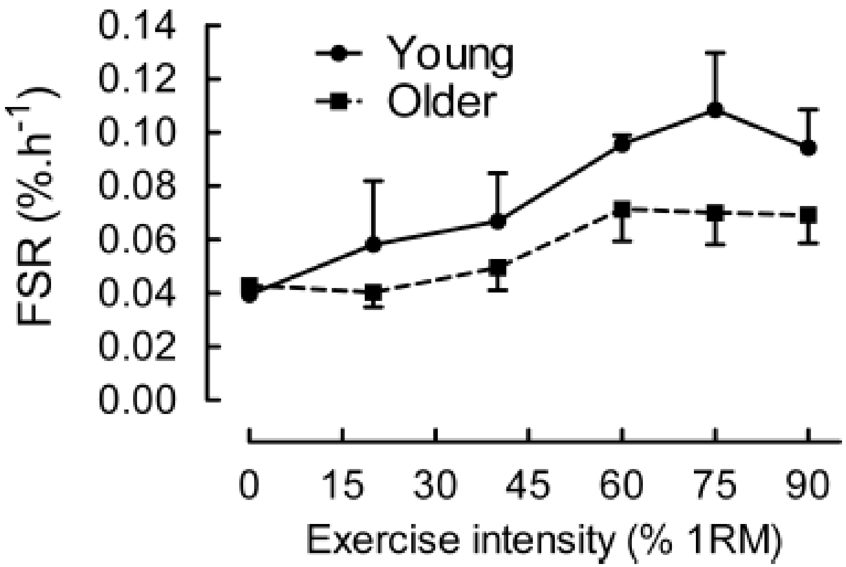


Figure 2. Dose–response relationship of myofibrillar protein synthesis (FSR, fractional synthetic rate, % h^{-1}) measured at 1–2 h post-exercise for 5 young men and 5 older men at each intensity
The responses of the young men overall were greater than those of the older men ($P < 0.04$). The responses between 60 and 90% of 1 RM in young and old were indistinguishable from each other but those in the young were together significantly higher than in the older men ($P < 0.01$) for 15 subjects in each group

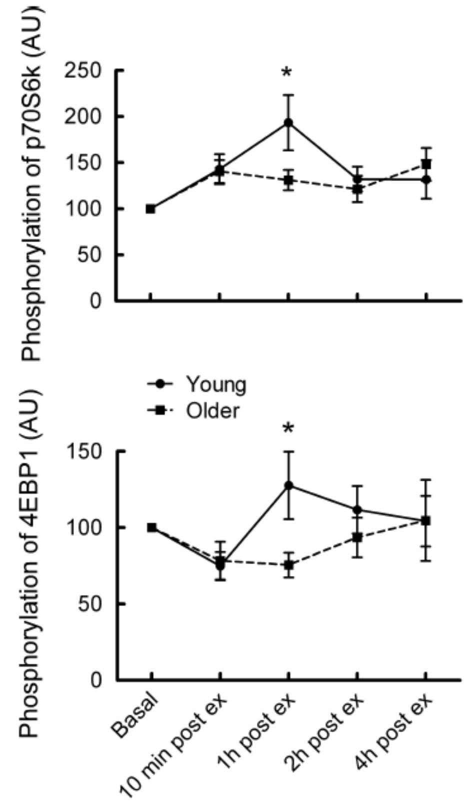


Figure 4. Time courses of the responses of phosphorylation of p70s6K and 4EBP1 (arbitrary units as percentage basal for each subject) averaged for intensities of 60–90% 1 RM
$n = 15$ in each group. *$P < 0.05$.

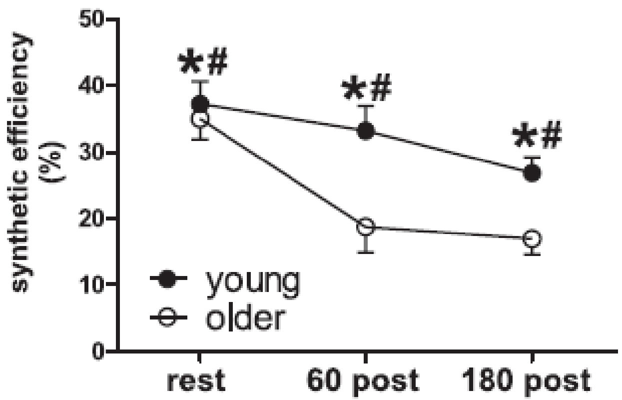
Older men show anabolic resistance of signalling and myofibrillar protein synthesis to resistance exercise.

The FASEB Journal • Research Communication

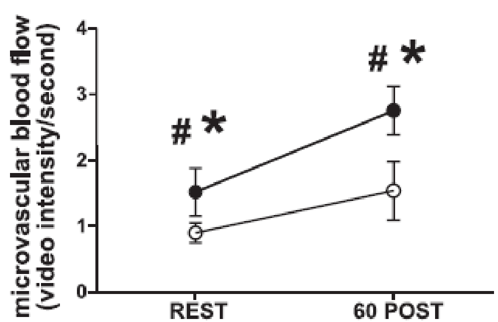
Age-related anabolic resistance after endurance-type exercise in healthy humans

William J. Durham,*[,1] Shanon L. Casperson,*[,1] Edgar L. Dillon,* Michelle A. Keske,¶ Douglas Paddon-Jones,*[,†] Arthur P. Sanford,‡ Robert C. Hickner,‖ James J. Grady,§ and Melinda Sheffield-Moore*[,2]

*Department of Internal Medicine, †Department of Physical Therapy, ‡Department of Surgery, and §Department of Preventive Medicine and Community Health, The University of Texas Medical Branch, Galveston, Texas USA; ‖Human Performance Laboratory, East Carolina University, Greenville, North Carolina, USA; and ¶Menzies Research Institute, University of Tasmania, Hobart, Tasmania, Australia



Aging induces anabolic resistance following endurance exercise, manifested as reduced (by 40%) efficiency of muscle protein synthesis.



J Appl Physiol 107: 549–557, 2009.
First published May 28, 2009; doi:10.1152/japplphysiol.00280.2009.

A transient antioxidant stress response accompanies the onset of disuse atrophy in human skeletal muscle

Luciano Dalla Libera,[1] Barbara Ravara,[2] Valerio Gobbo,[1] Elena Tarricone,[2] Maurizio Vitadello,[1] Gianni Biolo,[3] Giorgio Vescovo,[4] and Luisa Gorza[2]

[1]*Consiglio Nazionale delle Ricerche-Institute for Neuroscience, and* [2]*Department of Biomedical Sciences, University of Padova, Padova;* [3]*Department of Clinical, Technological and Morphological Sciences, Division of Internal Medicine, University of Trieste, Trieste; and* [4]*Division of Internal Medicine, San Bortolo Hospital, Vicenza, Italy*

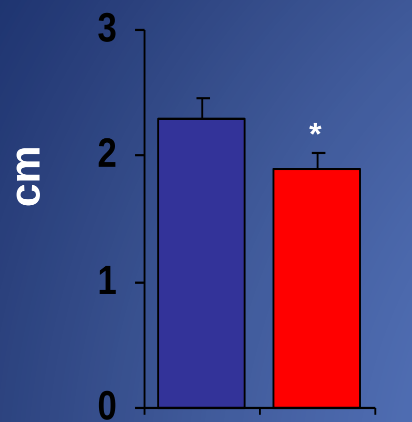
J Physiol 588.24 (2010) pp 5089–5104

Effects of inactivity on human muscle glutathione synthesis by a double-tracer and single-biopsy approach

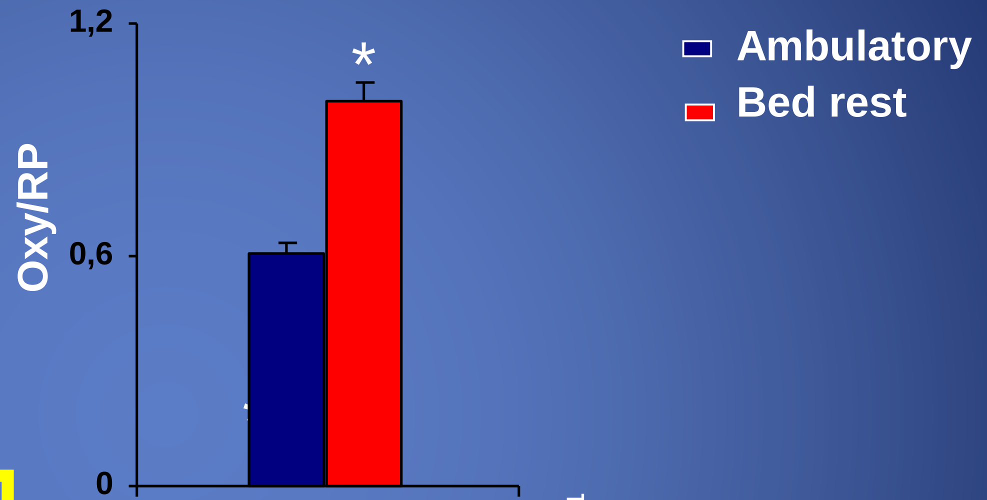
Francesco Agostini[1], Luciano Dalla Libera[2], Jörn Rittweger[3], Sara Mazzucco[1], Mihaela Jurdana[4], Igor B. Mekjavic[5], Rado Pišot[4], Luisa Gorza[2], Marco Narici[6] and Gianni Biolo[1]

[1]*Department of Medical, Technological and Translational Sciences, Division of Internal Medicine, University of Trieste, Trieste, Italy*
[2]*CNR-Institute for Neuroscience, Padova Section, and Department of Biomedical Sciences, University of Padova, Padova, Italy*
[3]*Institute of Aerospace Medicine, Department of Space Physiology, German Aerospace Center, Cologne, Germany*
[4]*Institute of Kinesiology Research, Science and research centre of Koper, University of Primorska, Koper, Slovenia*
[5]*Department of Automation, Biocybernetics and Robotics, Jozef Stefan Institute, Ljubljana, Slovenia*
[6]*Institute for Biomedical Research into Human Movement and Health, Manchester Metropolitan University, Manchester, UK*

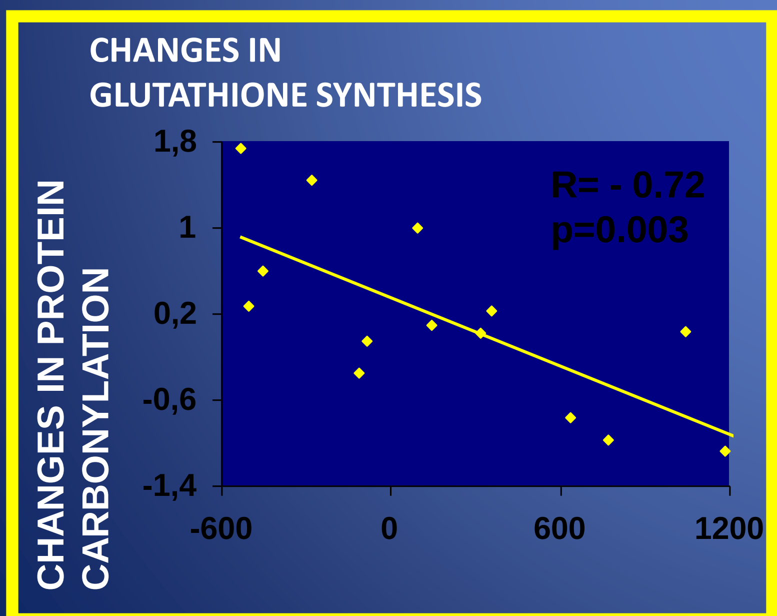
Effects of 5-wk bed rest on muscle oxidative stress and anti-oxidant capacity

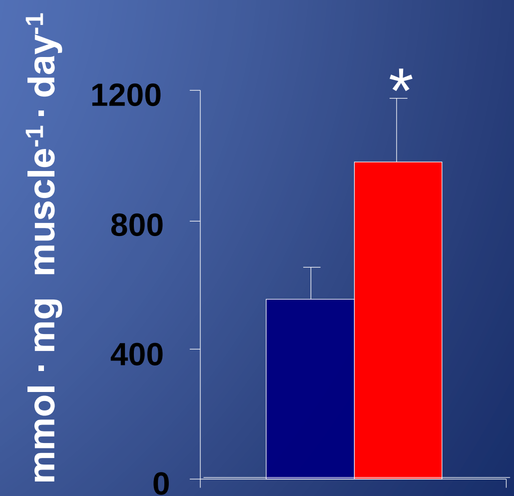


VASTUS LATERALIS THICKNESS



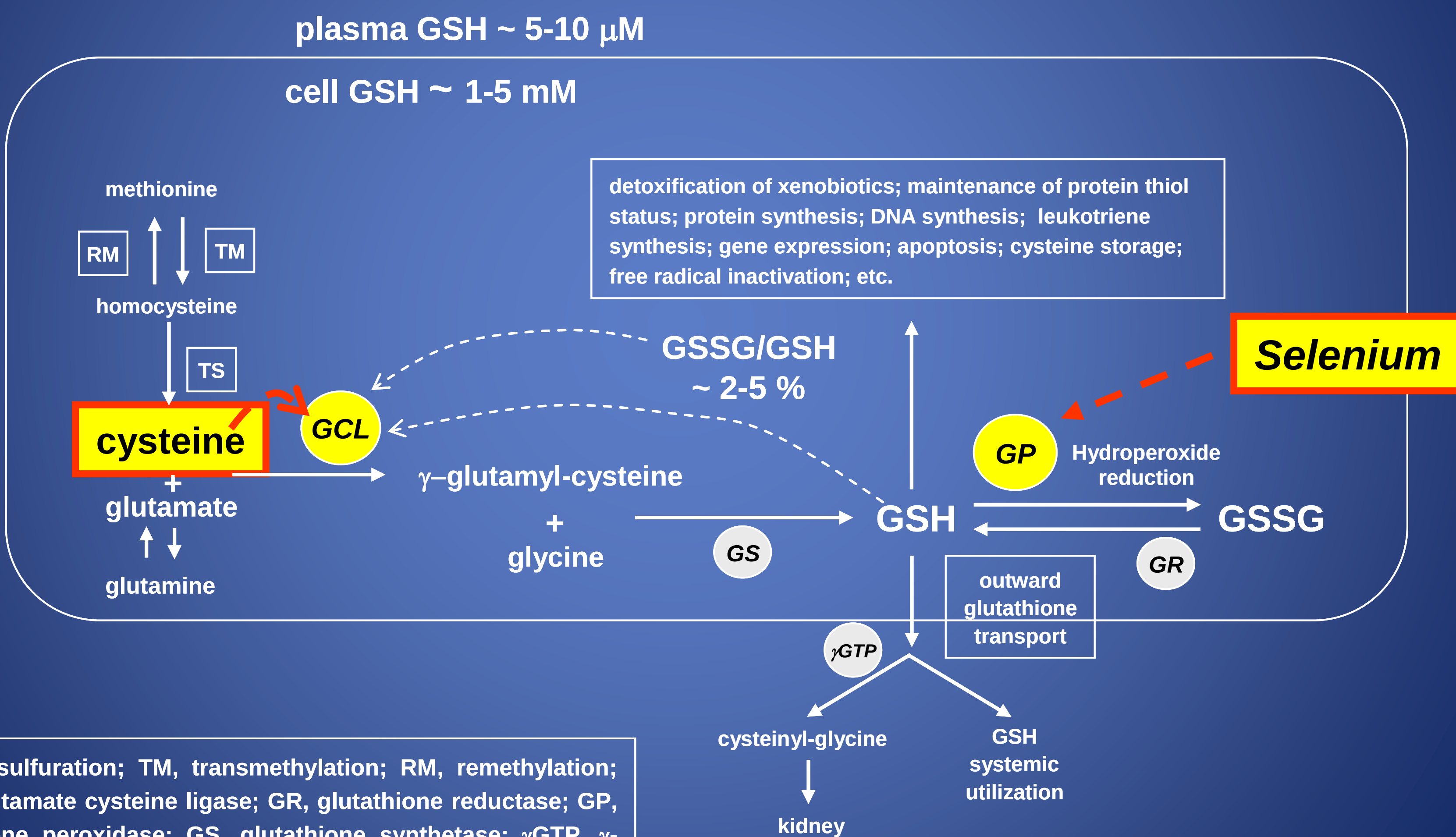
MUSCLE PROTEIN CARBONYLATION





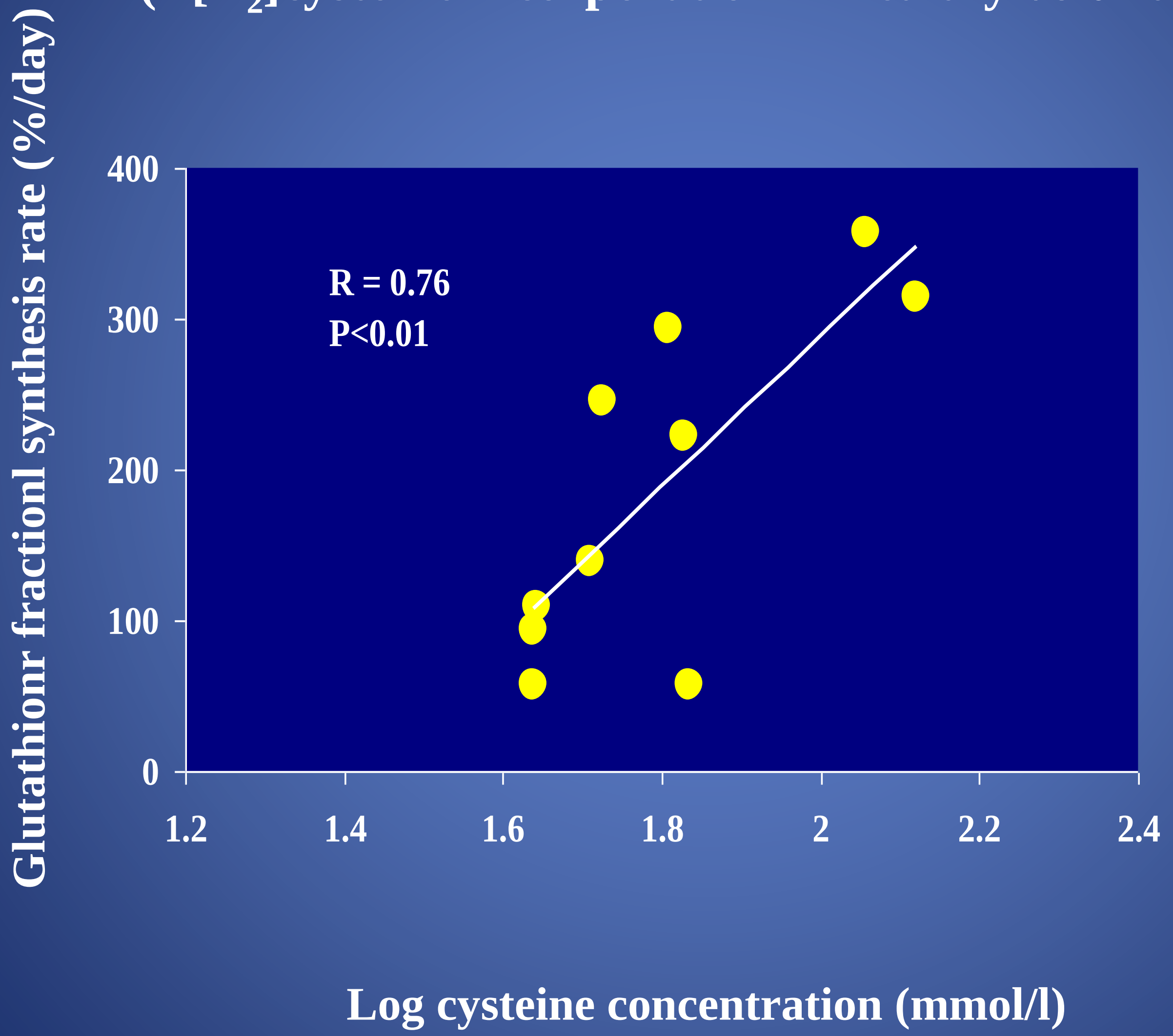
GLUTHATIONE SYNTHESIS RATE

RELATIONSHIPS BETWEEN PATHWAYS OF GLUTATHIONE SYNTHESIS AND DISPOSAL



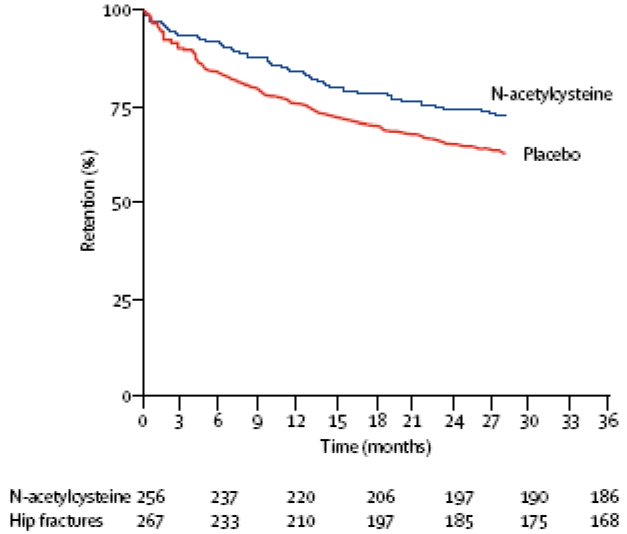
TS, transulfuration; TM, transmethylation; RM, remethylation; GCL, glutamate cysteine ligase; GR, glutathione reductase; GP, glutathione peroxidase; GS, glutathione synthetase; γGTP, γ-glutamyl transpeptidase.

Relationship between cysteine concentration and glutathione synthesis in erythrocytes ($L[D_2]$cysteine incorporation in healthy volunteers)



Effects of N-acetylcysteine on outcomes in chronic obstructive pulmonary disease (Bronchitis Randomized on NAC Cost-Utility Study, BRONCUS): a randomised placebo-controlled trial

Lancet 2005; 365: 1552–60



Effect of carbocisteine on acute exacerbation of chronic obstructive pulmonary disease (PEACE Study): a randomised placebo-controlled study

Lancet 2008; 371: 2013–18

	Risk ratio	95% CI	p
COPD stage			
Stage IV/stage II	1·44	1·07–1·94	0·015
Stage III/stage II	1·24	1·01–1·53	0·037
Treatment			
Carbocisteine/placebo	0·74	0·61–0·89	0·002

Table 2: Risk ratio of exacerbation affected by GOLD-defined COPD severity and treatment with carbocisteine

Clinical Nutrition xxx (2015) 1–6

Contents lists available at ScienceDirect

Clinical Nutrition

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

Original article

Amino acid supplementation in L-dopa treated Parkinson's disease patients

A. Cucca [a], S. Mazzucco [b], A. Bursomanno [c], L. Antonutti [c], F.G. Di Girolamo [b], G. Pizzolato [c], N. Koscica [c], G.L. Gigli [a], M. Catalan [c], G. Biolo [b, *]

[a] *University of Udine, Clinica Neurologica, Department of Experimental and Clinical Medical Sciences, Italy*
[b] *University of Trieste, Clinica Medica, Department of Medical, Surgical and Health Sciences, Italy*
[c] *University of Trieste, Clinica Neurologica, Department of Medical, Surgical and Health Sciences, Italy*

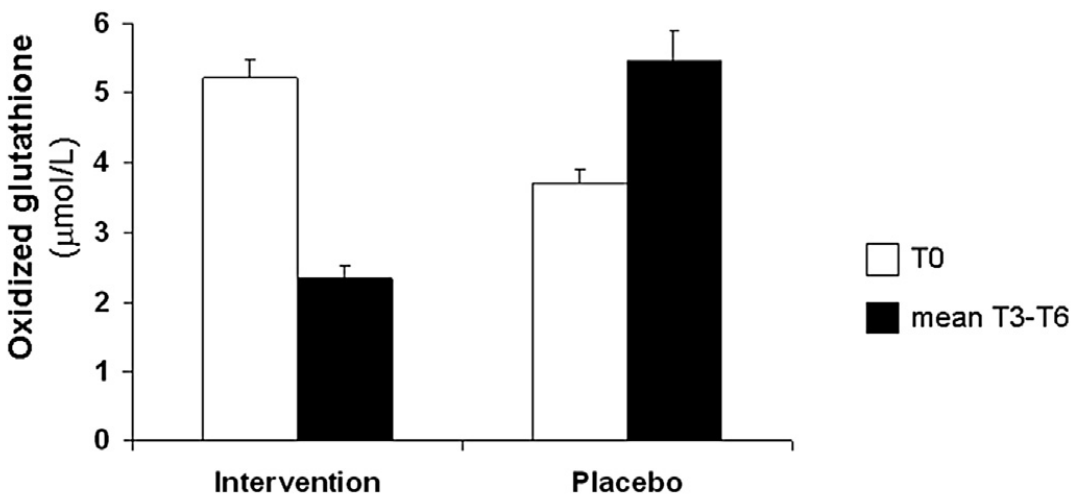


Fig. 2. Erythrocyte oxidized glutathione (GSSG) concentrations was reported at baseline (T0) and as mean of data collected after 3 and 6 months of treatment (mean T6-T3) with daily amino acid (Intervention group) or placebo (Placebo group) supplementation. There was a statistically significant time effect ($p = 0.05$) over the observation period as well as a statistically significant time × treatment interaction ($p = 0.05$), as determining using the repeated measure ANCOVA.

VALUTAZIONI ANTROPOMETRICHE

- **BILANCIA E STADIOMETRO:**
  - ✓ **Peso**
  - ✓ **Altezza**

Indice di massa corporea (IMC) =

(Peso, kg) / (Altezza, m)^2

Per una corretta valutazione si deve considerare anche l'ETÀ!

VALORI DI RIFERIMENTO IMC (popolazione anziana):

- **<21 kg/m^2: rischio malnutrizione**
- **21-23 kg/m^2: accettabile**
- **23-25 kg/m^2: ottimale**
- **25-30 kg/m^2: sovrappeso**

PANGEA
TELESNA AKTIVNOST IN PREHRANA ZA KAKOVOSTNO STARANJE
ATTIVITÀ FISICA E NUTRIZIONE PER UN INVECCHIAMENTO DI QUALITÀ

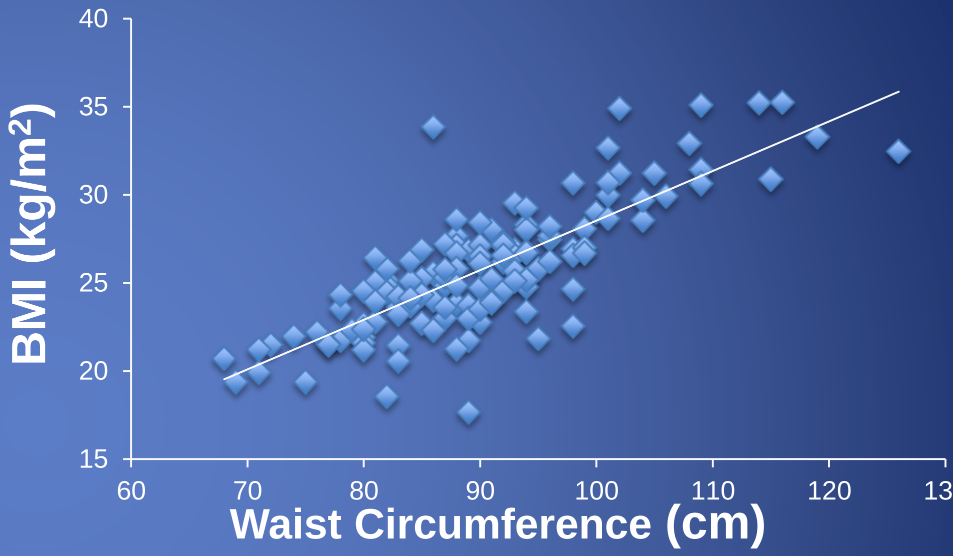
INDICE DI MASSA CORPOREA

Stesso indice di massa corporea ma differente proporzione tra massa muscolare e tessuto adiposo

Measuring Technique for body composition

Body mass index (BMI):

- No distinction between Fat Mass and Fat-Free Mass
- No information about fat distribution
- Not very sensible in elderly subjects



Biolo et al. Clin Nutr 2015

Waist Circumference (WC):

- Highly correlation with BMI

Measuring techniques	Measurements	Comments
Muscle size		
CT Scan	Muscle cross-sectional area	Radiation exposure, expensive
MRI Scan	Muscle cross-sectional area	Expensive, availability of MRI
BIA	Tissue conductivity	? reliability
Muscle circumferences	Mid arm and calf circumference	Measurements effected by subcutaneous fat
DXA scan	Total skeletal muscle mass	Reliable, low radiation exposure

Abbreviations: CT, computed tomography; MRI, magnetic resonance imaging; BIA, bioelectric impedence analysis; DXA, dual energy X-ray absorptiometry; SPPB, Short Physical Performance Battery.

ROLE OF TARGETED INTERVENTIONS TO MAINTAIN OR ENHANCE MUSCLE MASS

- **Exercise training**
  - n-3 FATTY ACIDS
- **High-quality protein intake**
- **Specific Amino Acids**
  - BCAA
  - LEUCINE
  - HMB
  - CYSTEINE
- **Energy balance**

COMPONENTI DEL FABBISOGNO PROTEICIO

- Quota minima di fabbisogno pari alle perdite obbligate 24,4 g/giorno (risultati studi su fabbisogno proteico minimo bilancio d'azoto)

- \+ quota del 30% che tiene conto dell'inefficacia di digestione e assorbimento (x 1,3)
- \+ quota del 30% che tiene conto della variabilità individuale presente nella popolazione nel fabbisogno (x 1.3)
- diversa efficienza di utilizzazione delle proteine presenti in diete con proteine di tipo misto (vegetali e animali) : 0,75

= 55 G DI PROTEINE TOTALI, 55:70 kg di peso = 0,78 g

0,8 g-0,9 /kg di peso ideale

INTROITO PROTEICO RACCOMANDATO PROTEINE (g/kg peso ideale)

EFSA 0.83 g/kg per adulti senza distinzione sesso ed età

LARN 0.9 g/kg, dai 18 fino ai 65 anni di età
1-1,2 g/kg oltre 65 anni di età

PROT-AGE 1-1,2 g/kg per soggetti anziani

Anziani attivi: 1,2 g /kg minimo