Protein Matters

Individualising Advice from CKD to Transplant and Active Living

Bruno Mafrici & Oscar Walton

Kidney Dietitians

3rd March 2026

Content

Nottingham University Hospitals NHS Trust

- Overview of Nitrogen Balance
- Current evidence on Protein requirements in
  - CKD 1-2
  - CKD 3-5
  - CKD 5D and transplantation
- Explore protein needs for those with CKD & Exercise

Nitrogen Balance, Protein and Exercise in Healthy individual

Nitrogen Balance

BALANCE= IN = OUT

External nitrogen factors, assessed:

- Protein intake g/kg/BW/day
- Energy, Fluid, Aging
- Physical Activity
- Metabolic status
- Nutritional Status
- Disease
- Medication
- Standard losses (TNL)



Total Nitrogen Losses (TNL)

Adapted from Mafrici et al *Journal of Renal Nutrition*, Vol 36, No 1 (January), 2026: pp 30-48

Nitrogen Balance

External nitrogen factors, assessed:

- Protein intake g/kg/BW/day
- Energy, Fluid, Aging
- Physical Activity
- Metabolic status
- Nutritional Status
- Disease
- Medication
- Standard losses (TNL)

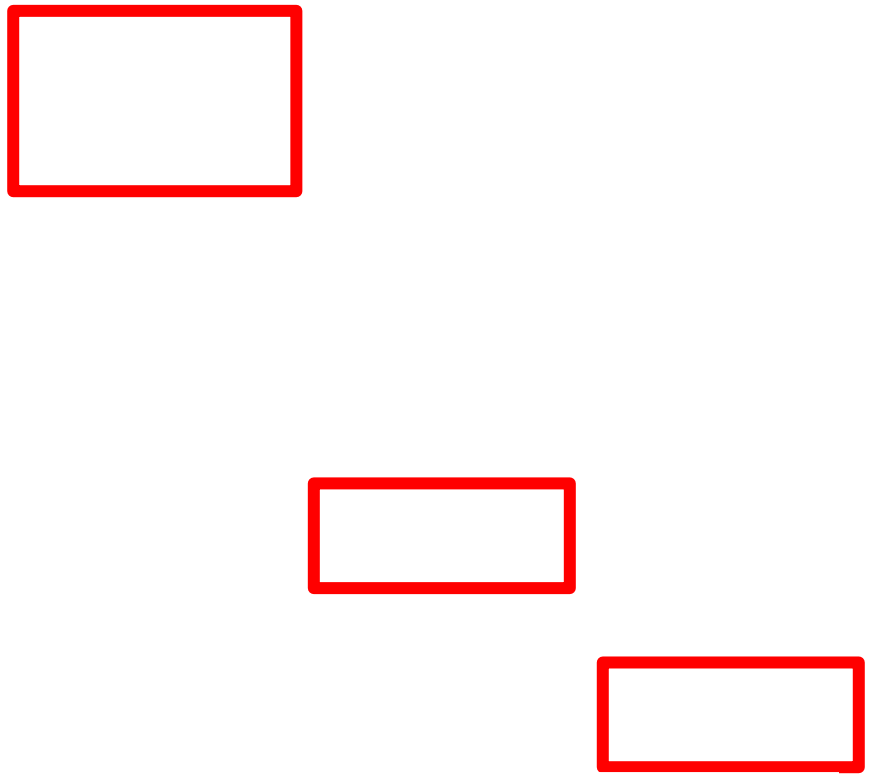
Internal nitrogen metabolism **not** assessed:

- Digestion absorption of amino acids
- Incorporation into muscle, structural proteins, cell membrane
- Manufacture of enzymes, proteins in the immune system, proteins in the blood, signalling proteins
- Deamination and production of N containing metabolites

Total Nitrogen Losses (TNL)

Adapted from Mafrici et al *Journal of Renal Nutrition*, Vol 36, No 1 (January), 2026: pp 30-48

Nitrogen Balance



Adapted from Mafrici et al *Journal of Renal Nutrition*, Vol 36, No 1 (January), 2026: pp 30-48

Front. Nutr., 23 May 2024
Sec. Sport and Exercise Nutrition
Volume 11 - 2024 | https://doi.org/10.3389/fnut.2024.1397090

Timing matters? The effects of two different timing of high protein diets on body composition, muscular performance, and biochemical markers in resistance-trained males

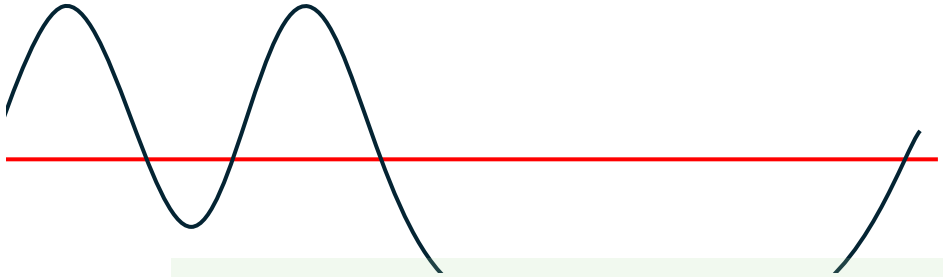
resistance-trained males, irrespective of intake time. These findings provide further evidence to the theory that the traditionally postulated "anabolic window" may not be as narrow as commonly proposed (38), at least in trained participants. Consequently, the total daily protein intake appears to be the primary factor in facilitating muscle growth induced by exercise. Future

Before exercise?



After exercise?

Before bed?



Nutrients. 2025 Jun 21;17(13):2070. doi: 10.3390/nu17132070

Does Protein Ingestion Timing Affect Exercise-Induced Adaptations? A Systematic Review with Meta-Analysis

Rafael A Casuso [1,*], Lennert Goossens [2]

after training (SMD: 0.70; 95% CI: 0.005 to 1.388; I^2 = 31%, p = 0.048). However, subgroup analysis did not reveal a significant effect difference (p = 0.07) for leg press and chest press. Lean body mass was not differently modulated by protein supplementation timing (SMD: −0.08; 95% CI: −0.398 to 0.244; I^2 = 0%, p = 0.641). Conclusions: Protein timing does not importantly modify exercise-induced changes in lean body mass. While upper and lower limbs strength may respond differently, more investigation is needed to reach a more robust conclusion. The present

Article | Open access | Published: 03 November 2023

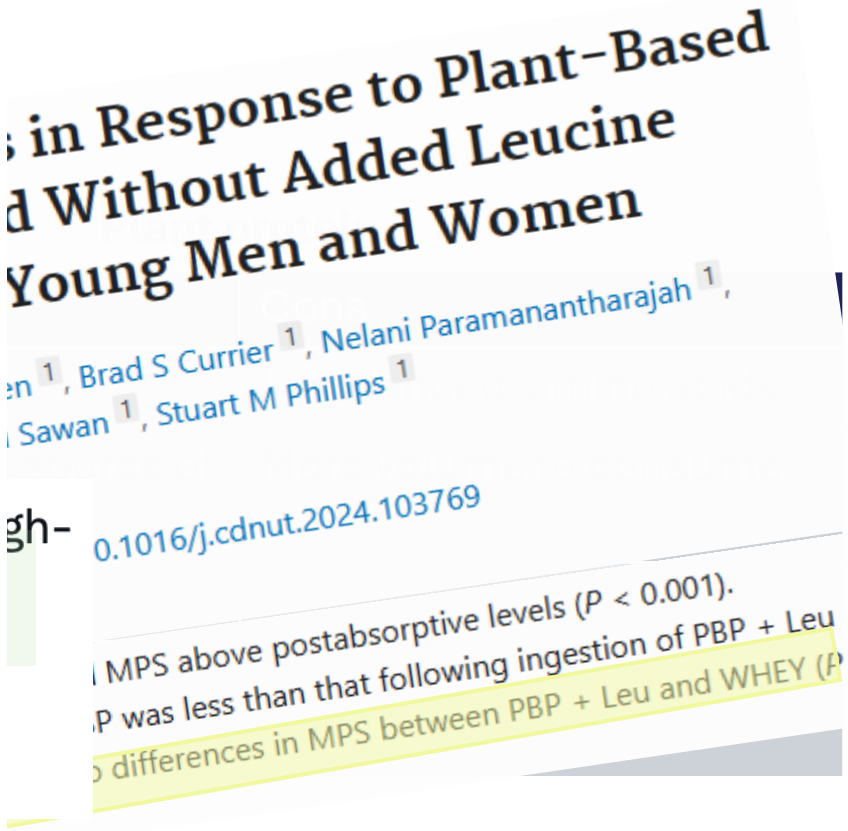
The impact of leucine supplementation on body composition and glucose tolerance following energy restriction: an 8-week RCT in adults at risk of the metabolic syndrome

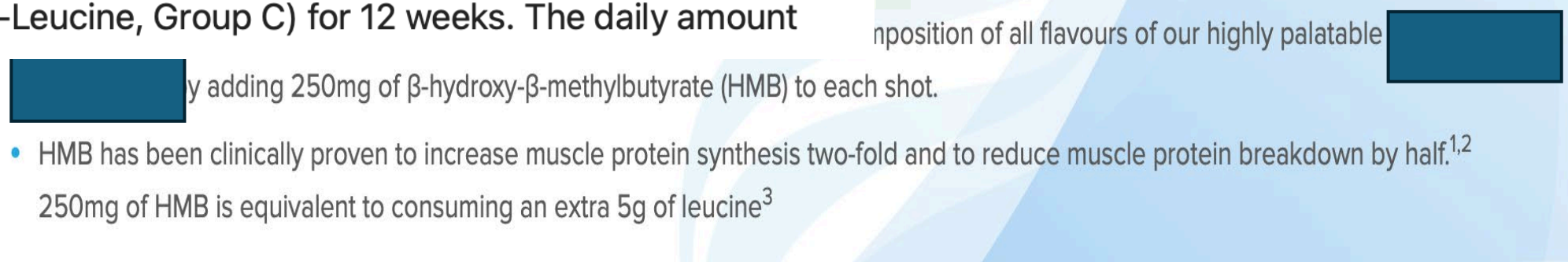
Thirty-seven adults, aged 20–65 years, with increased waist circumference and at least one other metabolic syndrome (MetS) component, were selected. We employed a two-arm parallel, double blind, randomized control trial (RCT) design. Participants were randomly assigned to an intervention group (leucine – 3 g/d) or placebo (lactose - 2.67 g/d), while following an individualised energy restricted diet for an 8-week period. Detailed body composition (DEXA), oral

Adjusted for baseline values and other covariates, FFM ($p = 0.045$) and lean tissue mass (LTM) ($p = 0.050$) were significantly higher following Leu. These

(Groups A and B containing 20% and 40% L-Leucine, respectively) or placebo (lactose containing 0% L-Leucine, Group C) for 12 weeks. The daily amount

protein synt





Nitrogen Balance, Protein and Exercise in Kidney disease

Nitrogen Balance in Kidney disease

Adapted from Mafrici et al *Journal of Renal Nutrition*, Vol 36, No 1 (January), 2026: pp 30-48

Factors influencing nitrogen balance in dialysis

Dialysis	Causes of nitrogen losses	Factors influencing nitrogen losses

HD, HDF, HHD, NHD	• Dialysis techniques (hemofiltration and hemodiafiltration techniques induce greater membrane permeability and facilitate greater losses of amino acids into the dialysate)
	• Haemodilution before the dialytic procedure
	• Inflammation and oxidative stress:
	  ○ Inflammatory activity by contact with the dialyzing membrane
	  ○ Inflammatory response (i.e. high CRP)
	  ○ Uremic hypercatabolic with chronic inflammatory status (uremic wasting syndrome)
	  ○ role of inflammation from the gastrointestinal tract (unclear)
	• Solute removal
	• Pore size of the dialyzer membrane
	• Multiple dialyzer reuse
	• High dialysis efficacy and adequacy (Kt/V)
	• Dialysis membrane (diffusion):
	  ○ physiochemical characteristics
	  ○ electric charge
	  ○ polymer composition
	  ○ interface free energy
	  ○ surface hydrophobicity or hydrophilicity
	  ○ thickness, protein accumulation
	  ○ capacity for capture of AA
	• Ultrafiltration volume exchange and ultrafiltration rate (convection)
	• Duration of dialysis regimens
	• Blood and dialysate flow
	• Depuration effectiveness
		• Pre-treatment plasma concentrations
		• Dialysis vintage
		• Uremic disturbances in amino acid metabolism
		• Loss of functional renal mass
		• Residual kidney function
		• Metabolic acidosis
		• Hormonal derangements
		  ○ Insulin resistance (promotes muscle proteolysis)
		  ○ Parathyroid hormone
		• Comorbidities
		• Psychosocial Factors (depression, lack of social support financial constrains)
		• Decreased physical function and exercise
		• Catabolic effects of the dialysis treatments
		• Factors that may potentially affect binding of some AA with plasma proteins
		• Transfer of AA through dialysis membrane pores and their absorptive effect
		• Sample handling (timing, storage time and temperature)
		• Reduced activity of protein
		• Molecular weight of amino acids
		• postprandial and postabsorptive state (which, leads to greater AA removal during hemodialysis)
		• Inadequate nutritional intake, specifically low dietary protein
		• Intradialytic food consumption/nutrition
		• Ingestion of protein during dialysis
		• Intradialytic exercise (unclear)

PD (CAPD, APD)	• The transport of big molecules throughout the peritoneal capillary endothelium is mostly conditioned by the vasodilation and intercellular fenestra status.
	• Dialysis techniques (CAPD & APD)
	• Inflammation and oxidative stress:
	  ○ Inflammatory response (i.e. High CRP)
	  ○ Uremic hypercatabolic with chronic inflammatory status (uremic wasting syndrome)
	  ○ High glucose solution and its degradation products can cause chronic inflammatory reactions and peritoneal fibrosis
	• Solute removal
	• Duration of dialysis regimens
	• Presence of absence of feeding during dialysis
	• Pre-treatment plasma concentrations
	• Loss of functional renal mass
	• Dialysis composition (i.e. concentration of glucose for PD)
	• Hydrostatic pressure–driven leak of plasma proteins through the large-pore pathway
	• Overhydration (linked with higher losses leak of plasma proteins through the large-pore pathway)
		• Inflammation
		• Peritoneal fibrosis
		• Time receiving PD (over 4 years)
		• Peritonitis episodes
		• Molecular weight of protein (the lower the molecular weight of the protein, the higher its concentration in dialysate compared with plasma)
		• Decrease of peritoneal protein transport with PD duration
		• Vasculopathy (a sign of membrane dysfunction, leading toa decree in PPL)
		• Comorbidities: cardiovascular disease is associated with increase PPL losses (however, PPL do not seem to influence medium-term patients' survival)
		• Hormonal derangements
		  ○ Insulin resistance (promotes muscle proteolysis)
		  ○ Parathyroid hormone
		• Nutritional status
		• Dietary protein intake
		• Kidney residual function
		• Medications (such as ACE inhibitor)
		• Incremental dialysis

REVIEW ARTICLE

Amino Acid and Protein Losses in Adult Patients Receiving Maintenance Dialysis: A Literature Review

Bruno Mafrici, RD, BSc, MSc,†‡ Daniela Viramontes-Hörner, BSc, MRes, PhD,‡ David S. Gardner, BSc, PhD, DSc,§ Kenneth Smith,¶ Maarten W. Taal, FRCP, MD,‡ Nicholas M. Selby, BMedSci, BMBS, DM,‡ and Matt Hall, MA, MBBChir, MD, FRCP*†‡*

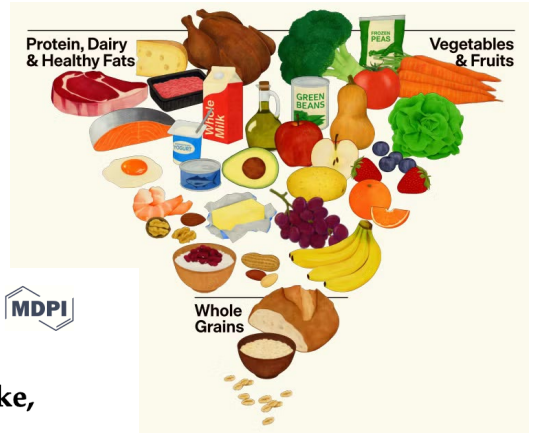
Journal of Renal Nutrition, Vol 36, No 1 (January), 2026: pp 30-48

Nitrogen Balance

Amino acid roles: not just protein!

Protein Formation	Other roles
Protein in the Immune system (i.e. Antibodies)	Neurotransmitters and pre-courses
Protein for Muscle Mass (actin, myosin)	Hormones (Thyrosine)
Protein for Structure (Callogen)	Specific role in Muscle Mass Synthesis (MMS) , such as Leucine
Enzyme for digestion and absorption	Amino acids play a role in the synthesis of purine and pyrimidine nucleotides (DNA)
Signaling protein	Energy (when the removal of nitrogen occur)
Protein in the blood	Sulphur containing AA form bile
Cell Membrane	Other functions not fully understood (D-serine; D-alanine, especially in kidney disease)

Protein Requirements Healthy Adult



In Healthy adults

- WHO 2007 – 0.83g protein per kg of BW
- Health, Age, Activity
- Daily distribution, Protein quality
- This value represents the minimum rather than the ideal requirements and is likely to vary between individuals

nutrients

MDPI

Review

Protein for Life: Review of Optimal Protein Intake, Sustainable Dietary Sources and the Effect on Appetite in Ageing Adults

Marta Lonnie [1], Emma Hooker [1], Jeffrey M. Brunstrom [2], Bernard M. Corfe [3,4], Mark A. Green [5], Anthony W. Watson [6], Elizabeth A. Williams [3], Emma J. Stevenson [6], Simon Penson [7] and Alexandr...

Nutrients **2018**, *10*, 360; doi:10.3390/nu10030360

Athletes

PENG 2025

PROT-AGE ESPEN Adults over 65

PROT-AGE ESPEN Adults over 65 malnutrition

WHO 2007

PROTAGE ESPEN Adults over 65

DGA 2025-2030

0.83 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 ...2.0

Landscape of CKD is changing 2026

GFR and ACR categories and risk of adverse outcomes		ACR categories (mg/mmol), description and range
		<3 Nor in
>90 Normal and high	G1	No C absenc of kid
60–89 Mild reduction related to normal range for a young adult	G2	
45–59 Mild–moderate reduction	G3a[1]	
30–44 Moderate–severe reduction	G3b	
15–29 Severe reduction	G4	
<15 Kidney failure	G5	

GFR categories (ml/min/1.73 m²), description and range

[1] Consider using eGFRcystatinC for people v

Abbreviations: ACR, albumin:creatinine ratio;

Adapted with permission from Kidney Diseas 2012 clinical practice guideline for the evalua (Suppl. 3): 1–150

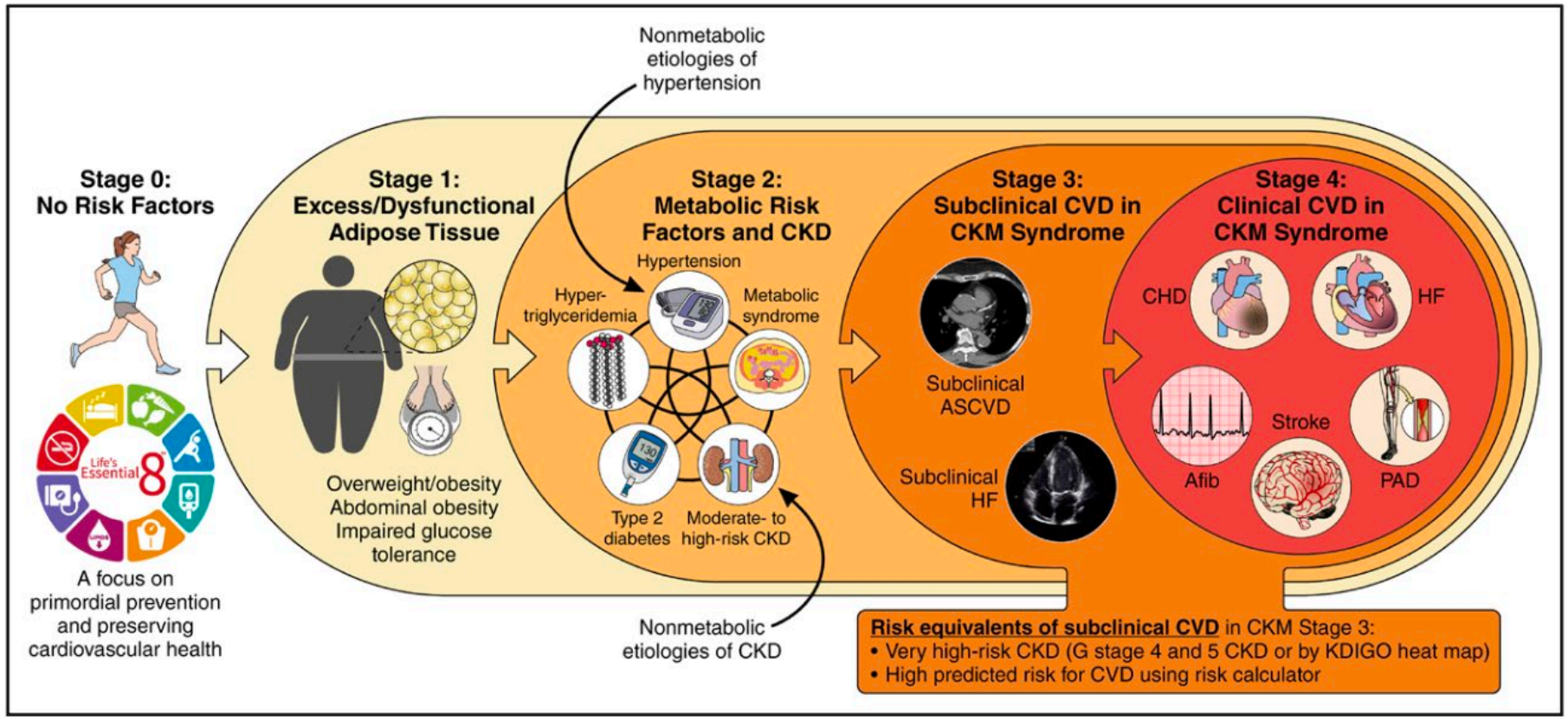
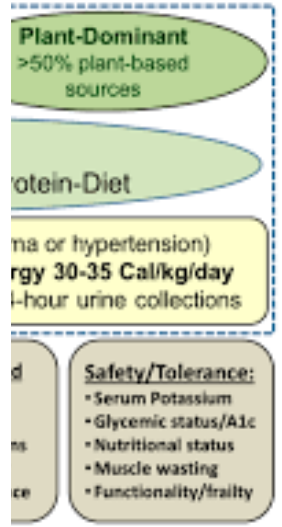


Figure 1. Stages of CKM syndrome.

The cardiovascular-kidney-metabolic (CKM) staging construct reflects the progressive pathophysiology and increasing absolute cardiovascular



Basic principles of Protein in CKD

- Protein should never be considered in isolation (age, Health status, PAL, metabolic status, nutritional support, other medical conditions, medication, etc.)
- We don’t eat protein but food
- Relationship between protein and energy and fluid
- In CKD high fiber and plant-based protein are preferable, which mirror DASH/Mediterranean diet

Protein requirements CKD 1-2

Received: 31 October 2021 | Accepted: 19 November 2021
DOI: 10.1111/sdi.13046

SPECIAL ISSUE ARTICLE

Seminars in Dialysis WILEY

Do the high-protein recommendations for athletes set some on a path to kidney injury and dialysis?

Meredith Marinaro[1] | Dayna S. Alexander[1] | Desiree de Waal[2]

Clinical Nutrition 39 (2020) 3497–3503

Contents lists available at ScienceDirect

Clinical Nutrition

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

Original article

The impact of protein diet on bone density in people with/without chronic kidney disease: An analysis of the National Health and Nutrition Examination Survey database

Chia-Lin Lee [a, b, c, d], Shang-Feng Tsai [a, e, f, *]

JAMA Network Open™

Original Investigation | Nutrition, Obesity, and Exercise

Protein Intake and Mortality in Older Adults With Chronic Kidney Disease

Adrián Carballo-Casla, PhD; Carla Maria Avesani, PhD; Giorgi Beridze, MD; Rosario Ortolá, MD, PhD; Esther García-Esquinas, MD, PhD; Esther Lopez-Garcia, PhD; Lu Dai, MD, PhD; Michelle M. Dunk, PhD; Peter Stenvinkel, MD, PhD; Bengt Lindholm, MD, PhD; Juan Jesús Carrero, PhD; Fernando Rodríguez-Artalejo, MD, PhD; Davide Liborio Vetrano, MD, PhD; Amaia Calderón-Larrañaga, PhD

etes

AGE ESPEN
ts over 65
nutrition

0.55 0.6 0.7 0.8 0.83 0. 2.0

External nitrogen factors, assessed:

- Protein intake g/kg/BW/day
- Energy, Fluid, Aging
- Physical Activity
- Metabolic status
- Nutritional Status
- Disease
- Medication
- Standard losses (TNL)

Unclear are

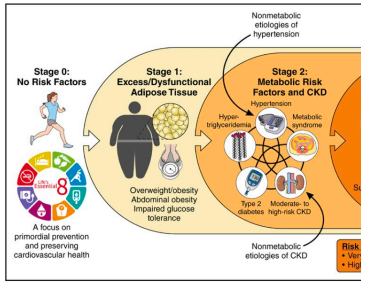
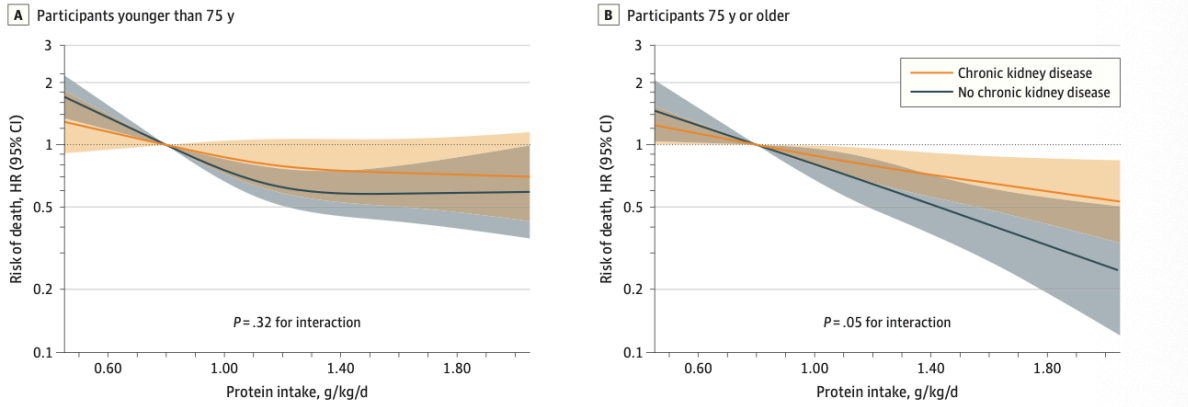


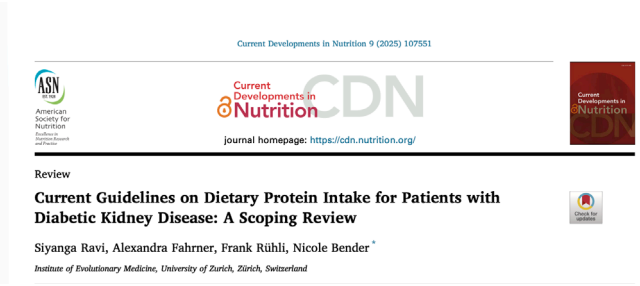
Figure 1. Stages of CKM syndrome.

Figure 1. Association of Total Protein Intake With 10-Year All-Cause Mortality, Stratified by Chronic Kidney Disease and Age



Analyses used Cox proportional hazards regression models. Protein intake was modeled as a 3-knot restricted cubic spline. Hazard ratios (HRs) and 95% CIs were plotted for protein intake above the 1st percentile and below the 99th percentile and obtained from models with interaction terms among protein intake, chronic kidney disease, and age. Models were adjusted for cohort, sex, age, living arrangement, previous occupation, educational level, tobacco smoking, light physical activity, moderate-to-vigorous physical activity, body mass index, diabetes, cardiovascular disease, chronic lung disease, musculoskeletal disease, cancer, depression and mood disorders, and intake of energy, monounsaturated fat, sugar, alcohol, and sodium.

Protein requirements CKD 3-5


Current Developments in Nutrition 9 (2025) 107551

Current Developments in Nutrition CDN

journal homepage: https://cdn.nutrition.org/

Review

Current Guidelines on Dietary Protein Intake for Patients with Diabetic Kidney Disease: A Scoping Review

Siyanga Ravi, Alexandra Fahrner, Frank Rühli, Nicole Bender *

Institute of Evolutionary Medicine, University of Zurich, Zürich, Switzerland

Athletes

PENG 2025

PROT-AGE ESPEN Adults over 65

PROT-AGE ESPEN Adults over 65 malnutrition

WHO 2007

PROTAGE ESPEN Adults over 65

DGA 2025-2030

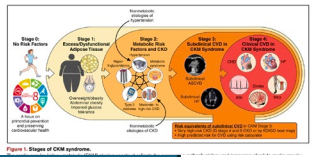
0.55 0.6 0.7 0.8 0.83 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0

NICE 2021
Do not offer low-protein diets (dietary protein intake less than 0.6 to 0.8 g/kg/day) to adults with CKD.

KDOQI 2020 Diabetes CKD 3-5

KDOQI 2020 No Diabetes CKD 3-5

KDIGO 2024 CKD 3-5



External nitrogen factors, assessed:

- Protein intake g/kg/BW/day
- Energy, Fluid, Aging
- Physical Activity
- Metabolic status
- Nutritional Status
- Disease
- Medication
- Standard losses (TNL)

GLP1 agonist

KDIGO 2024
Avoid to exceed in people at risk of disease progression

Protein requirements CKD 3-5

	eGFR ml/min per 1.73m^2	People with Diabetes	People without Diabetes
KDOQI 2000	< 25ml/min	< 0.6g protein/kg body weight/day If not tolerated 0.75g protein/kg/body weight	
Cochrane Review 2007	Moderate to severe < 30ml/min	More research needed as compliance to a low protein diet was not achieved (intake was 0.7-1.1g/protein/kg/ BW/day)	n/a
Cochrane Review 2009	Moderate to severe < 30ml/min	n/a	Reducing protein intake in patients with chronic kidney disease reduces the occurrence of renal death by 32% as compared with higher or unrestricted protein intake. The optimal level of protein intake cannot be confirmed from these studies.
KDIGO Guidelines 2012	< 30ml/min	0.8g/kg/BW/day avoid >1.3g/kg/BW/day in people at-risk of progression	
UKKA 2019, endorsed by RNG	< 30ml/min	0.8-1.0g /kg/ideal BW/day	
KDOQI 2020	< 60ml/min	0.6-0.8 g/kg/BW/day (Opinion)	In adult with CKD 3-5 who are metabolically stable we recommend under close supervision protein restriction with or without keto analogues, to reduce the risk of ESKD /death (1A) and Improve QOL (2c): • 0.55-0.6g/kg/BW /day or • 0.28-0.43 g/kg/BW/day + keto acid/amino acid analogue
Cochrane - Meta analysis 2020	< 30ml/min	n/a	Very low protein diet may reduce ESKD progression. No data on QOL. Studies on QOL are needed before implementation of very low protein diet.
KDIGO 2020	(unclear) < 60ml/min	0.8 g/kg/BW/day	
NICE 2021 guidelines	(unclear) < 60ml/min	Do not offer low protein diet, dietary intake less than 0.6-0.8g/kg/BW/day to adults with CKD.	
KDIGO 2024	CKD 3-5	0.8g/kg/BW/day avoid >1.3g/kg/BW/day in people at-risk of progression	

Protein recommendations in CKD 3-5 vs Sport

Guidelines	Protein per kg/ body weight/day (CKD3-5)	Grade of evidence
KDOQI 2020	0.55-0.6g/kg (0.6-0.8g/kg in those with diabetes)	
KDIGO 2024	Aim for <0.8g/kg Avoid intake >1.3g/kg	
NICE NG203 2021	0.6-0.8g/kg	

British Association of Sport and Exercise Sciences

	Protein per kg/bodyweight/day	Quality of Evidence
	≥1.6g/kg	Opinion
	Minimum 1.4-2.0g/kg 1.3g/kg to preserve FFM	Opinion

ort Nutrition

Cochrane Library

Trusted evidence.
Informed decisions.
Better health.

Cochrane Database of Systematic reviews | Review - Intervention

Free access

Low protein diets for non-diabetic adults with chronic kidney disease[14]

Deirdre Hahn, Elisabeth M Hodson, Denis Fouque

Authors' declarations of interest

Version published: 29 October 2020 Version history

https://doi.org/10.1002/14651858.CD001892.pub5

evidence). Compared with normal protein diets (0.8 to ≥ 1.0 g/kg/day), low protein diets (0.5 to 0.6 g/kg/day) in participants with CKD 3 may make little or no difference to the number progressing to ESKD (low certainty evidence). However

A high protei
heavy resista
composition
follow-up inv

Jose Antonio, Anya Ellerbroek, Tobin Silver, Steve Orris, Max Scheiner, Adriana Gonzalez & Peacock

Journal of the International Society of Sports Nutrition 12, Article number: 39 (2015) | Cite this article

rotein diet (4.4
sistance-trained

erbroek, Brandon Fromhoff & Tobin Silver

rnal Society of Sports Nutrition 11, Article number: 19 (2014) | Cite this article

Nottingham University Hospitals NHS Trust

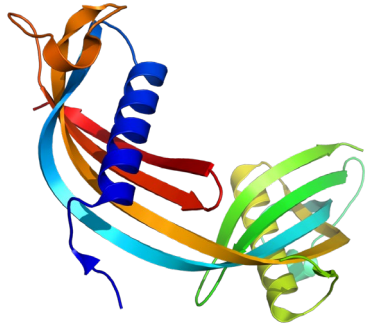
Who can be flexible

- Without significant proteinuria= PCR <50mg/mmol or ACR <30mg/mmol
- Stable eGFR = eGFR dropping less than <3mL/min/1.73m^2/year
- Activity level – how much high intensity exercise?
- Their body composition – how much lean tissue?

Ideal vs Actual BW vs other markers?

Cystatin C based eGFR?









Muscle loss in CKD

- Low muscle mass via DEXA was associated with a significant risk of all cause mortality HR 1.615, independent of frailty status[5]



Importanc

- Renal Association
- 150 mins moderate
  75 mins vigorous
- Exercise focusing
  twice/week

907 people with CKD

- 29% reported no lec
- 30.2% were insuffici
active

- Vigorous exampl

Cycling, football/ru
martial arts, resist
exercise . .

Impact of resistance exercise on patients with chronic kidney disease [6]

Chong-Cheng Chen, Yue-Yang Huang, Hua-Zhang, Xia-Liu, Xue-Qin Li, Yan-Qiong Long, Zheng-Wen Chen & Tao Jin

BMC Nephrology **25**, Article number: 115 (2024) | Cite this article

4605 Accesses | **11** Altmetric | Metrics

Overall	N	n (I/C)	WMD	95%CI	P (H)	I^2	*P*
GFR (ml/(min•1.73m^2))	7	191/185	1.82	-0.59 ~ 4.23	0.002	71.8%	0.139
CRP (mg/L)	9	202/187	-2.46	-4.21 ~ -0.72	0.000	75.9%	0.006
Serum creatinine (mg/dL)	5	93/89	-0.01	-0.17 ~ 0.14	0.137	42.7%	0.849
Hemoglobin (g/dL)	5	67/74	-0.07	-0.62 ~ 0.47	0.260	24.1%	0.787
HBA1c (%)	3	75/74	-0.46	-0.63 ~ -0.29	0.100	56.6%	0.000
HDL (mg/dL)	6	167/161	2.24	-2.54 ~ 7.02	0.004	71.0%	0.359
LDL (mg/dL)	6	165/159	1.72	0.07 ~ 3.36	0.512	0.0%	0.040
6-min walk (m)	2	52/51	89.93	50.12 ~ 129.74	0.136	55.0%	0.000
BMI (kg/m^2)	8	175/162	0.09	-0.52 ~ 0.70	0.411	2.4%	0.776
Fat-free mass (kg)	2	46/45	6.53	1.14 ~ 11.93	0.013	83.6%	0.018
Fat mass (kg)	2	46/45	-5.38	-13.29 ~ 2.53	0.008	85.8%	0.183
Grip strength (kgf)	7	159/160	3.97	1.89 ~ 6.05	0.032	56.5%	0.000

Protein requirements Kidney transplant

Current Opinion

Nutritional and dietary interventions to prolong renal allograft survival after kidney transplantation

2021

Ekamol Tantisattamo[a,b,c], Kamyar Kalantar-Zadeh[a,b,d], and Miklos Z. Molnar[e]

BTS British Transplantation Society
The Voice of Transplantation in the UK

2023

Athletes

PENG 2025

PROT-AGE ESPEN Adults over 65

PROT-AGE ESPEN Adults over 65 malnutrition

WHO 2007

PROTAGE ESPEN Adults over 65

DGA 2025-2030

0.55 0.6 0.7 0.8 0.83 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0

NICE 2021
Do not offer low-protein diets (dietary protein intake less than 0.6 to 0.8 g/kg/day) to adults with CKD.

KDOQI 2020 Diabetes CKD 3-5

KDOQI 2020 No Diabetes CKD 3-5

KDIGO 2024 CKD 3-5

Re enter the CKD cycle?

Although strong evidence is still lacking, a low protein diet of 0.6–0.8 g/kg/day with at least 50% of the protein source from plant-based components in kidney transplant recipients with stable kidney allograft function should be considered as the dietary target.

KDIGO 2024
Avoid to exceed in people at risk of disease progression

Up to 1.4g during the first 4 weeks

REVIE
published: 03 April 20
doi: 10.3389/ti.2025.142

Dietary Guidelines Post Kidney Transplant: Is This the Missing Link i Recovery and Graft Survival?

Suzanne Schneider[1], Deborah Biggerstaff[1] and Thomas M. Barber[2,3]*

Protein requirements in dialysis

Guidelines	HD	PD	HHD	NHD
National Kidney Foundation/ Kidney Disease Outcomes Quality Initiative (KDOQI) 2020	1.0-1.2g	1.0-1.2g	No Data	No Data
UK Kidney Association (UKKA) 2014	1.1-1.4g	1.0-1.2g		
Japanese Society of Dialysis Guidelines (JSDG) 2014	0.9-1.2g	0.9-1.2g		
Caring for Australasians with Renal Impairment (CARI) 2014	1.1g	1.0 -1.2g		
Renal Nutrition Group British dietetic Association (RNG, BDA) 2001	Min 1.1g	1.0 - 1.2g		
European Renal Best Practice (EBPG) 2007	1.1-1.2g	-		
European Renal Best Practice (EBPG) 2005	-	1.1-1.3g		
European Society for parenteral and enteral nutrition (ESPEN) 2006	1.2-1.4g	1.2-1.5g		
National Kidney Foundation/ Kidney Disease Outcomes Quality Initiative (KDOQI) 2000	1.2g	1.2g-1.3g		

Protein requirements Haemaodialysis

Athletes

PENG 2025

PROT-AGE ESPEN Adults over 65

PROT-AGE ESPEN Adults over 65 malnutrition

WHO 2007

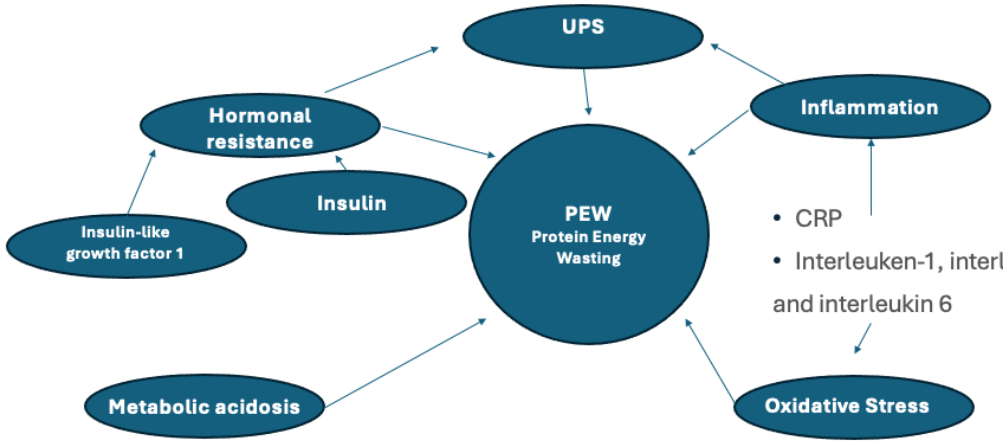
PROTAGE ESPEN Adults over 65

DGA 2025-2030

KDOQI 2020

0.55 0.6 0.7 0.8 0.83 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0

UKKA 2019



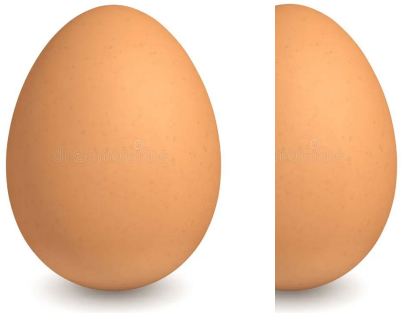
External nitrogen factors, assessed:

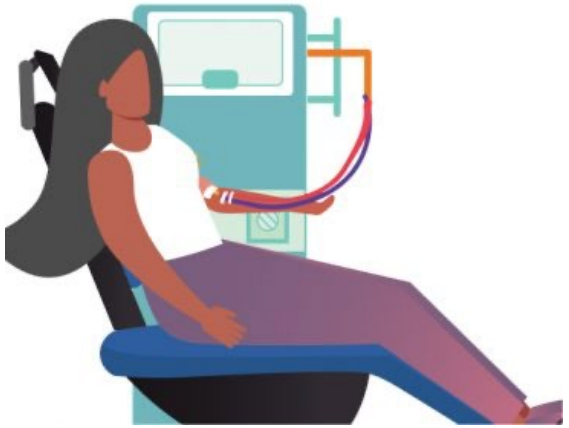
- Protein intake g/kg/BW/day
- Energy, Fluid, Aging
- Physical Activity
- Metabolic status
- Nutritional Status
- Disease
- Medication
- Standard losses (TNL)

Haemodialysis or Haemodialfiltration?

Protein Losses

- Mean amino acid can vary between 9.3 -10g per sessio
- Difference between HD and HDF







3 sessions/week: 18-30g protein lost/week

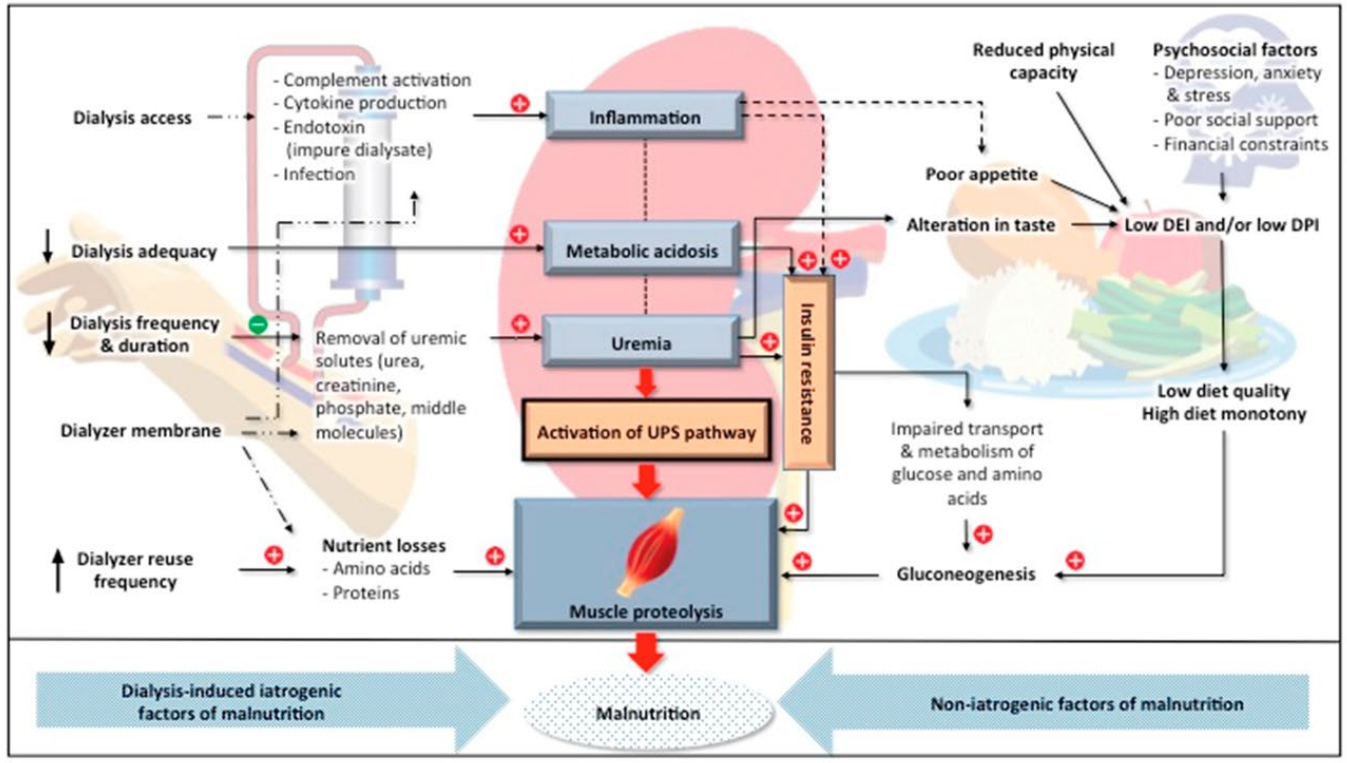
REVIEW ARTICLE

Amino Acid and Protein Losses in Adult Patients Receiving Maintenance Dialysis: A Literature Review

Bruno Mafrici, RD, BSc, MSc,†‡ Daniela Viramontes-Hörner, BSc, MRes, PhD,‡ David S. Gardner, BSc, PhD, DSc,§ Kenneth Smith,¶ Maarten W. Taal, FRCP, MD,‡ Nicholas M. Selby, BMedSci, BMBS, DM,‡ and Matt Hall, MA, MBBChir, MD, FRCP*†‡*

Journal of Renal Nutrition, Vol 36, No 1 (January), 2026: pp 30-48

Protein Losses are complex



Abbreviations: DEI, dietary energy intake; DPI, dietary protein intake; UPS, ubiquitin-proteasome system
Notes:
- - ▶ Association, causal-effect relationship yet to be established
— · ▶ Influences
⊕ Exarcebates
⊖ Treatment insufficiency

Figure 1. Etiology of malnutrition in dialysis patients.

Protein requirements Peritoneal Dialysis

External nitrogen factors, assessed:

- Protein intake g/kg/BW/day
- Energy, Fluid, Aging
- Physical Activity
- Metabolic status
- Nutritional Status
- Disease
- Medication
- Standard losses (TNL)

Athletes

PENG 2025

PROT-AGE ESPEN Adults over 65

PROT-AGE ESPEN Adults over 65 malnutrition

WHO 2007

PROTAGE ESPEN Adults over 65

DGA 2025-2030

0.55 0.6 0.7 0.8 0.83 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0

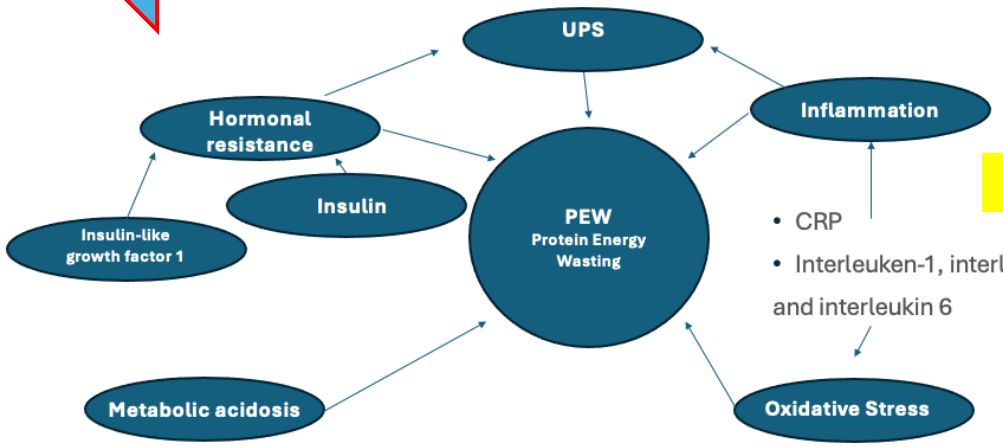
KDOQI 2020

UKKA 2019

CARI 2014

JDSG

Peritonitis

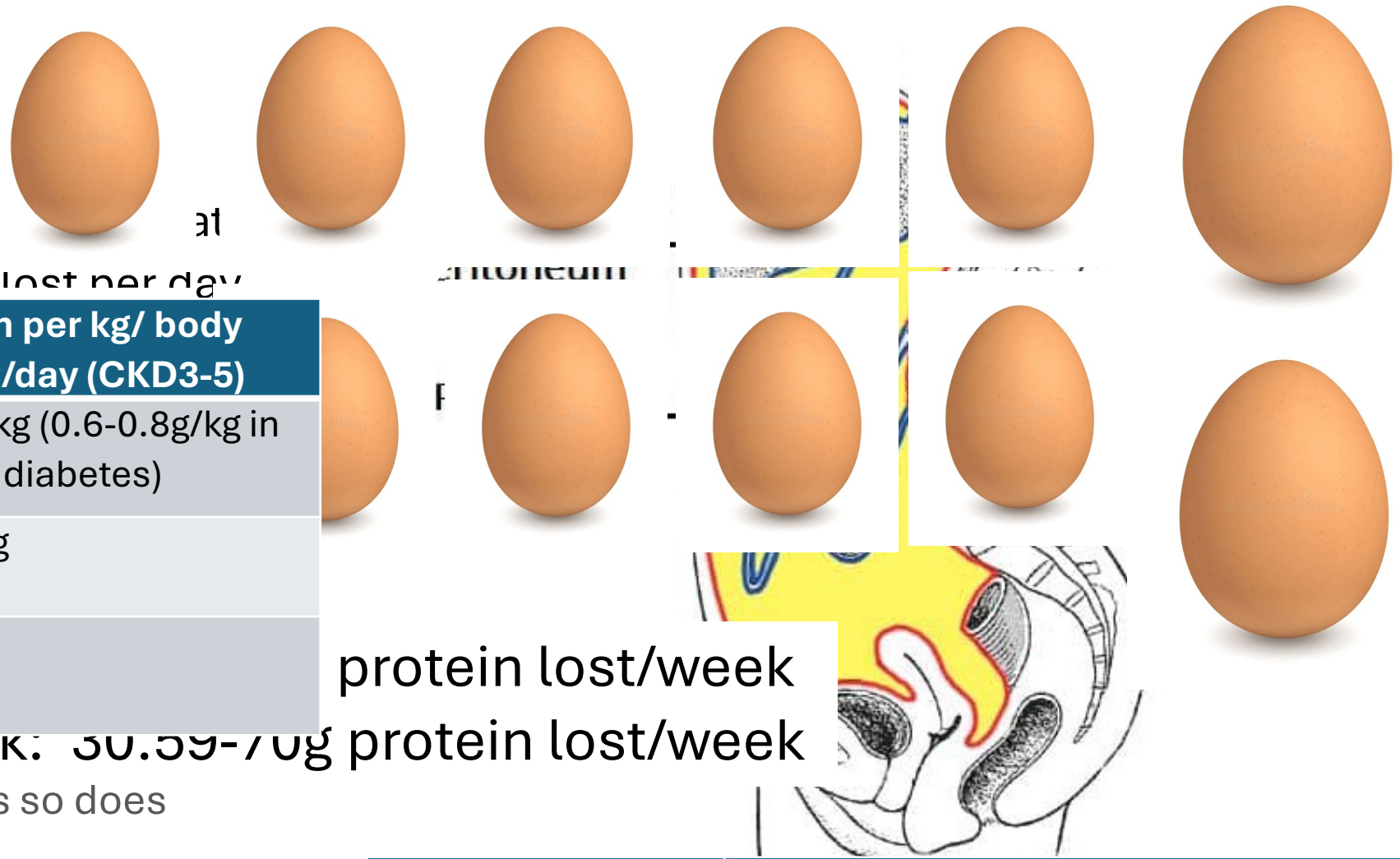


- CRP
- Interleuken-1, interleukin 1RA and interleukin 6

Protein

- Protein losses on
  - Arrival onto dialysis
  - Protein shedding
  - Prior advice
  - 4.37-10.0g protein lost per day

Guidelines	Protein per kg/ body weight/day (CKD3-5)
KDOQI 2020	0.55-0.6g/kg (0.6-0.8g/kg in those with diabetes)
NICE NG203 2021	0.6-0.8g/kg
KDIGO 2024	<0.8g/kg



protein lost/week

7 sessions/week: 30.59-70g protein lost/week

- As PD vintage increases so does protein leakage
- Overall risk of protein energy wasting (PEW)

Guidelines	Protein per kg/ body weight/day on PD
Range of recommendations	0.9-1.5

POSTER/FRIDAY: PERITONEAL DIALYSIS: CURRENT TOPICS

Pe Effect of Protein Supplement in Patients With Peritoneal Dialysis-Associated Peritonitis on Clinical Outcomes: A Multicenter, Randomized-Controlled Trial

- **FR-PO474**

Faisatjatham, Surasak[1,2]; Chuengsaman, Piyatida[3]; Pisutpaisan, Chaiwat[4]; Lawsuwanakul, Rhonachai[5]; Boonyakrai, Chanchana[6]; Kananuraks, Sarassawan[2]; Chieochanthanakij, Rutchanee[7]; Khositrangsikun, Kamol[8]; Phannajit, Jeerath[1]; Tungsanga, Somkanya[1]; Eiam-Ong, Somchai[1]; Kanjanabuch, Talerngsak[1]

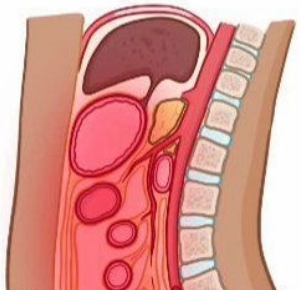
osses

toneum

Conclusions:

Serum albumin concentrations in patients with PD-associated peritonitis were higher with protein supplementation compared with nutritional counseling alone, although death or relapsing/repeat peritonitis were not affected. Further studies with a longer follow-up period and a larger number of participants are warranted.

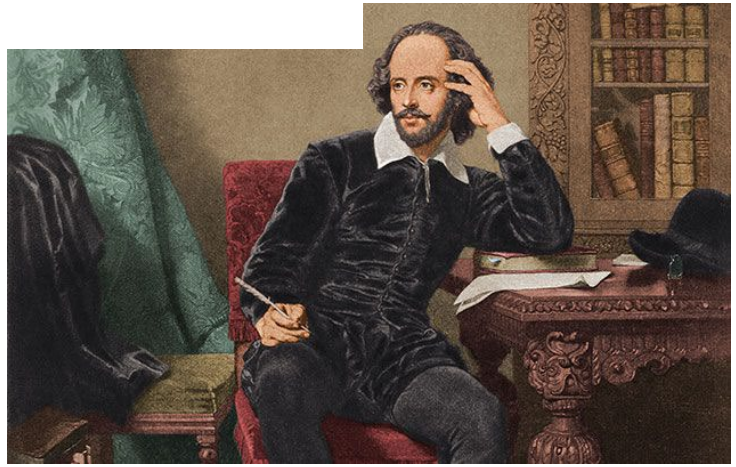
PERITONITIS
INFLAMMATION of PERITONEUM



catabolic rate were obtained. The control group
ıe peritoneal fluid vs. an average of 15.1 gm
s (p less than .01). Serum albumin did not



- Depends on presentation
- Loss of appetite?
- Abdo-pain?
- Nausea/vomit?



To supplement or not to supplement?

It’s not just plugging the gap

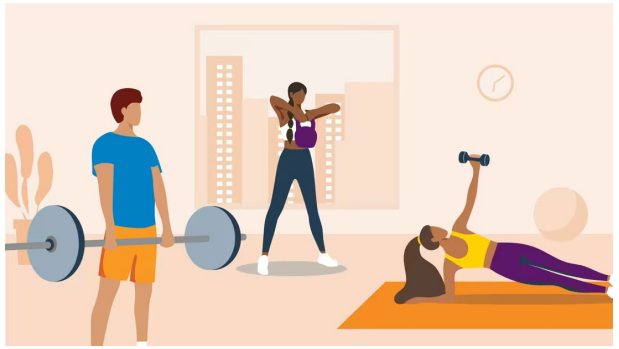






What about exercise?

Exercise in Haemodialys



2.2 We recommend that haemodialysis patients should aim for 150 minutes of moderate intensity activity a week (or 75 minutes of vigorous activity) or a mixture of both as per the UK Chief Medical Officers' Guideline. This may include a combination of exercise outside of dialysis (interdialytic) or exercise during dialysis (intradialytic) (1B).



What kind of exercise? Stable on maintenance haemodialysis

- Exercise should be performed at a moderate exercise intensity. This should be between
  - Patients should avoid exercise:
    - Less than three months after initiation of haemodialysis.
    - If they have any uncontrolled medical condition (clinically unstable) including (but not limited to) infection or fever, recent (within 2 weeks) myocardial infarction or undiagnosed chest pain.
    - If they have any perceived physical or psychological barriers to exercise participation.
    - In patient in class D (unstable condition) as per the American Heart Association/American College of Sports Medicine Joint Position Statement: 1) unstable ischemia; 2) heart failure that is not compenstated;3) uncontrolled arrhythmias; 4) severe and symptomatic aortic stenosis; 5) hypertrophic cardiomyopathy or cardiomyopathy from recent myocarditis; 6) severe pulmonary hypertension; or 7) other conditions that could be aggravated by exercise (for example, resting systolic blood pressure >200 mm Hg or resting diastolic blood pressure >110 mm Hg; active or suspected myocarditis or pericarditis; suspected or known dissecting aneurysm; thrombophlebitis and recent systemic or pulmonary embolus).
    - Symptomatic hyper- or hypotension.
-
- Re
  inc
  up
- On
  co

ercising
istance on

light

to



Exercise in PD

When to start

What kind of exercise?



Practice points

- Core strengthening exercises are rec
  PD patients. **(2C)**
- Stronger core muscles can support the
  prevent/manage low back pain. **(1C)**
- Stronger transverse abdominal muscles can support IAP secondary to PD fluid, potentially reducing hernia risk. **(2D)**

physical activity

- For activities that are not associated with a signifi-
  cantly higher IAP such as walking, hiking and
  ging, PD fluid does not need to be drained pric
  exercise unless the 'fullness' contributes to pa
  discomfort. **(2D)**
- For activities such as weightlifting, snow shovel
  and jumping, which are associated with much hi
  IAP, PD fluid should be drained prior to exercise.

- P

2.2. Contact sports and sports requiring vigorous activity

- Participation or gradual return to sport is recom-
  and exercise are
  he post-operative
  al interdisciplinary
  1B)
  on
  lifting
  When
  factors
  risk of
  physic
  ous inj
- Patient
  empty for
  greater comfort when participating in sports. **(2C)**
  f a PD
  protectio
  te. **(2D)**
  ay need
  ting acti
  ed-tinge
  Followin
  ant profe
  activity may resum











In summary!

Nottingham University Hospitals NHS Trust

- Protein and amino acid needs are more than just muscles
- Estimated protein requirements should be individualised. Consider: **current protein intake,** activity level, stage of CKD and KRT and other co-morbidities
- Where possible, we should be recommending whole food sources of protein with incorporation of plant-based sources of protein.
- If we are focusing on protein for muscle, then we also need adequate energy and activity to be in place to best promote muscle adaptation.
- Exercise is good. Just do it with consideration for their safety.