

Protein in Critically ill: Maintenance of Muscle Mass and Performance

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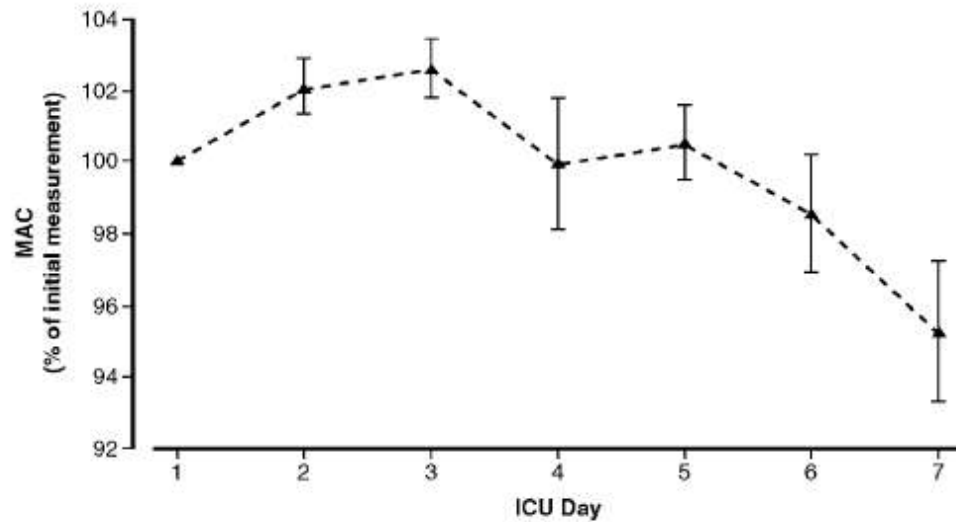
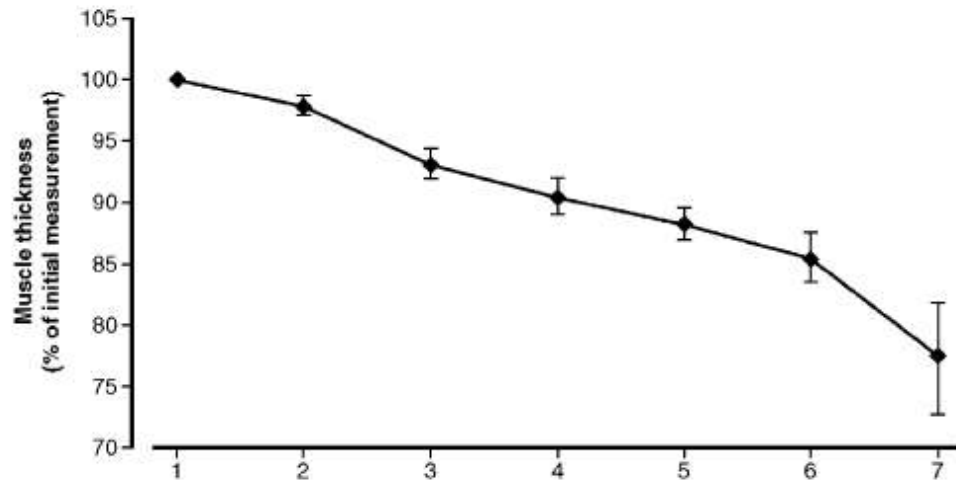
Disclosure of potential conflicts of interest during the last 2 years:

Member of the Medical Advisory Boards and also invited speaker for Baxter, Danone, Fresenius-Kabi, GE Health Care, Grifols, and Nestlé

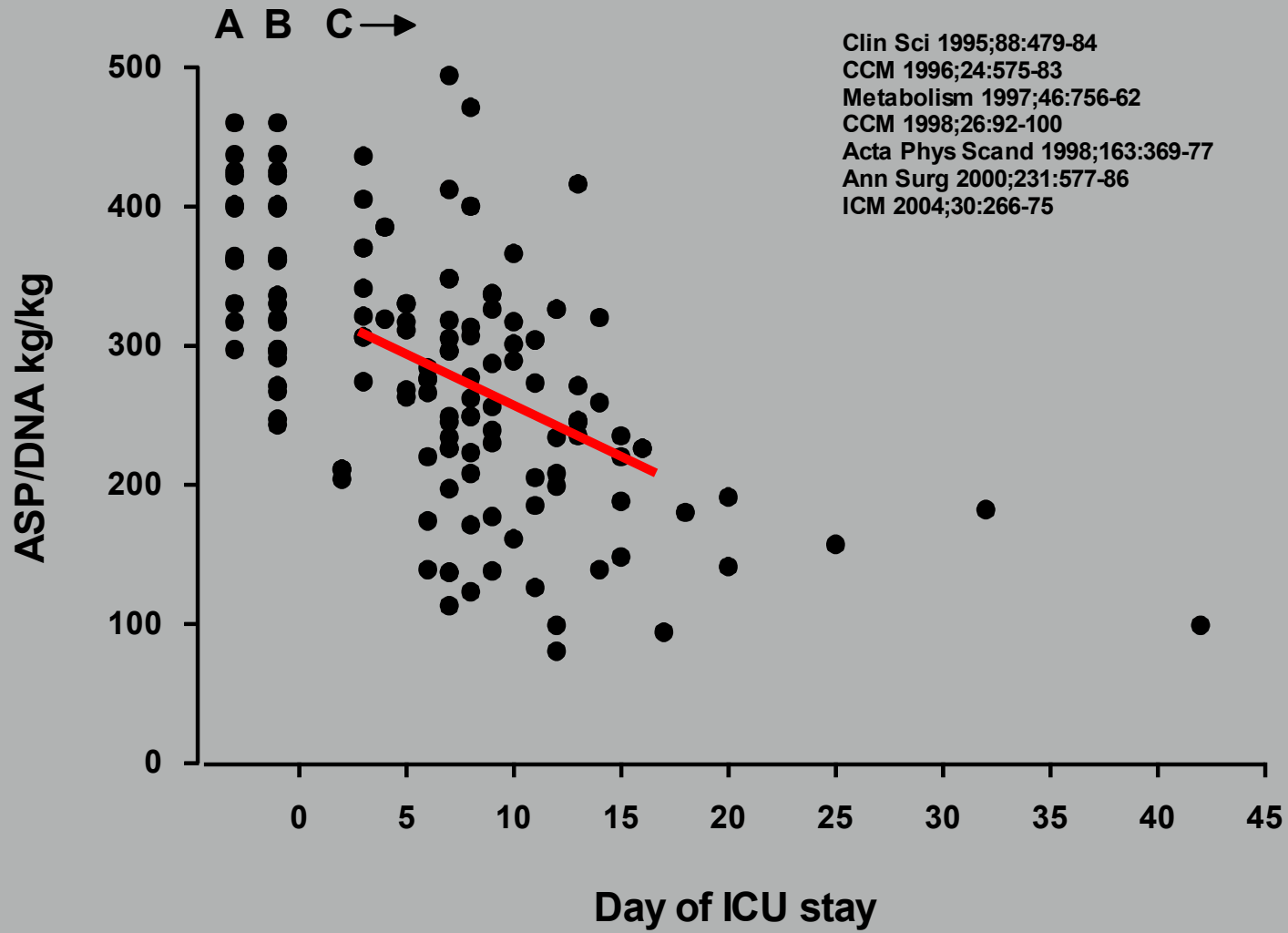
Protein in Critical Illness: Muscle mass and performance

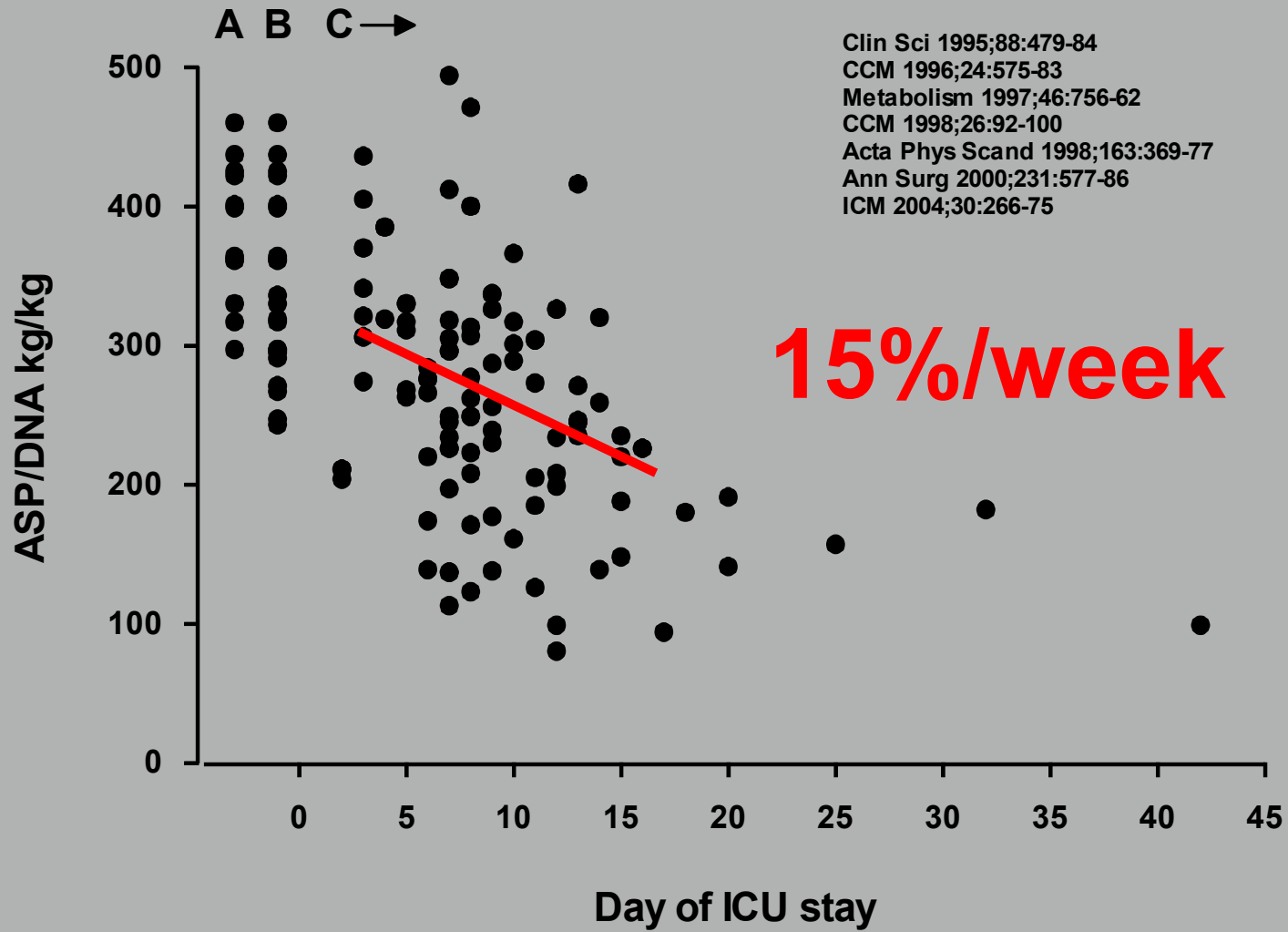
1. Muscle mass
2. Nitrogen balance
3. Observational studies
4. Randomized studies
5. Protein turnover





Reid et al, Clin Nutr 2004;23:273-80





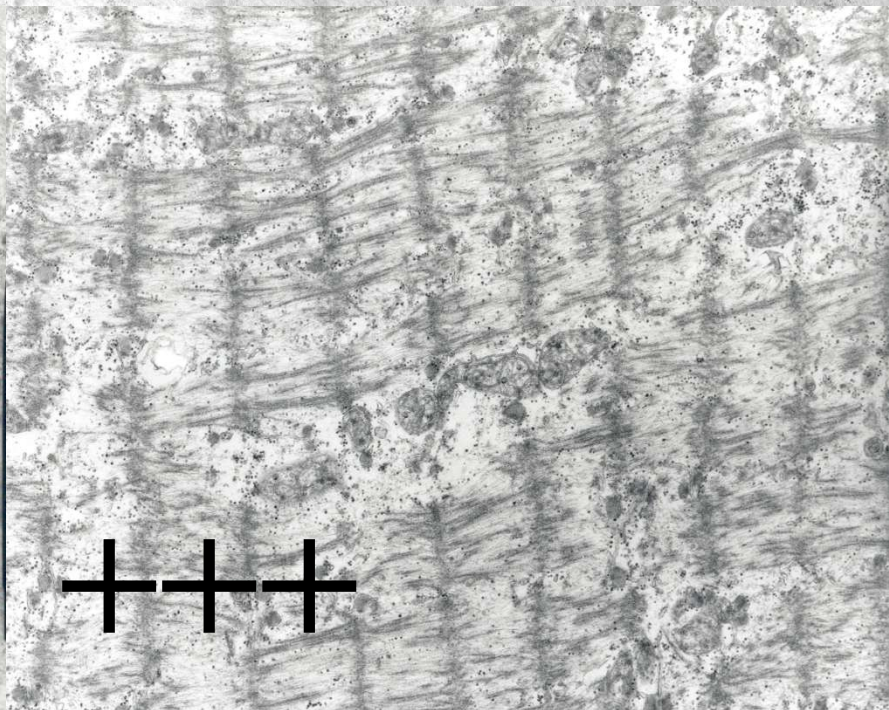
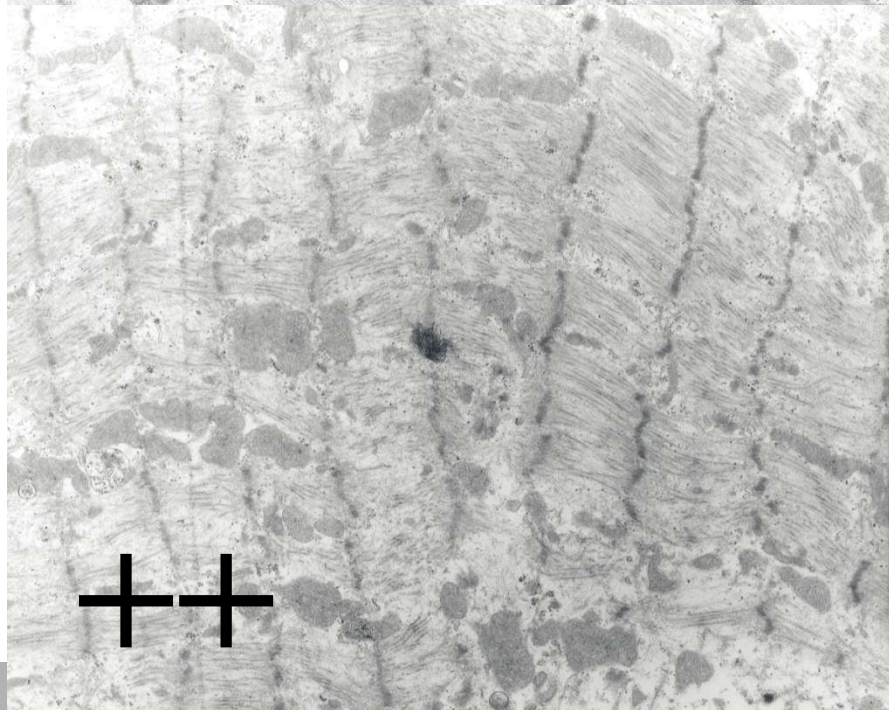
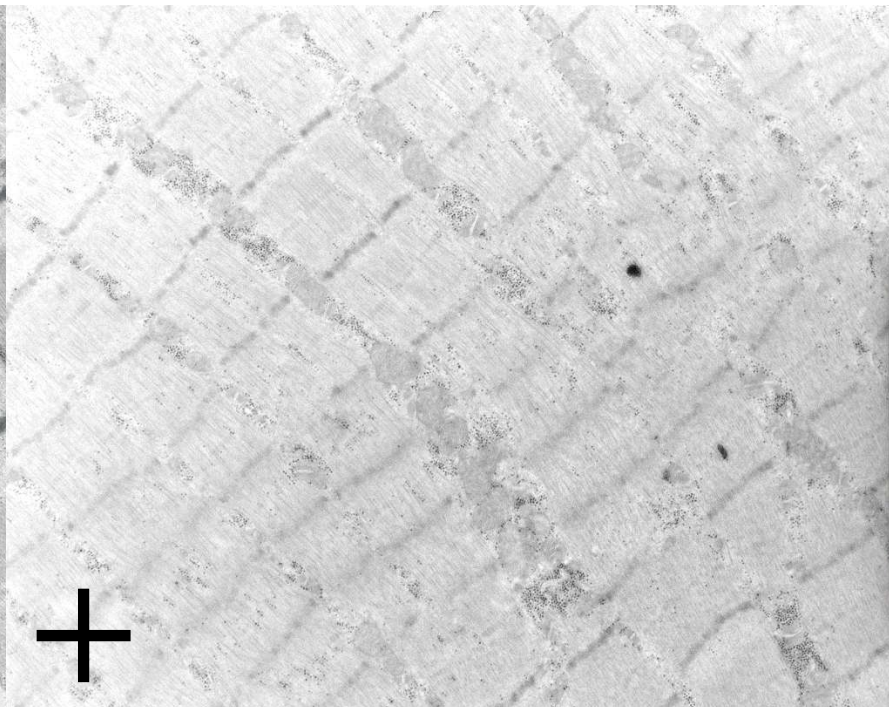
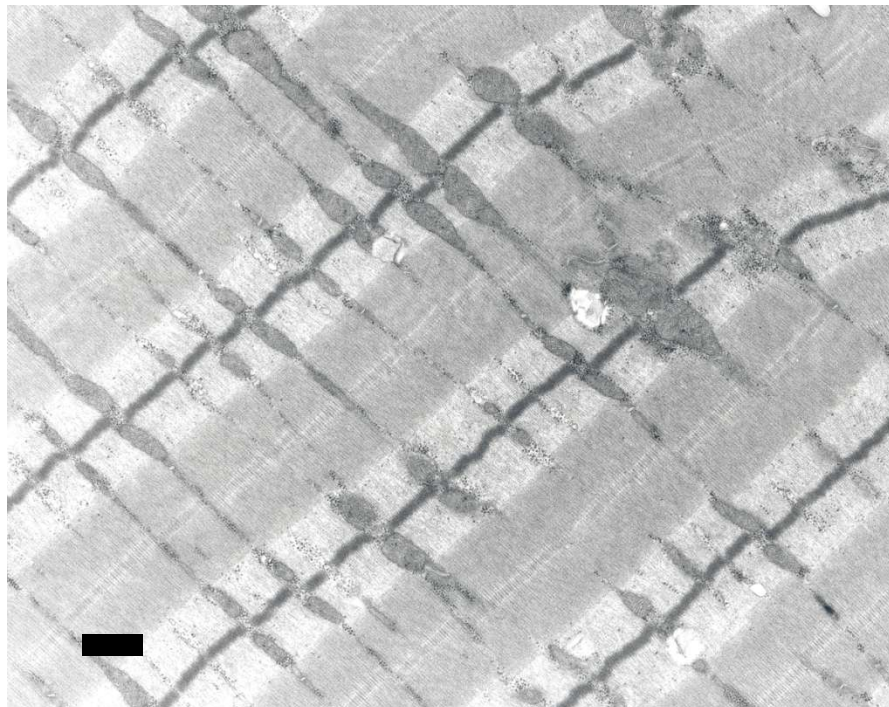
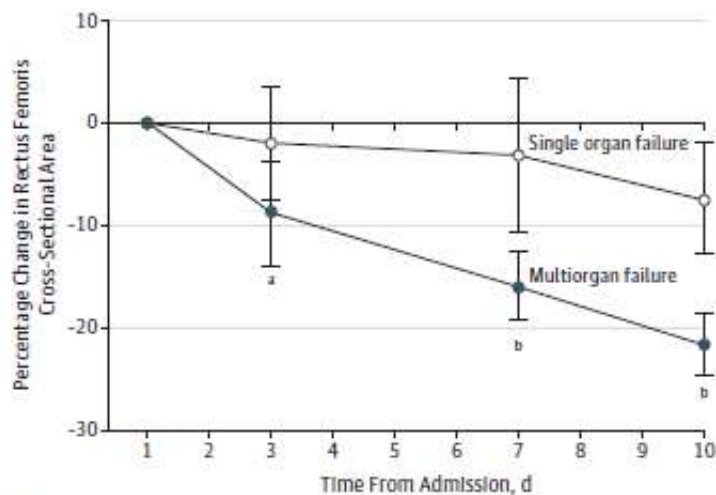


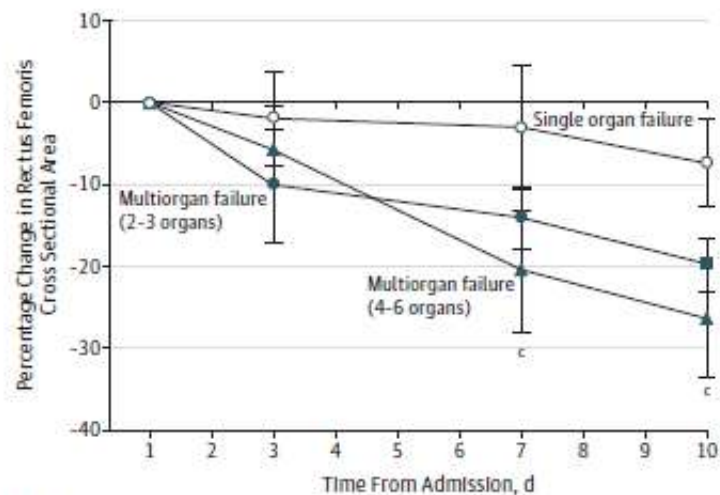
Figure 5. Measurements of Muscle Wasting During Critical Illness by Organ Failure

A Single vs multiorgan failure



No. of patients	1	3	7	10
Single organ failure	15	14	15	15
Multiorgan failure	47	43	45	47

B Single vs multiorgan failure



No. of patients	1	3	7	10
Single organ failure	15	14	15	15
Multiorgan failure				
2-3 Organs	33	31	32	33
4-6 Organs	14	12	13	14

Data are expressed as medians and 95% confidence intervals.

^a $P = .03$ for change from day 1 to day 3 in multiorgan failure vs single organ failure.

^b $P < .001$ for change from day 1 to day 7 and day 1 to day 10 in multiorgan failure vs single organ failure.

^c $P < .001$ for difference between failure of 2-3 organs and 4-6 organs from day 1 to day 7 and day 10.

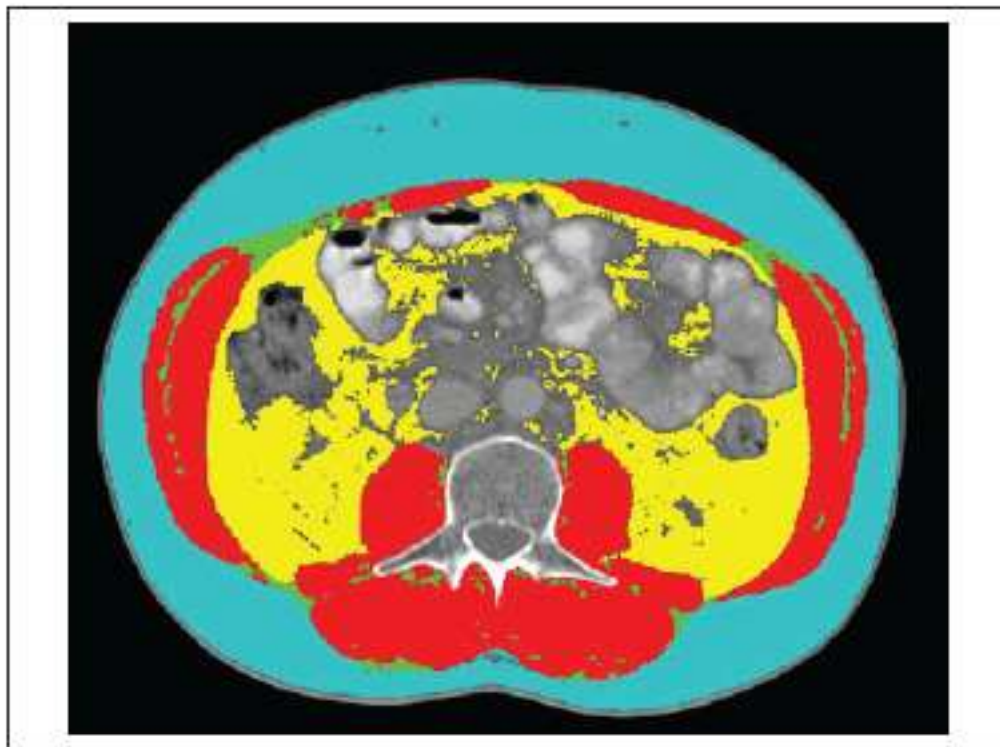
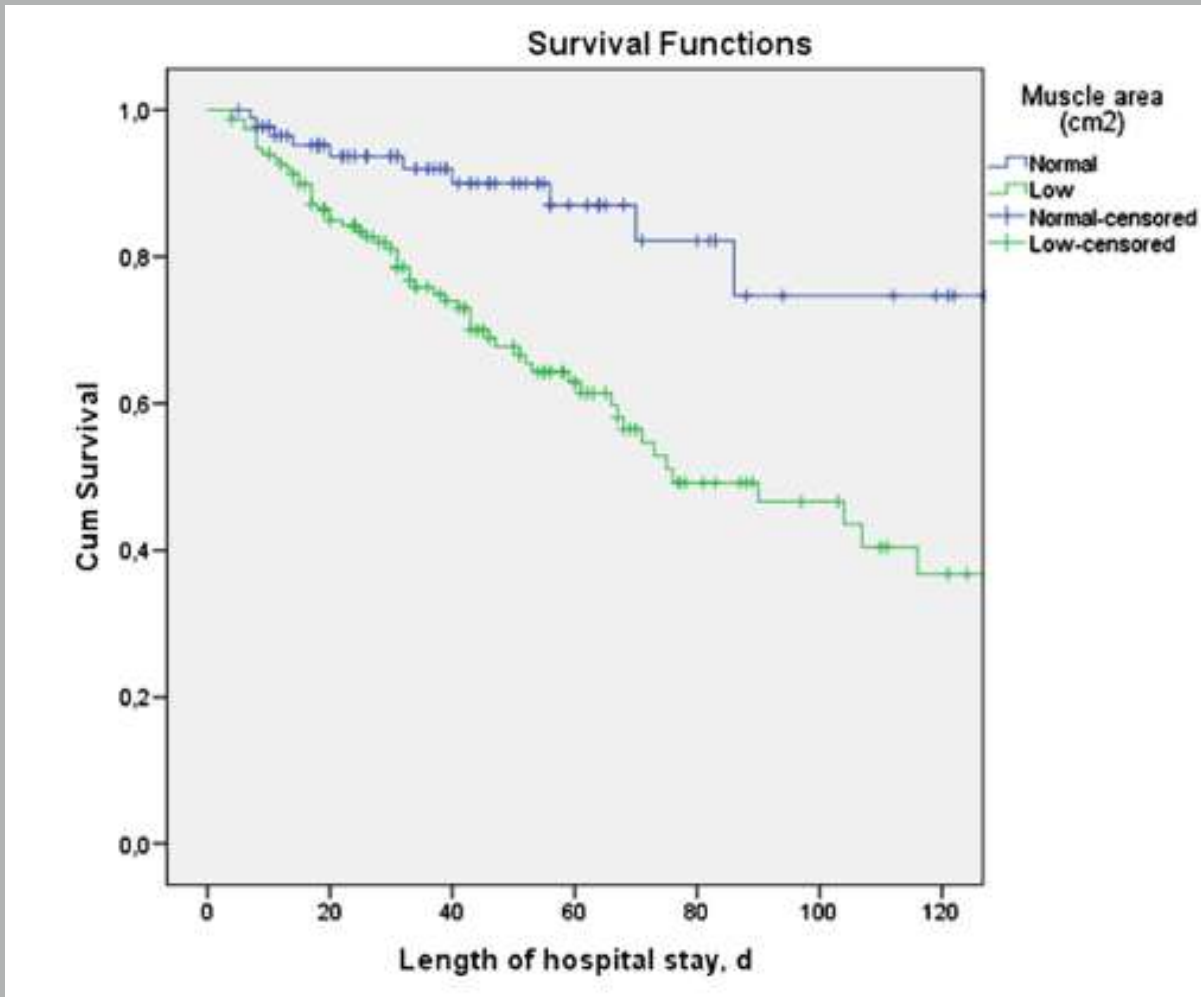


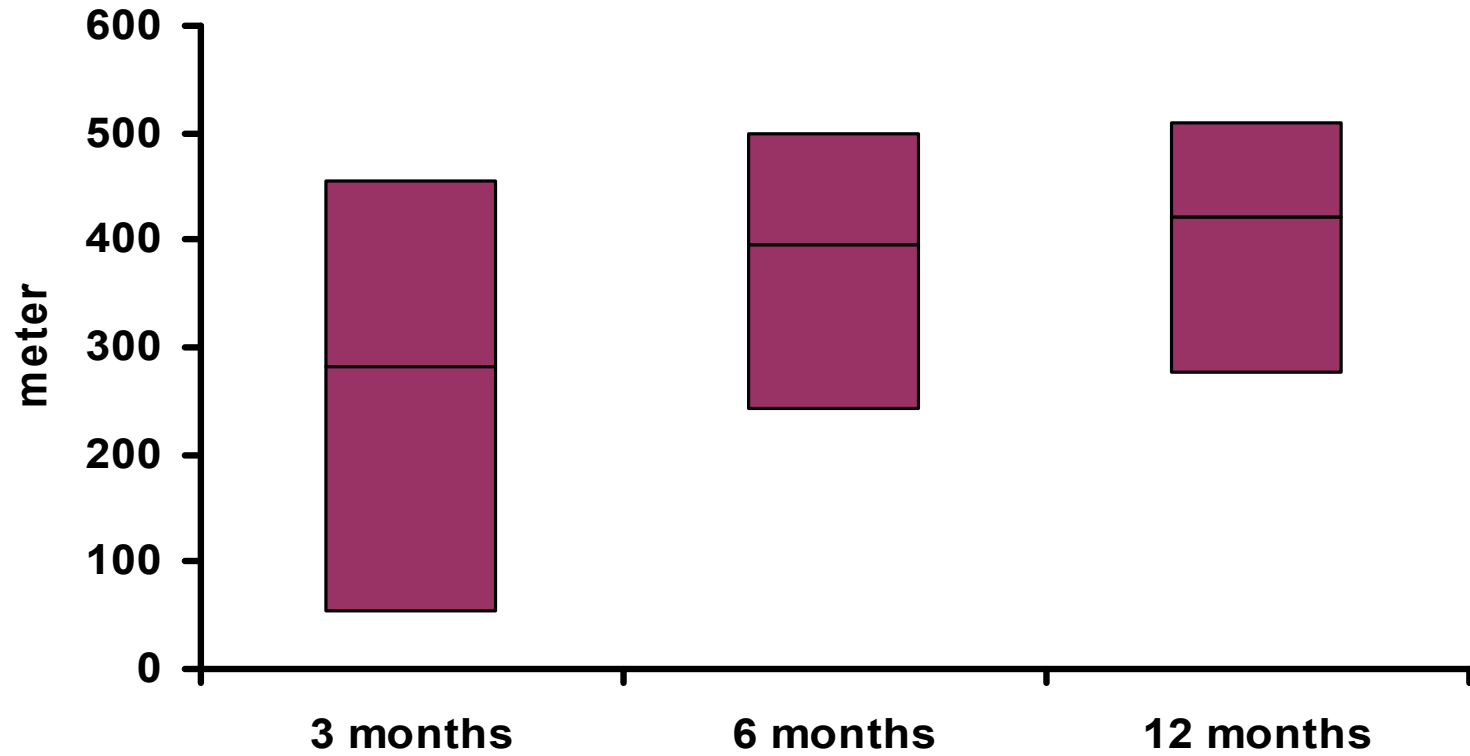
Figure 1. Representative patient showing transverse computed tomography image at the 3rd lumbar vertebrae demonstrating subcutaneous adipose tissue (light blue), abdominal skeletal muscle (red), intermuscular fat (green) and visceral fat (yellow).

Braunschweig et al. AJCN 2013;20:1-6



Weijs et al. Crit Care 2014;18:R12

Distance walked in 6 minutes



Herridge et al. NEJM 2003

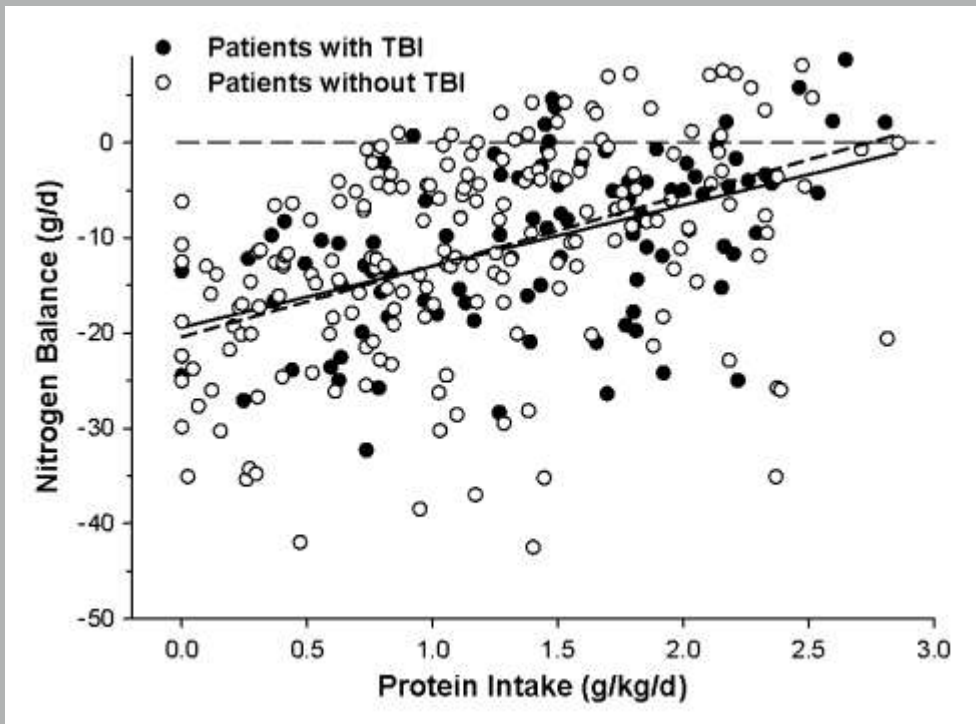
Protein in Critical Illness

Muscle Mass

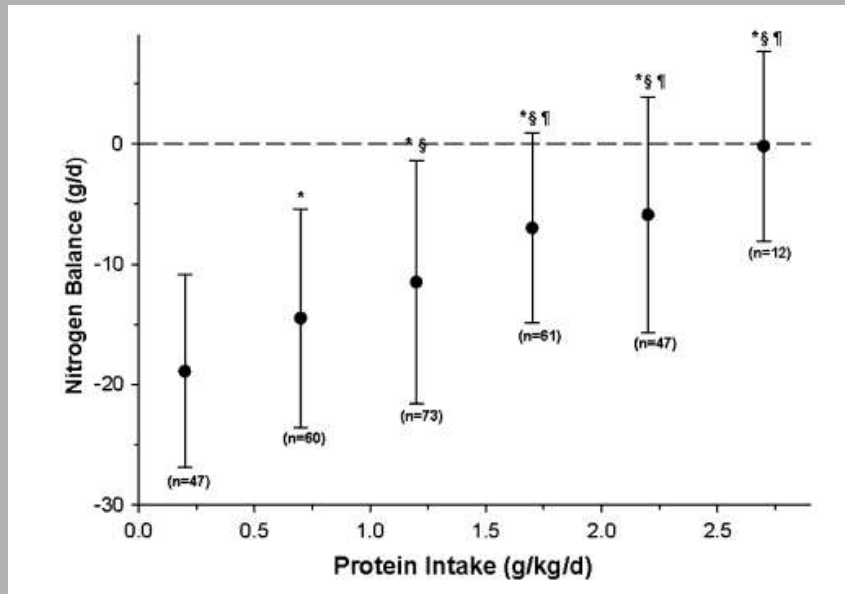
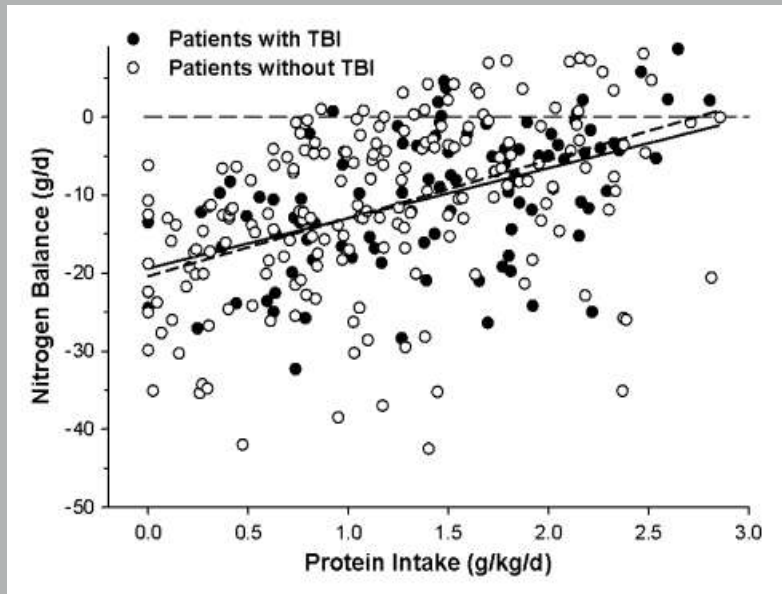
There is a muscle protein depletion of 10% per week initially in critical illness.

Muscle mass is a predictor for ICU survival.

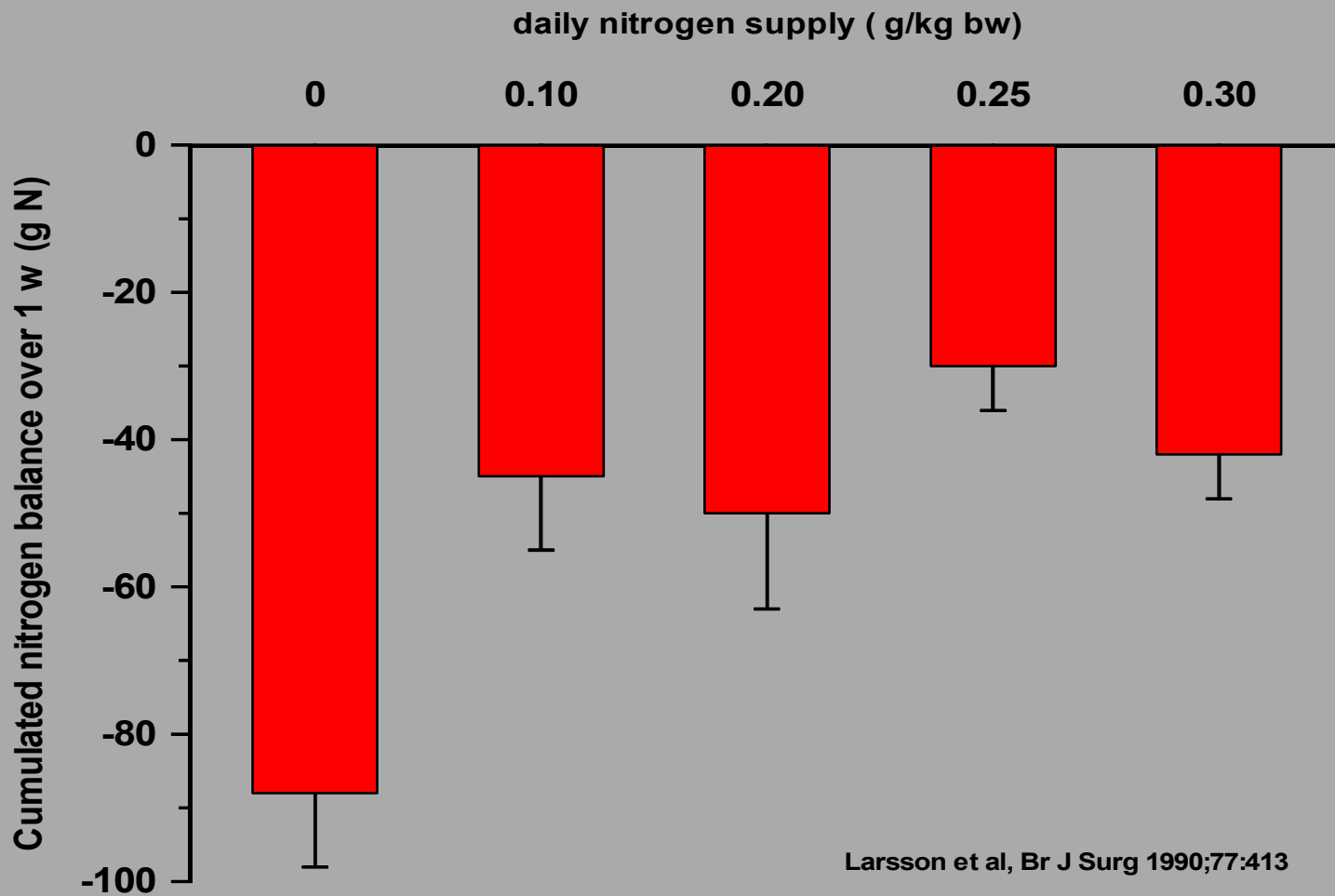
Regain of muscle mass and function is slow.

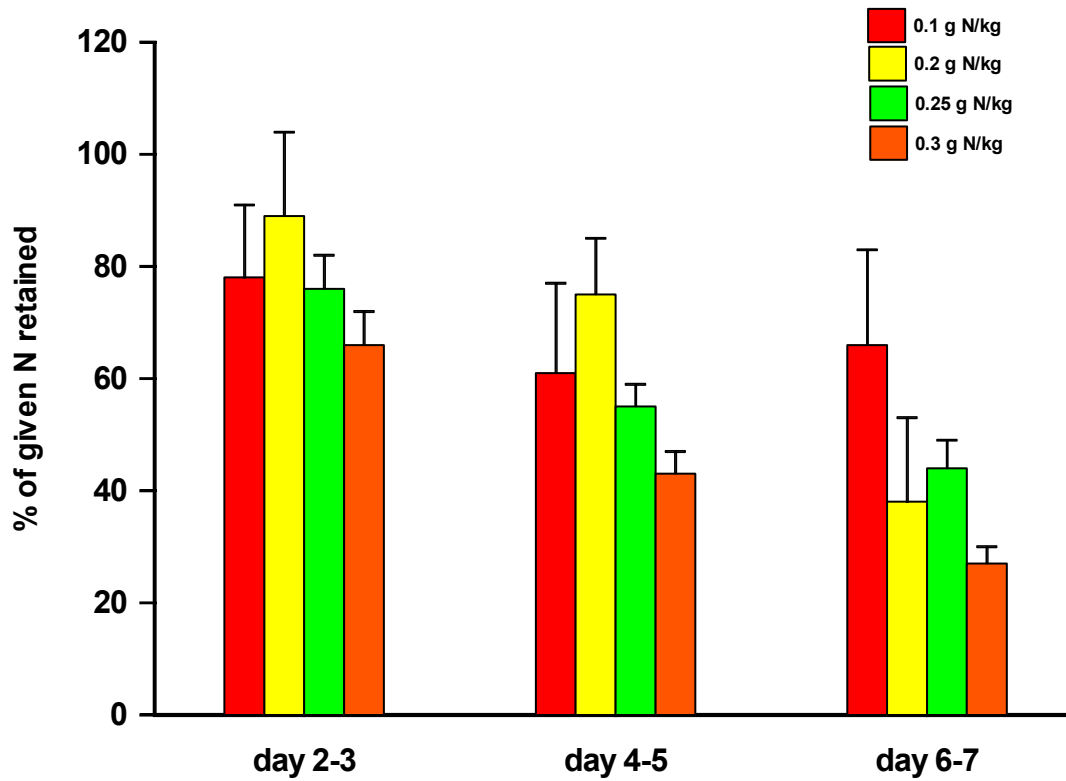


Dickerson et al, J Trauma Acute Care Surg 2012;73:549-557



Dickerson et al, J Trauma Acute Care Surg 2012;73:549-557





Larsson et al, Br J Surg, 1990;77:413-6

Protein in Critical Illness

Nitrogen balance

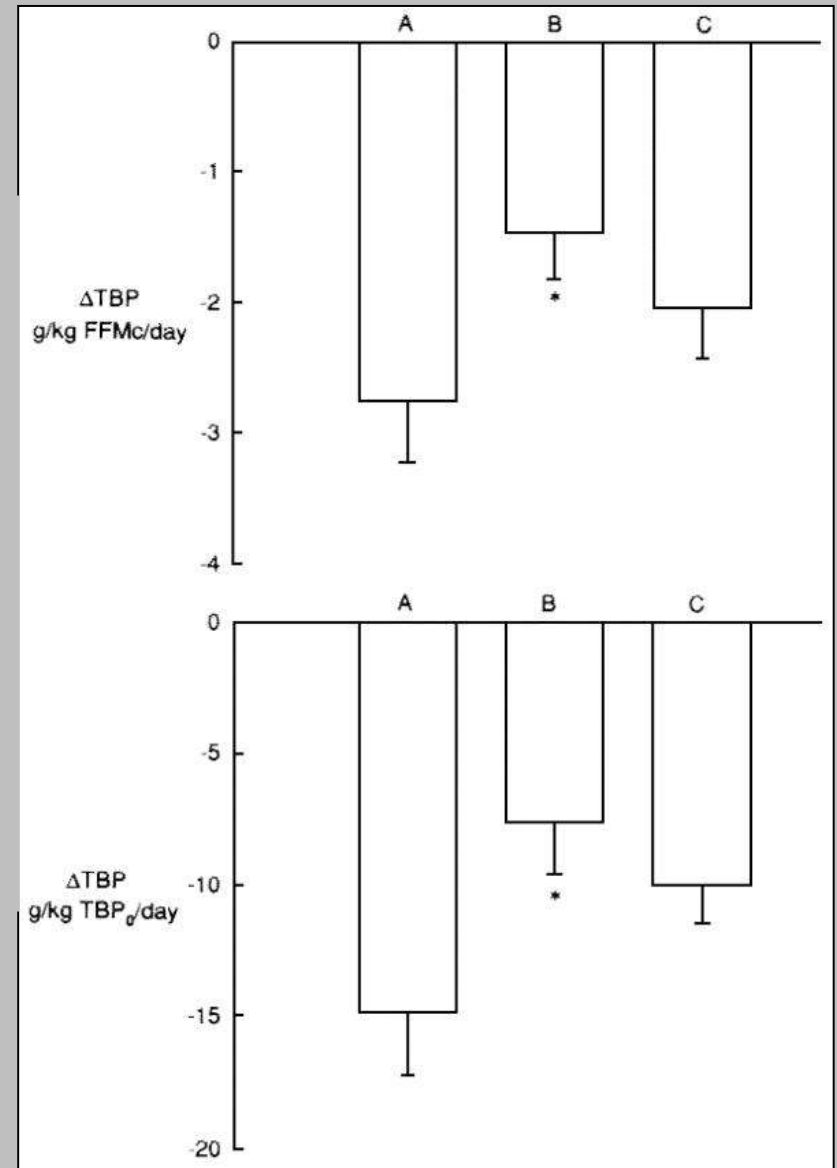
For reliable results there must be an adapted steady state in both caloric and protein intake.

Furthermore the study subjects must be in a steady state during that adaptive period.

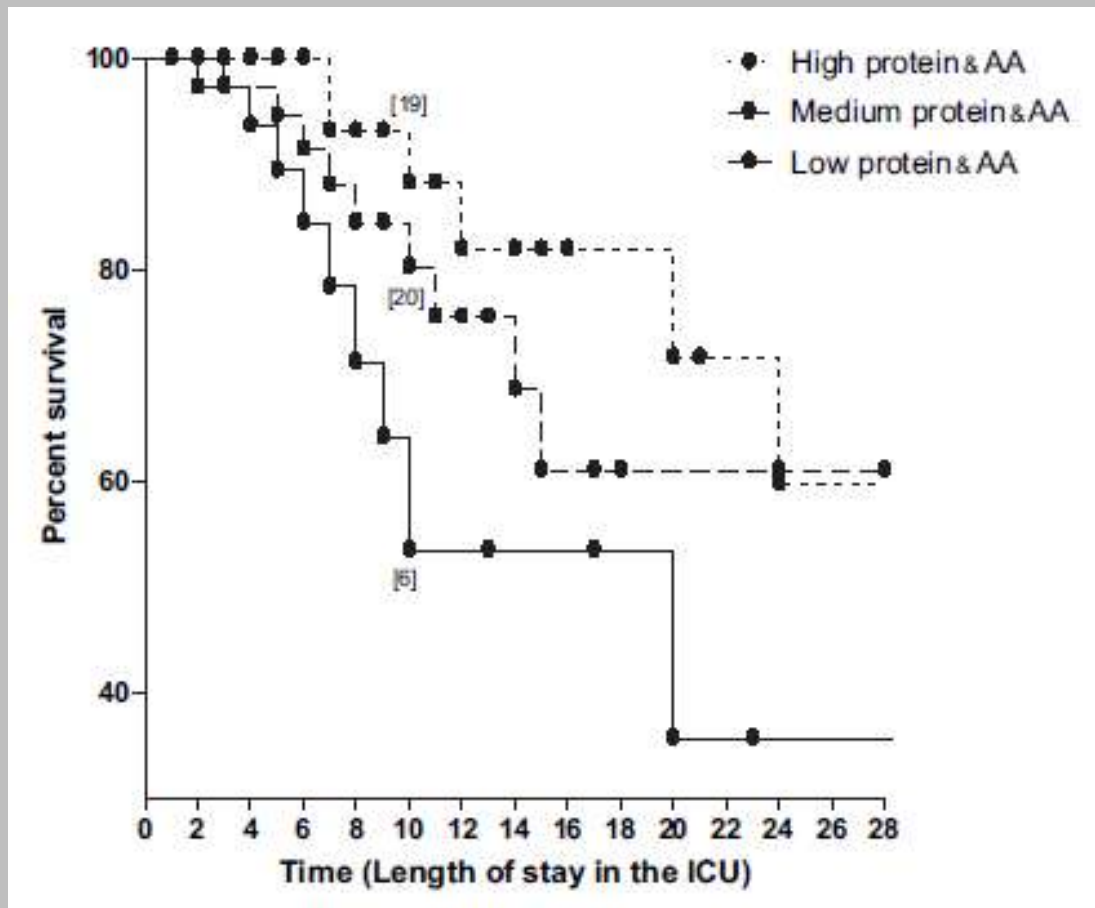
Ergo. Nitrogen balance has considerable limitations in critical illness

Change in Total Body Protein

Patient Group	Protein (g/kg/day)
A (n = 7)	1.14 ± 0.13 ^{a,b}
B (n = 8)	1.47 ± 0.11 ^b
C (n = 8)	1.86 ± 0.14 ^b
	<i>p</i> ^d <.001



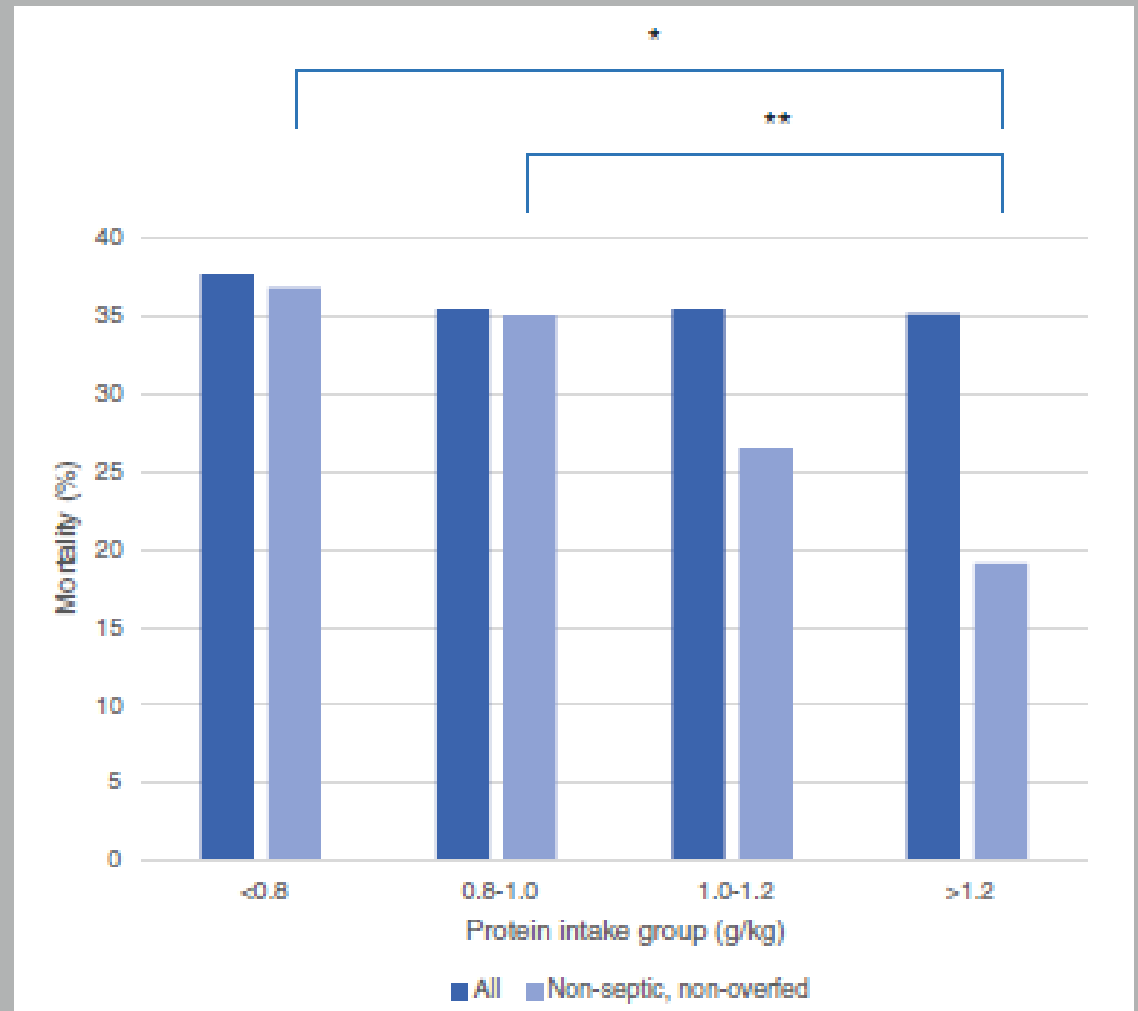
Ishibashi et al, CCM 1998;26:1529-35



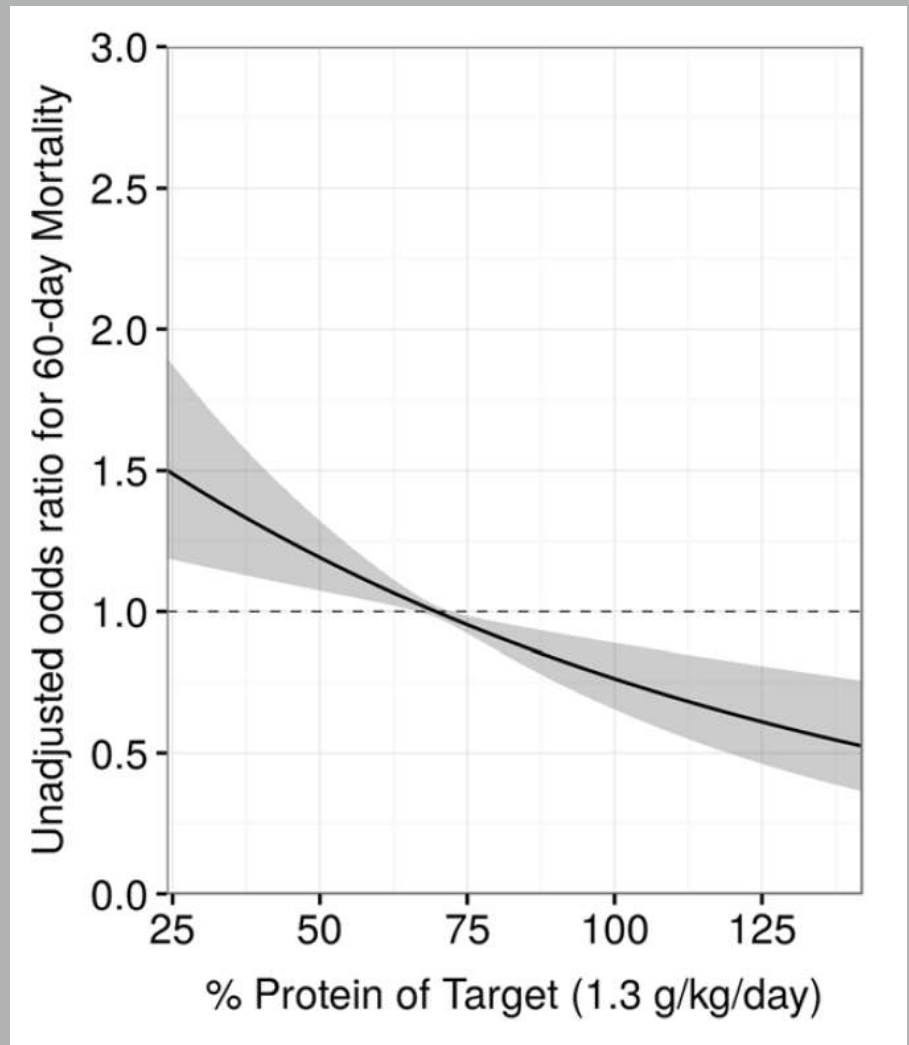
Allingstrup et al,
 Clin Nutr 2012;31:462-8

0.79 ± 0.29 1.06 ± 0.23 1.46 ± 0.29

**Weijs et al,
Crit Care 2014;18:701**



Zusman et al, Crit Care
2016;20:367

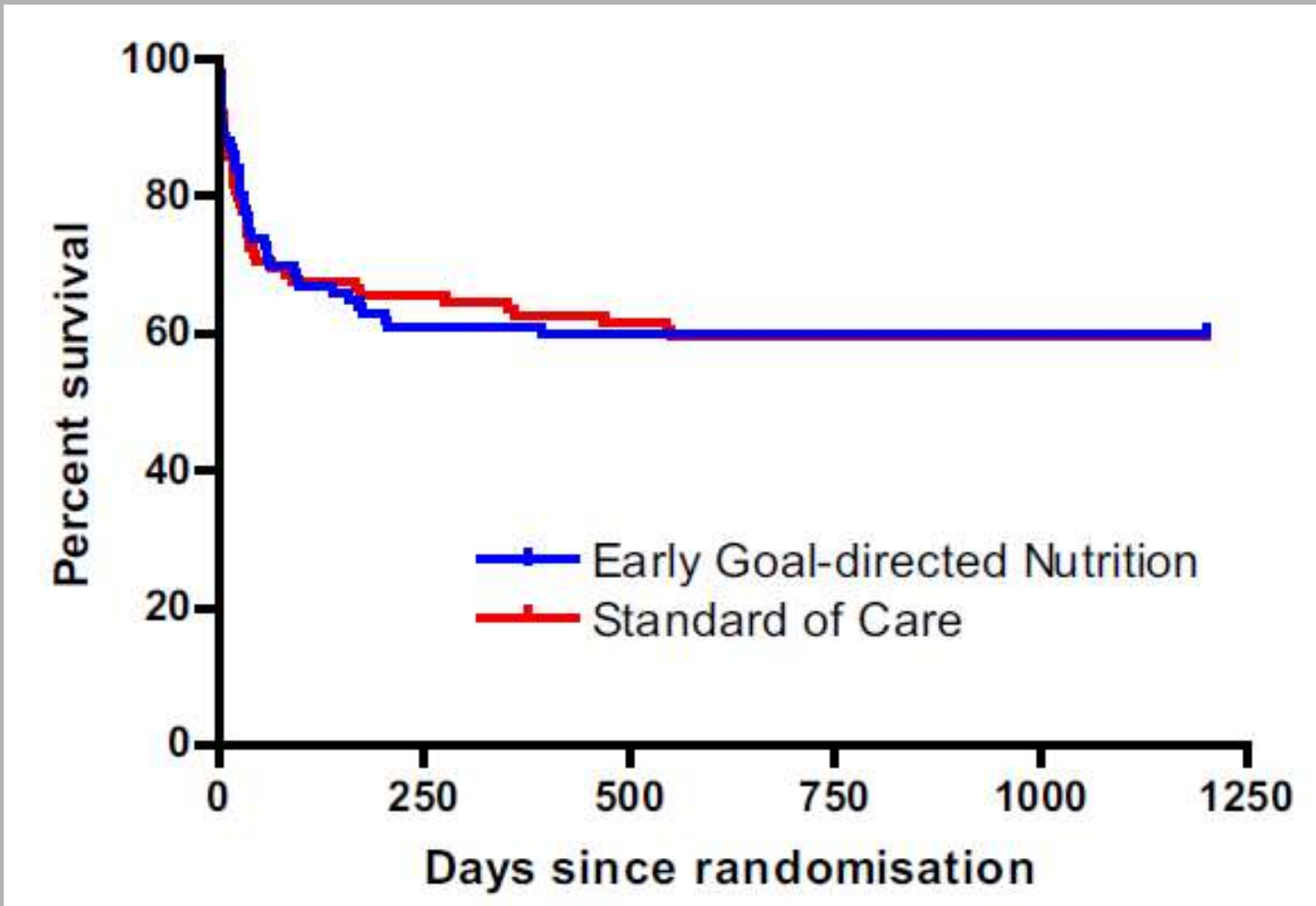


Protein in Critical illness

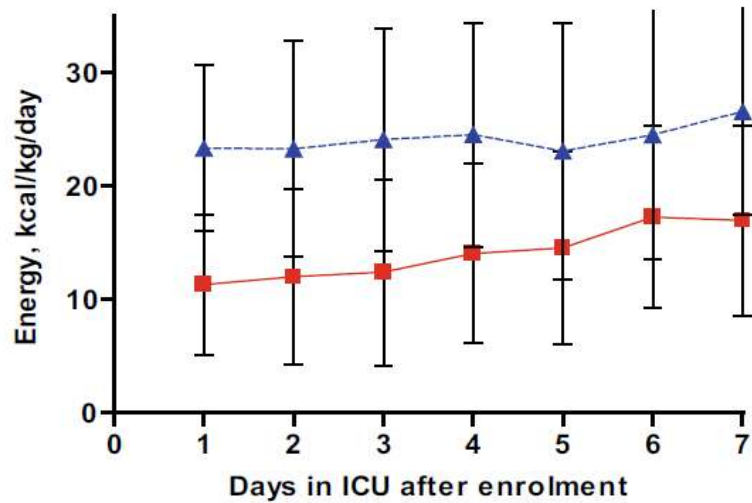
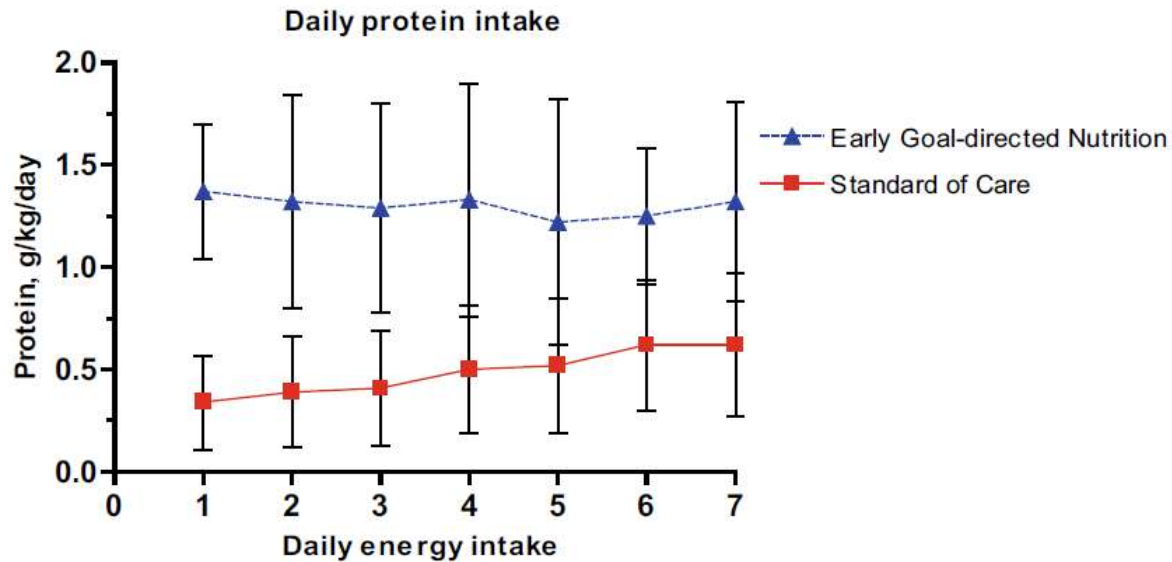
Observational studies

Even when prospective in character, observational studies are case series where the variation in protein intake usually relates to the fixed proportions between calories protein in commercial products and the success in the feeding protocol.

Ergo. Hypothesis generating and possibly good for safety evaluation, but do not allow for conclusions of treatment.

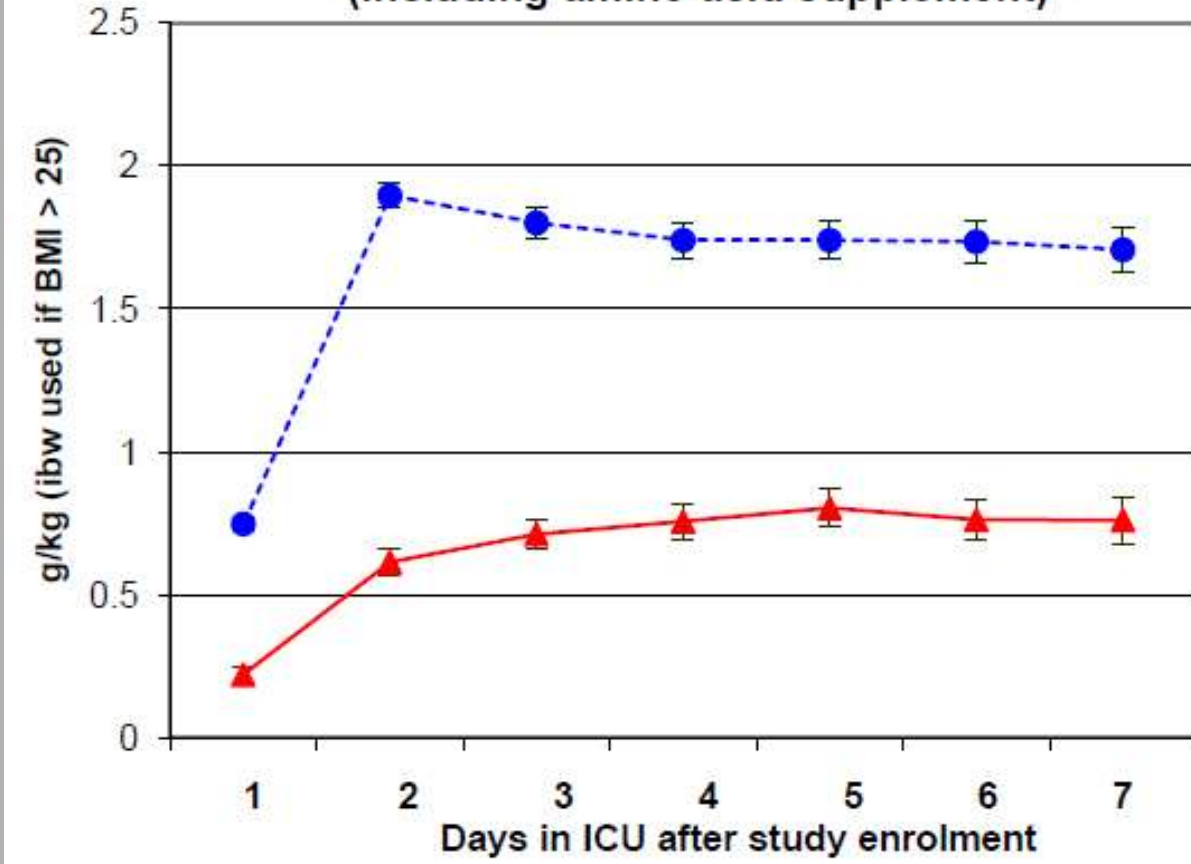


Allingstrup et al, ICM 2017;43:1637-47

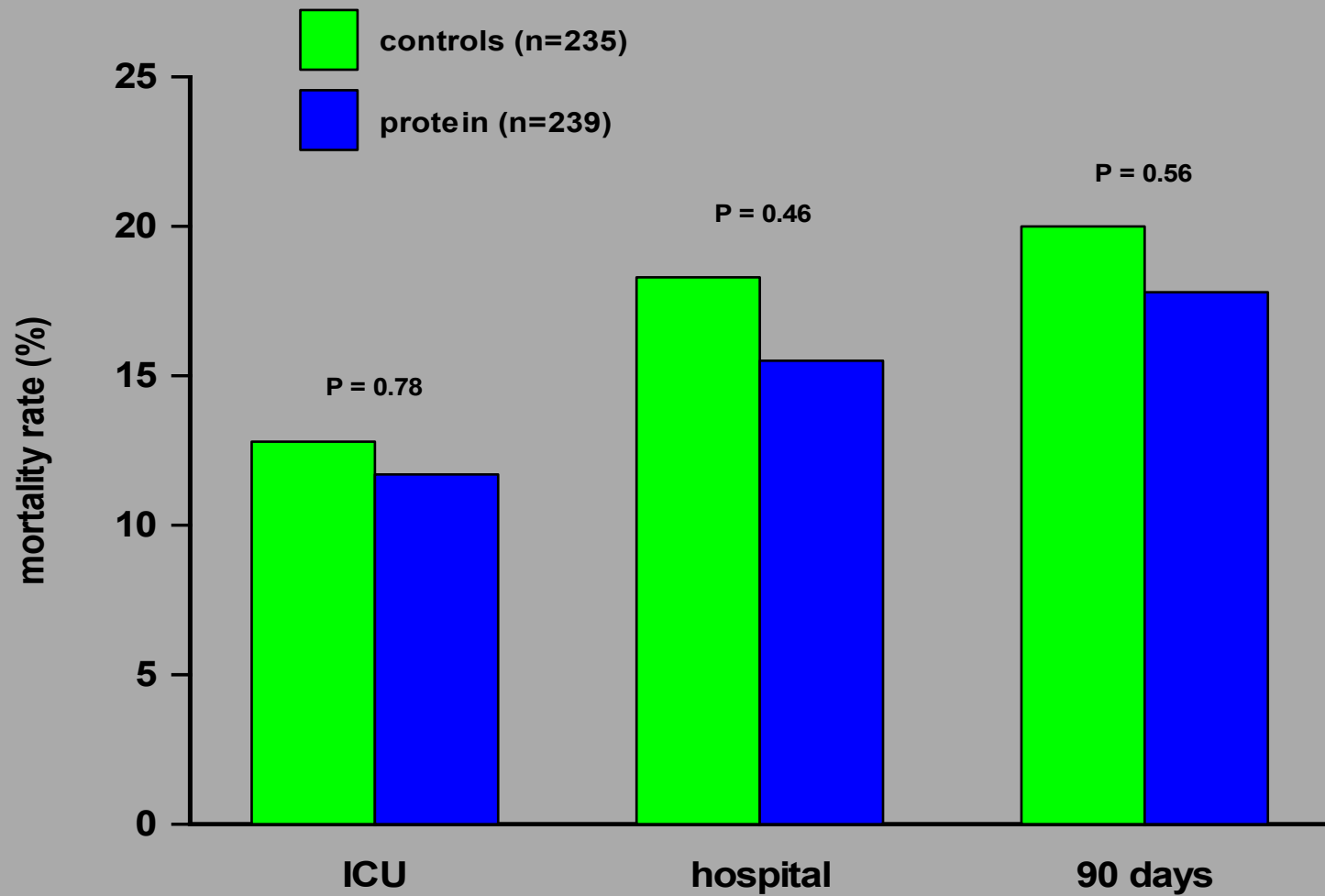


Allingstrup et al,
 ICM 2017;43:1637-47

Protein delivered per patient (including amino acid supplement)



Doig et al, ICM 2015;41:1197-1208



Doig et al, ICM 2015;41:1197-1208

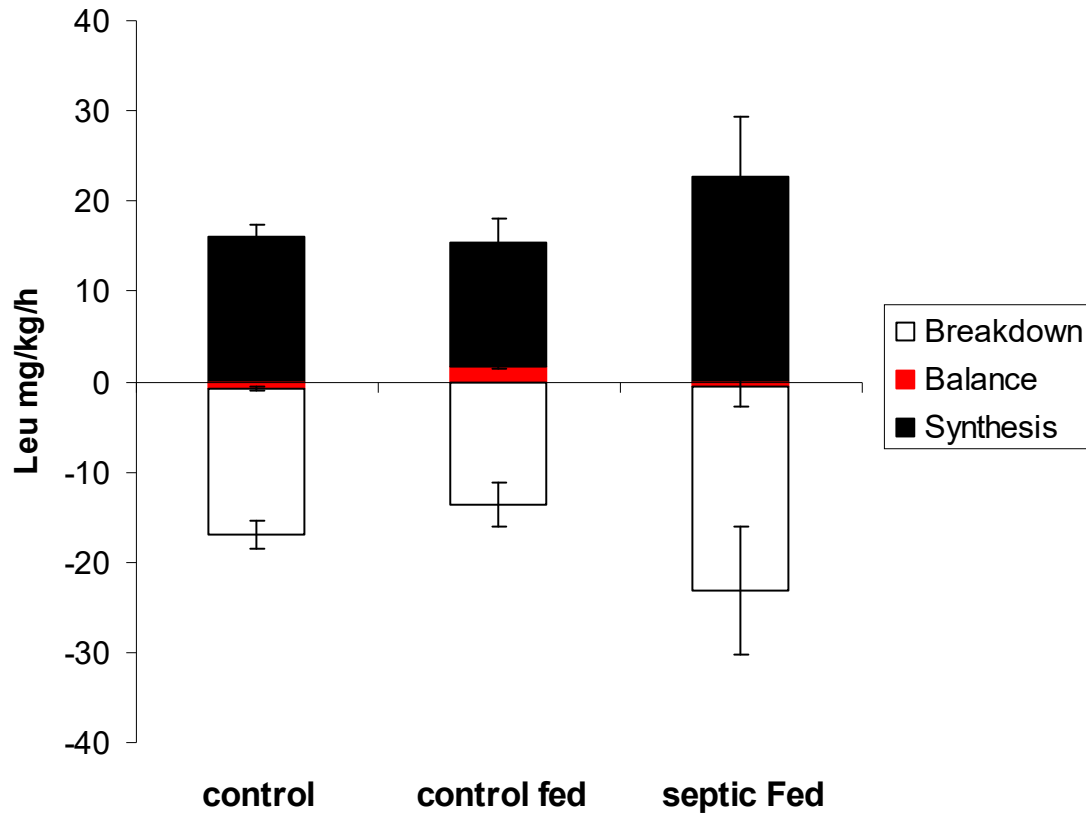
Protein in Critical illness

Prospective studies

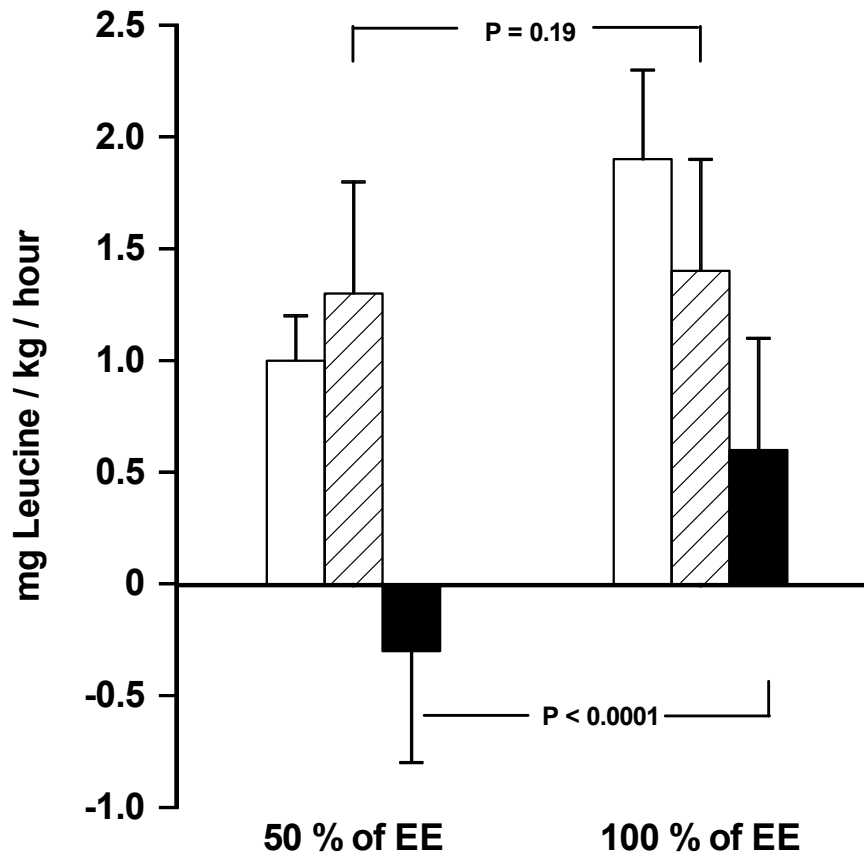
Existing prospective randomized studies are few and have limitations in design.

Nevertheless there is no evidence so far to support the hypothesis of beneficial effects with a higher protein intake.

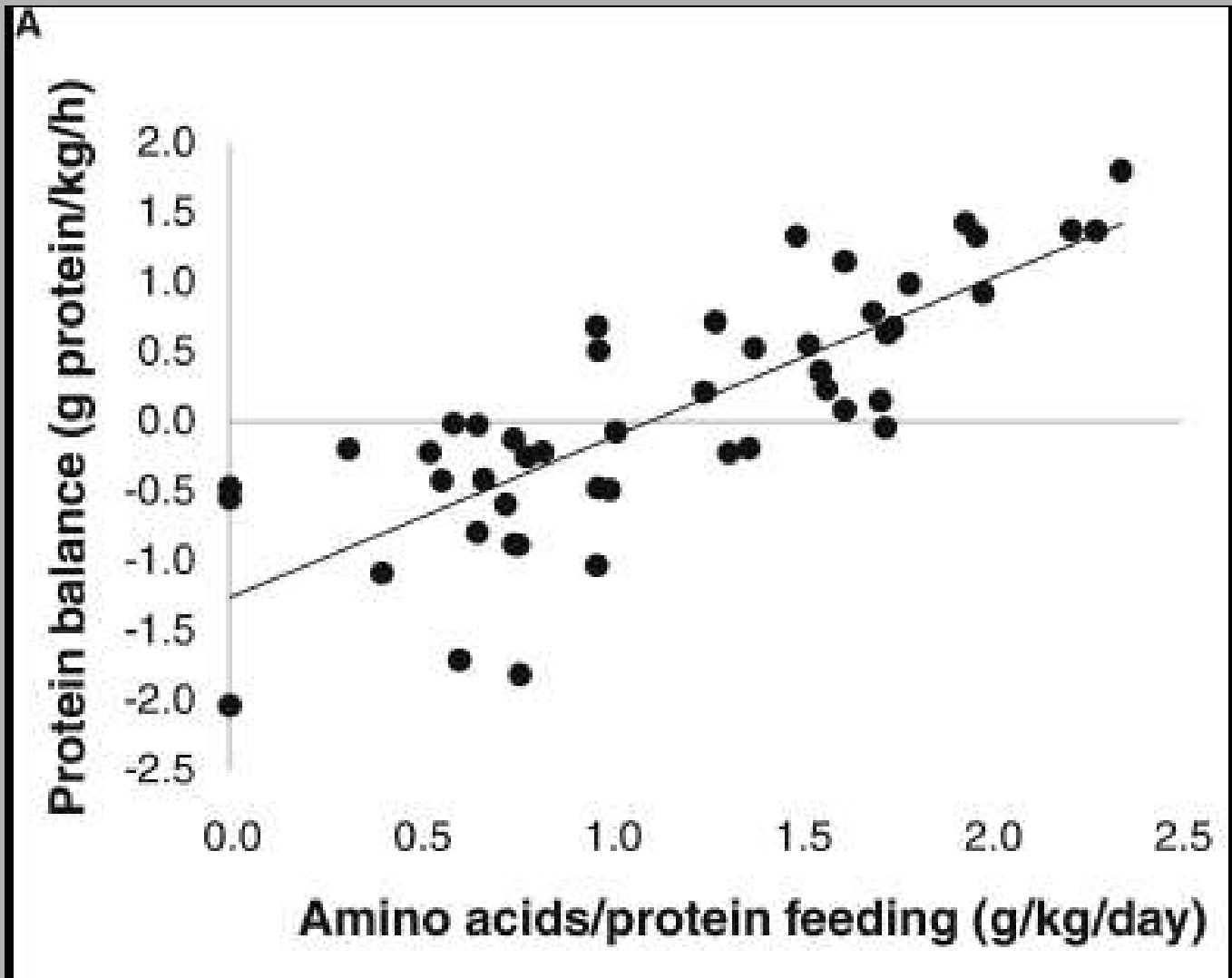
Whole body protein turnover



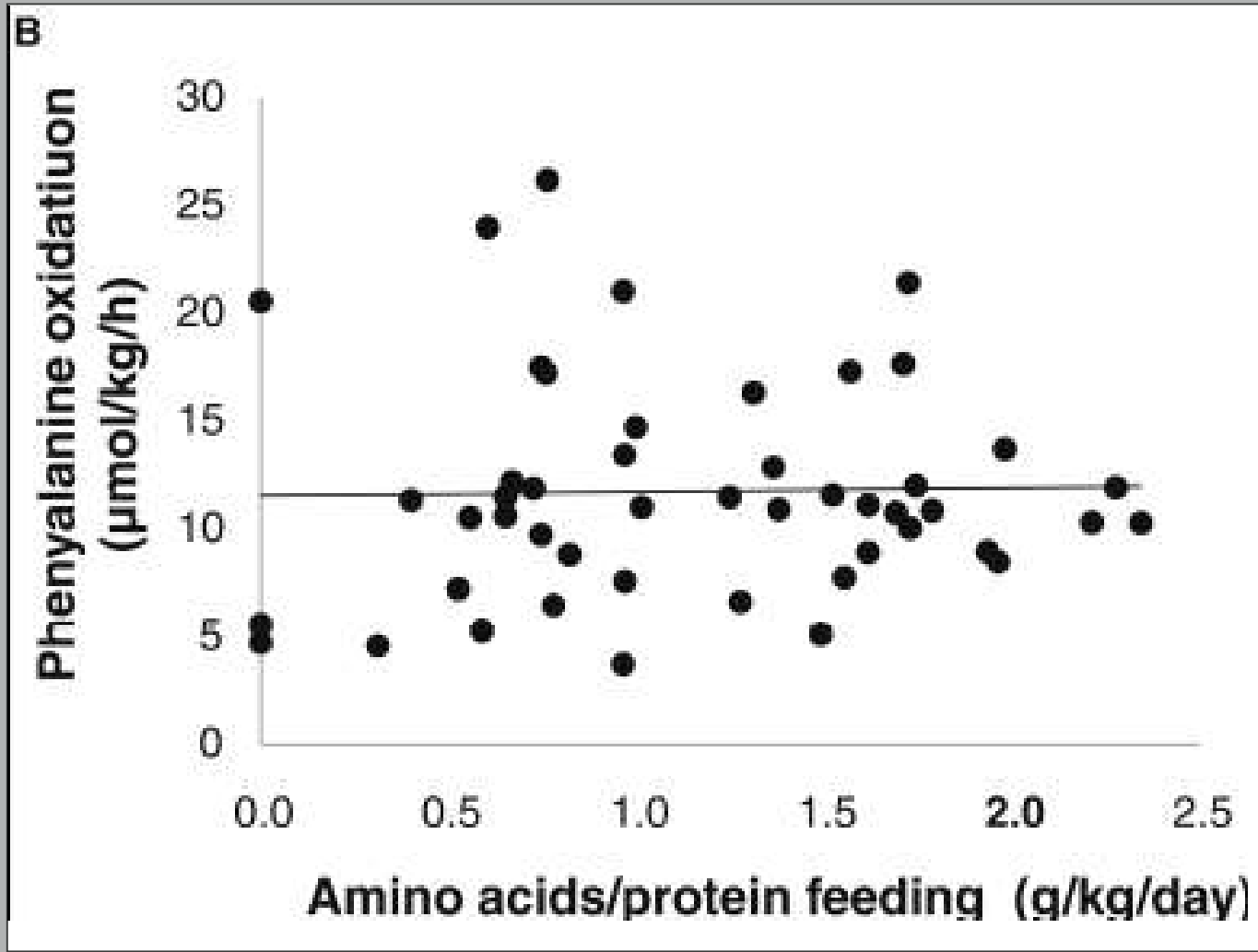
Rooyackers et al. Clin Nutr 2015;34:95-100



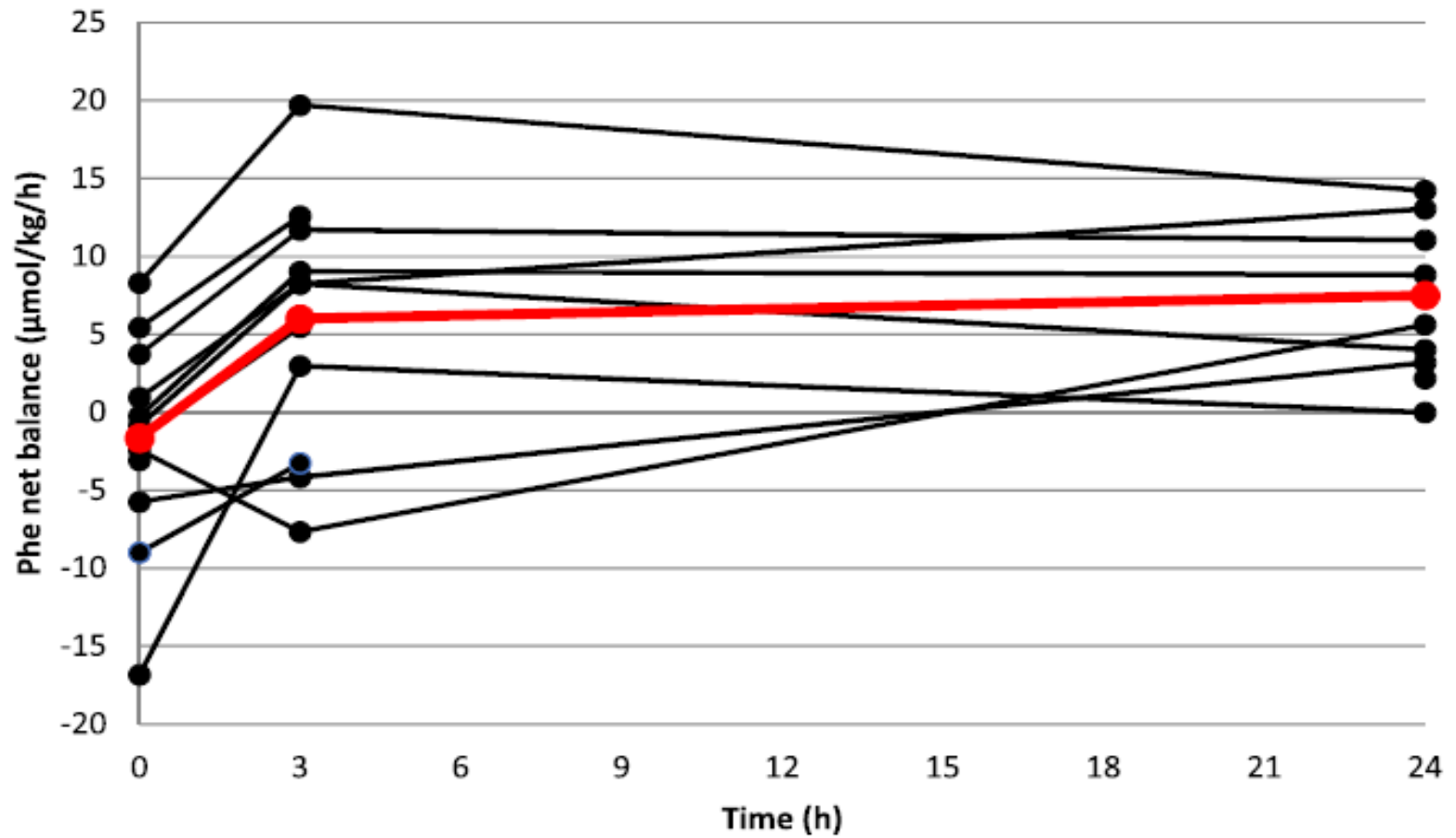
Berg et al. Critical Care 2013;17:R158



Liebau et al. Critical Care 2015 19:844



Liebau et al. Critical Care 2015 19:844



1.11 g/kg (0.59-1.72) 1.74 g/kg (01.56-2.68)

Sundström Rehal et al. Critical Care 2017 21:298

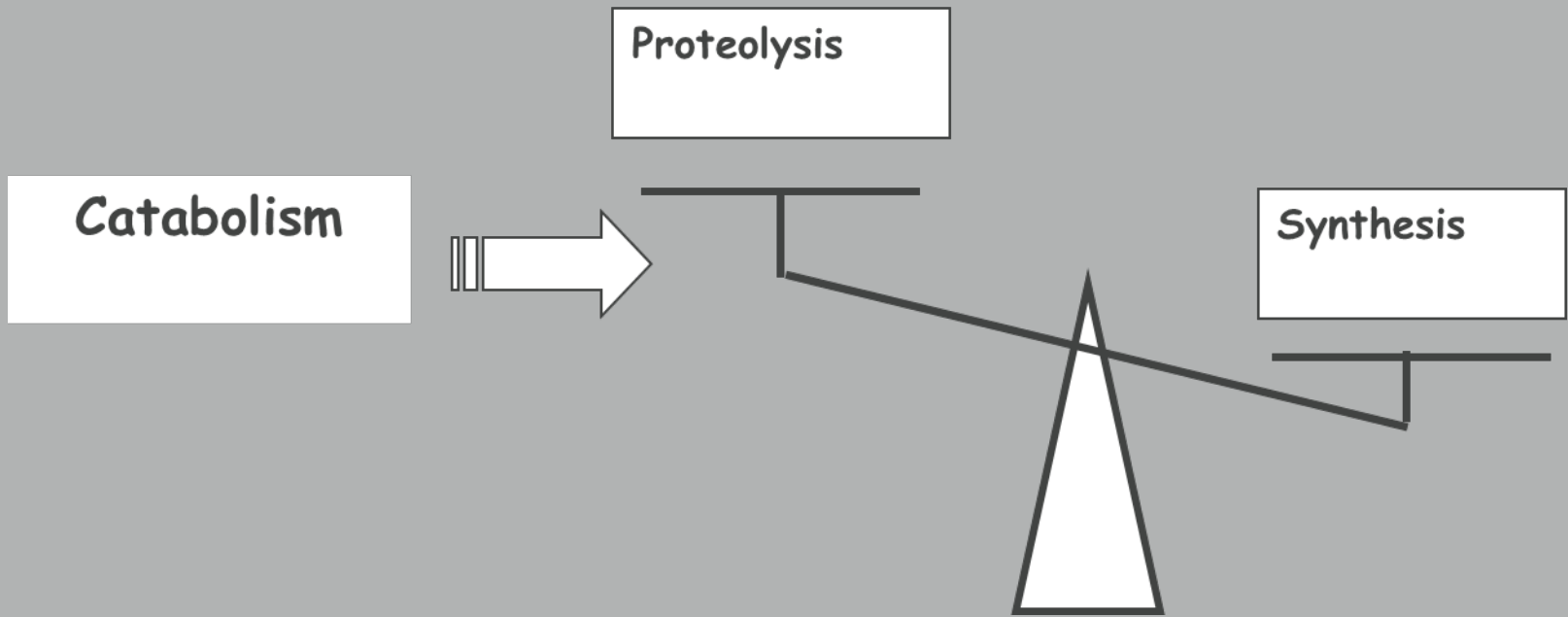
Protein in Critical Illness

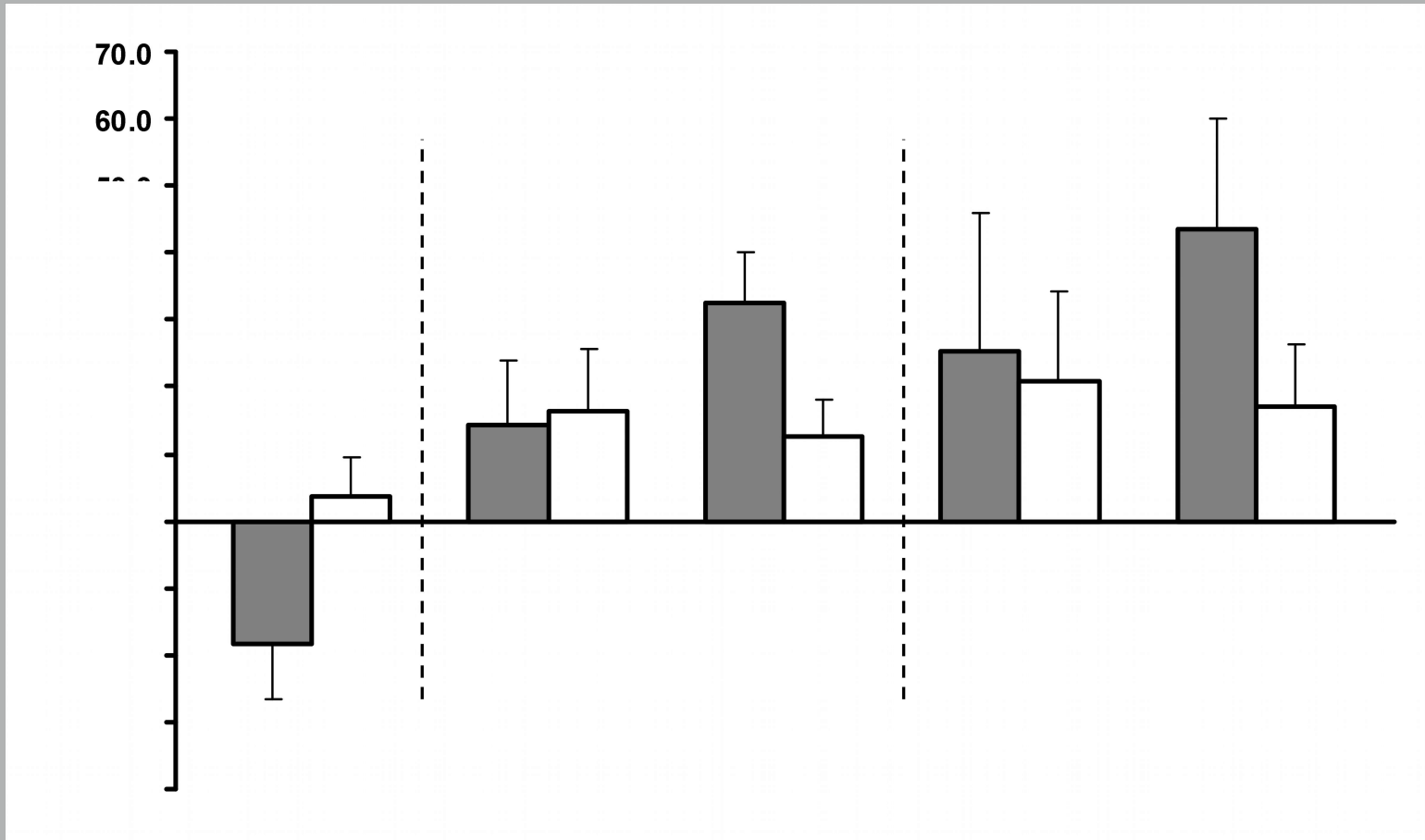
Whole body protein turnover

Singular measurements are snapshots. Enteral intake is difficult to monitor. Isotopic labelling of different amino acids gives slightly different results.

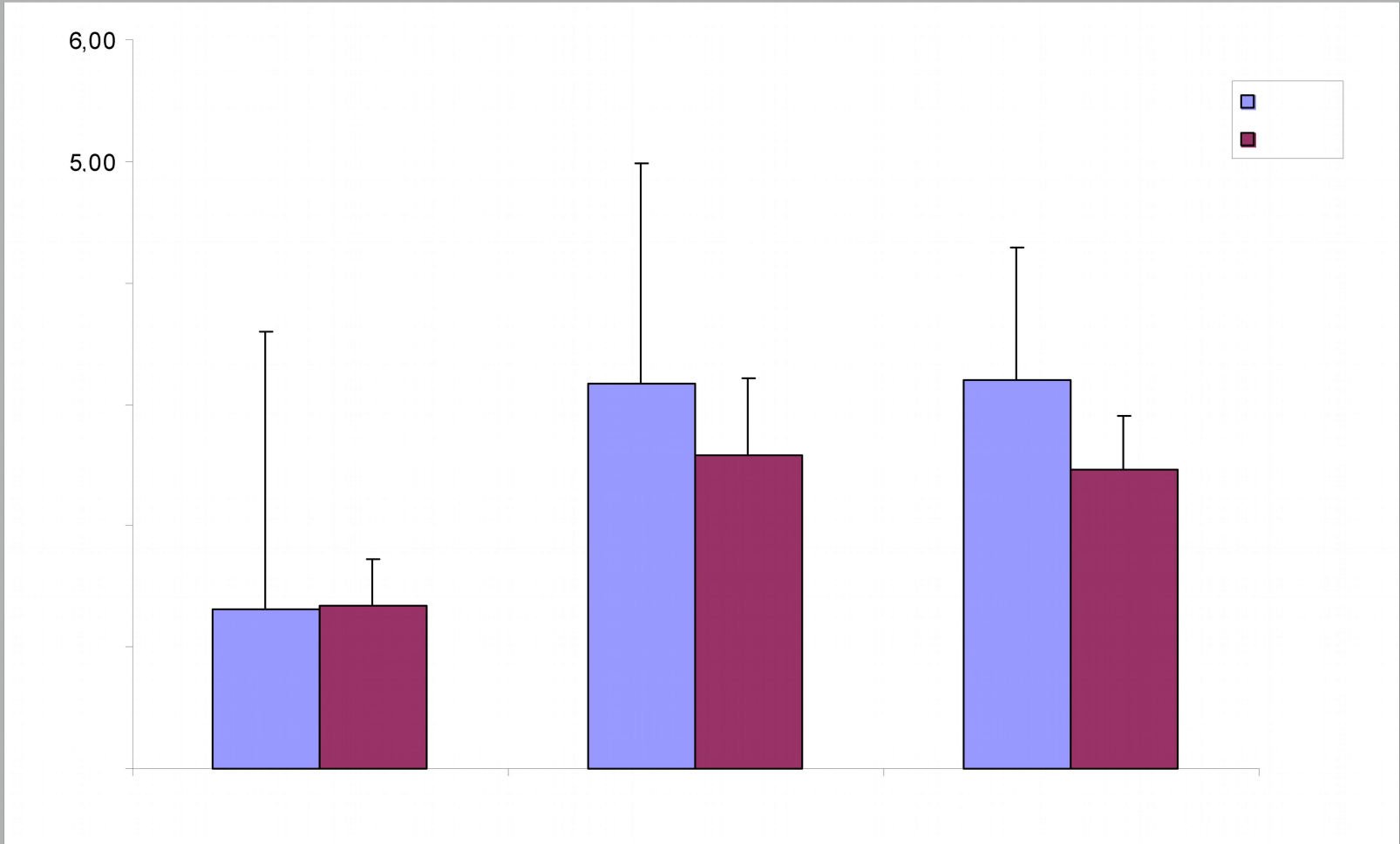
The literature is so far limited.

Ergo. Can potentially become gold standard to evaluate protein needs.

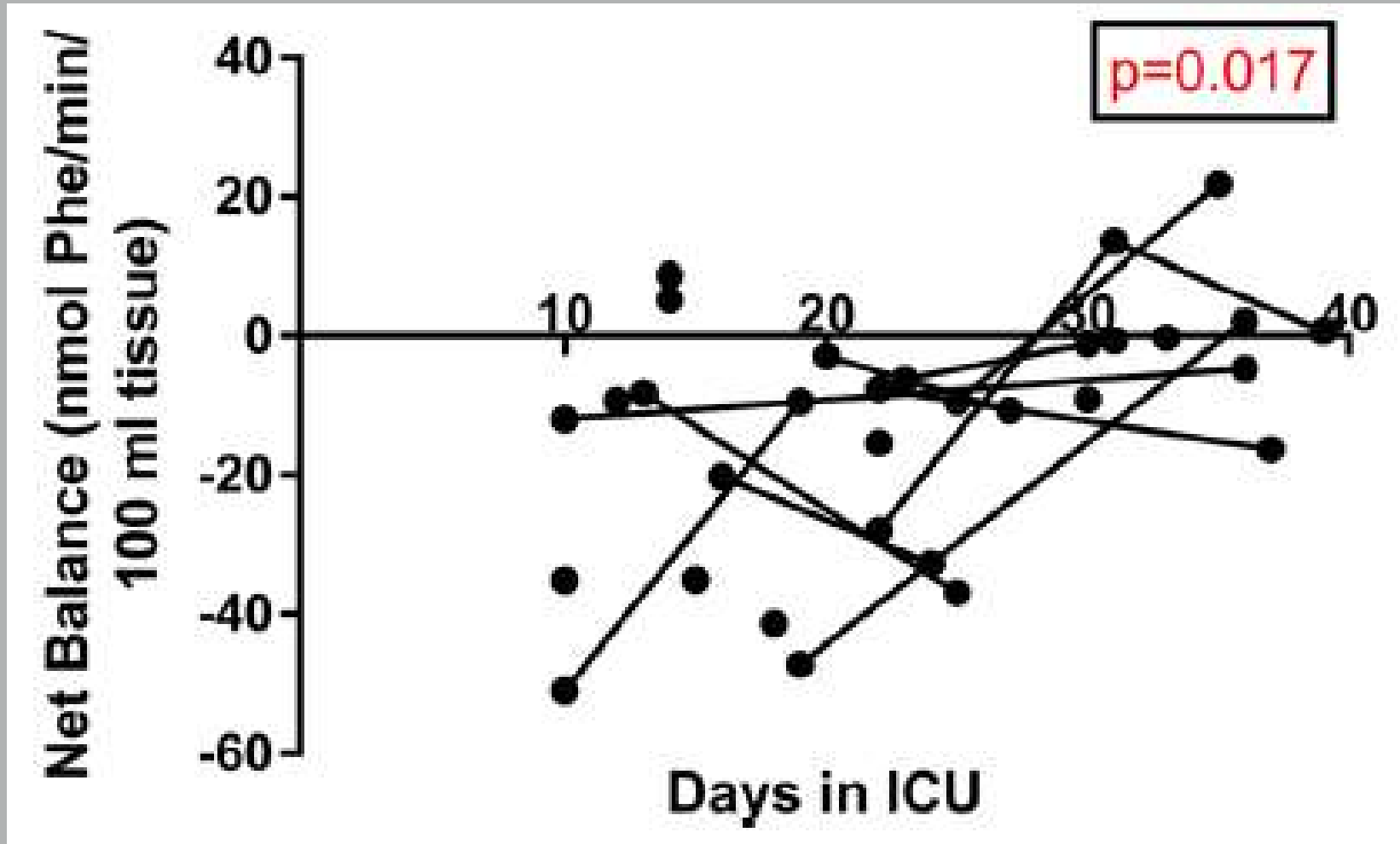




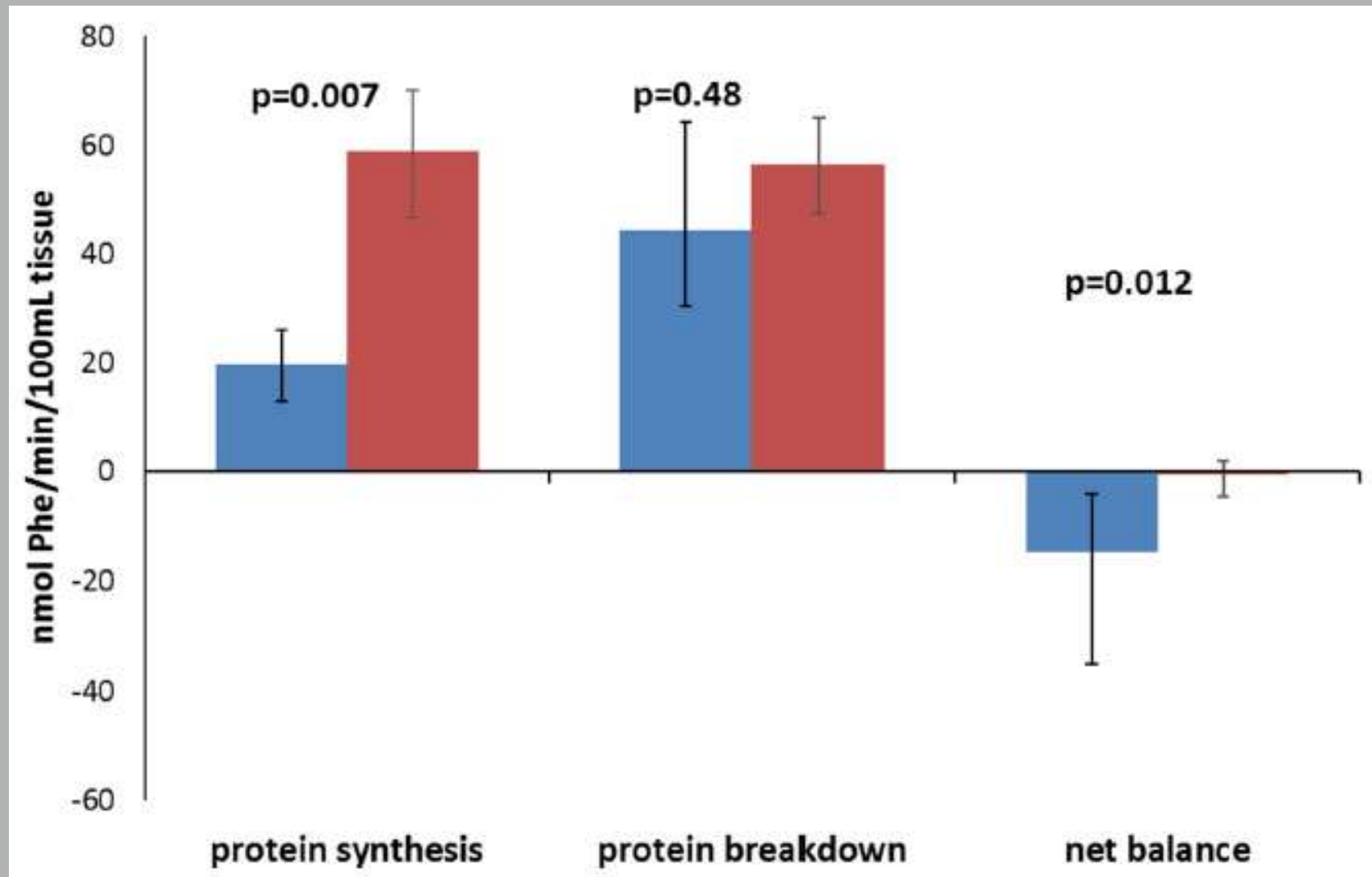
Klaude et al. Clin Sci 2012;122:133-42



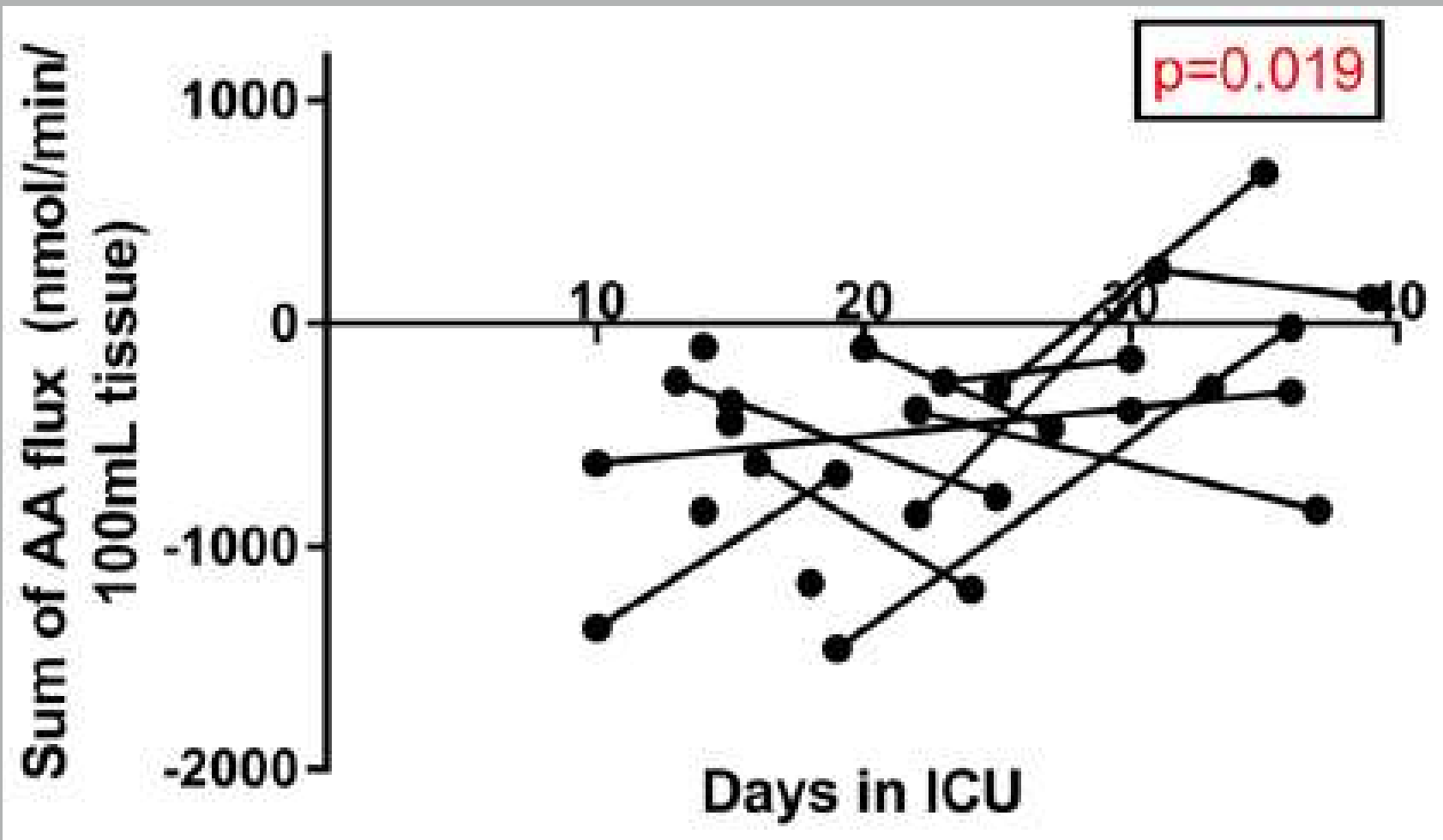
Tjäder et al, Clin Nutr 2005



Gamrin-Gripenberg et al. Crit Care 22:13, 2018



Gamrin-Gripenberg et al. Crit Care 22:13, 2018



Gamrin-Gripenberg et al. Crit Care 22:13, 2018

Protein in Critical Illness

Muscle protein turnover

Differences in muscle protein content are difficult to measure with sufficient precision.

Differences in muscle protein synthesis and degradation are possible to measure, but reliable technique is invasive.

For ICU longstayers muscle protein depletion levels out.

In conclusion

Despite more than 50 years of practice in clinical nutrition, protein needs for the critically ill is still not known.

Techniques to assess whole body protein metabolism and muscle protein metabolism are at hand, but with inherent limitations.



Home of the research group in ICU Metabolism and Nutrition at Karolinska Institutet and Karolinska University Hospital



Home

Who are we

What do we do

What have we done

Our lab

Tracer site

Our research is dedicated to the metabolic and nutritional problems of critically ill patients treated in the ICU.

We are a small research group dedicated to the metabolic and nutritional problems of critically ill patients in the intensive care unit (ICU).

Latest news/meetings



Program for our weekly wednesday research meeting can be found **here!**



Jonathan Grip will present his poster at the **ESCIM** meeting in Barcelona next week on wednesday.



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Thank you for listening