Renal Specific Oral Nutrition in CKD/Dialysis

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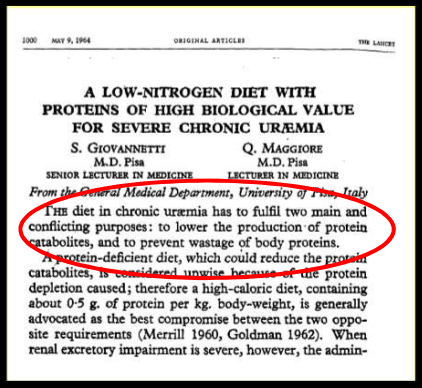
After 1st HD in the early sixties, Dr Scribner rapidly pointed out key questions:

- How to better control blood pressure?
- How to manage chronic anemia?
- **Which nutrients should be recommended to these patients?**

Scribner BJ, et al. *Trans ASAIO* 1960

8 pts,
FU: 3-10 mths
10 gr of proteins (1.5 grams of N) plus amino acids.
Main results:
↓s urea
↑anemia
↓uric acid



1000 MAY 9, 1964 ORIGINAL ARTICLES THE LANCET

A LOW-NITROGEN DIET WITH PROTEINS OF HIGH BIOLOGICAL VALUE FOR SEVERE CHRONIC URÆMIA

S. GIOVANNETTI M.D. Pisa, SENIOR LECTURER IN MEDICINE
Q. MAGGIORE M.D. Pisa, LECTURER IN MEDICINE

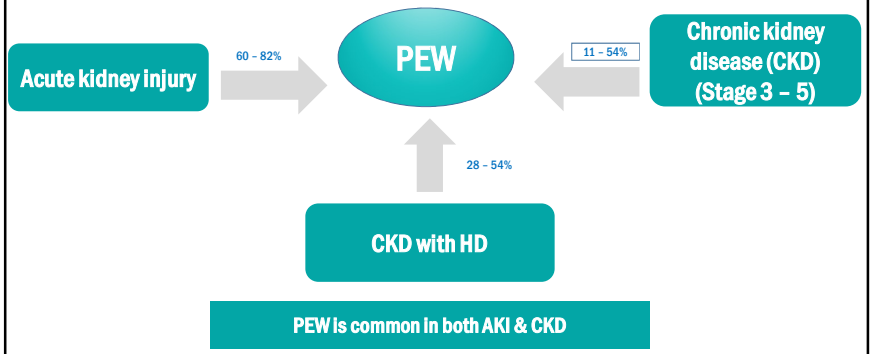
From the General Medical Department, University of Pisa, Italy

THE diet in chronic uræmia has to fulfil two main and conflicting purposes: to lower the production of protein catabolites, and to prevent wastage of body proteins.

A protein-deficient diet, which could reduce the protein catabolites, is considered unwise because of the protein depletion caused; therefore a high-caloric diet, containing about 0·5 g. of protein per kg. body-weight, is generally advocated as the best compromise between the two opposite requirements (Merrill 1960, Goldman 1962). When renal excretory impairment is severe, however, the admin-

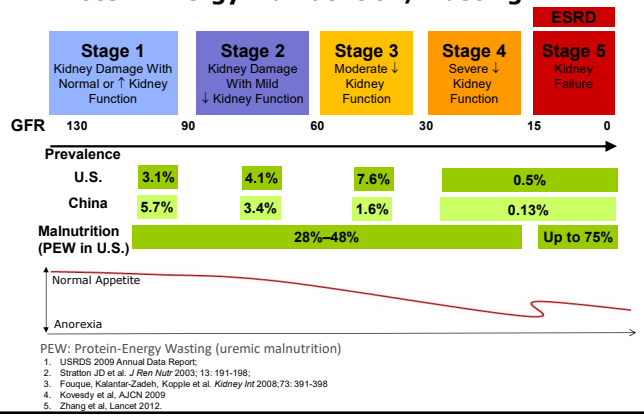
Lancet 1964; 1:100-3

PROTEIN ENERGY WASTING (PEW)



Juan J. C. *et al.*, Global Prevalence of Protein-Energy Wasting in Kidney Disease: A Meta-analysis of Contemporary Observational Studies From the International Society of Renal Nutrition and Metabolism, *Journal of Renal Nutrition* (2018), 28(6):380-392

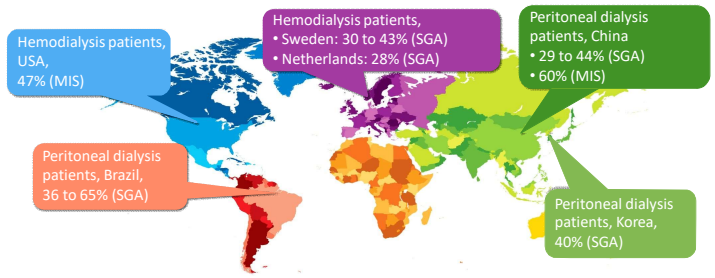
CKD Stages & Protein-Energy Malnutrition/Wasting



PEW: Protein-Energy Wasting (uremic malnutrition)

1. USRDS 2009 Annual Data Report;
2. Stratton JD et al. *J Ren Nutr* 2003; 13: 191-198;
3. Fouque, Kalantar-Zadeh, Kopple et al. *Kidney Int* 2008;73: 391-398
4. Kovesdy et al, AJCN 2009
5. Zhang et al, Lancet 2012.

PEW is present in 30 to 65% or more of dialysis patients around the world



PEW: Protein-Energy Wasting

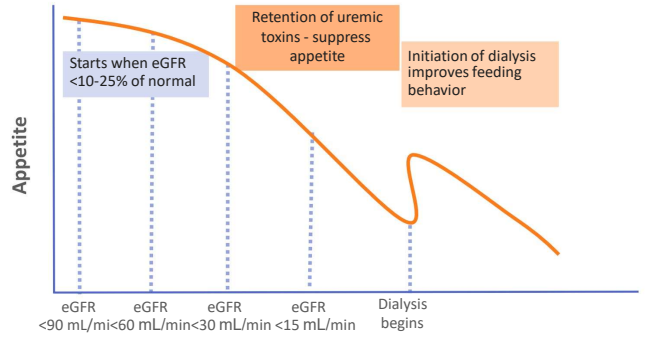
Adapted from TNT Renal

KDOQI CLINICAL PRACTICE GUIDELINE FOR NUTRITION IN CKD: 2020 UPDATE

During **progression of CKD**, the requirements & utilization of different nutrients change significantly. → ultimately place patients with kidney disease at **higher risk for nutritional & metabolic abnormalities.**

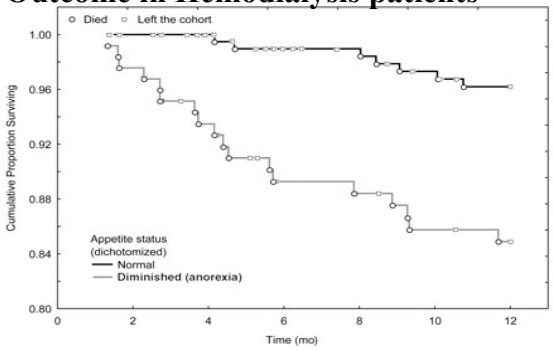
AJKD Vol 76 | Iss 3 | Suppl 1 | September 2020

Appetite decreases as CKD progresses



Carrero JJ. *J Ren Nutr*. 2009;19:10-15.

Appetite and inflammation, Nutrition, Anemia, and Clinical Outcome in Hemodialysis patients



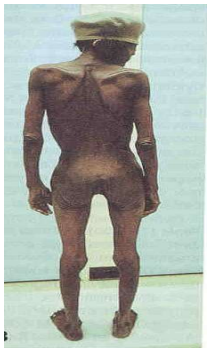
Kaplan-Meier diagram reflecting the cumulative proportion of surviving patients in 2 dichotomized appetite ...

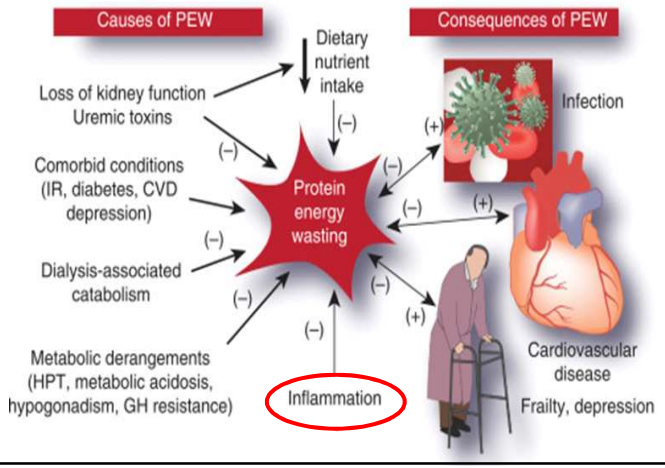
Kamyar Kalantar-Zadeh, et al. *Am J Clin Nutr*, Volume 80, Issue 2, August 2004, Pages 299–307, https://doi.org/10.1093/ajcn/80.2.299

Wasting/Cachexia/Undernutrition

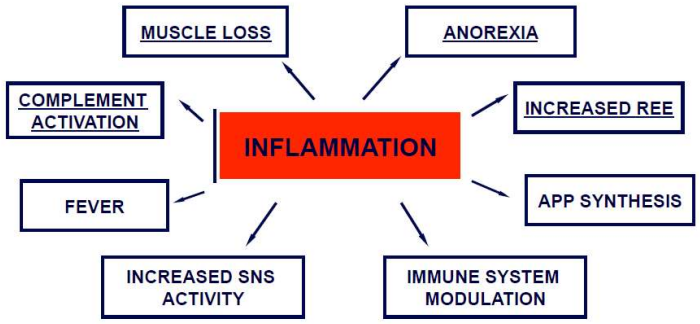
- AIDS: 5-15%
- Cancer: 20-50%
- Old age: 5-25%
- HD>CKD: 5-30%

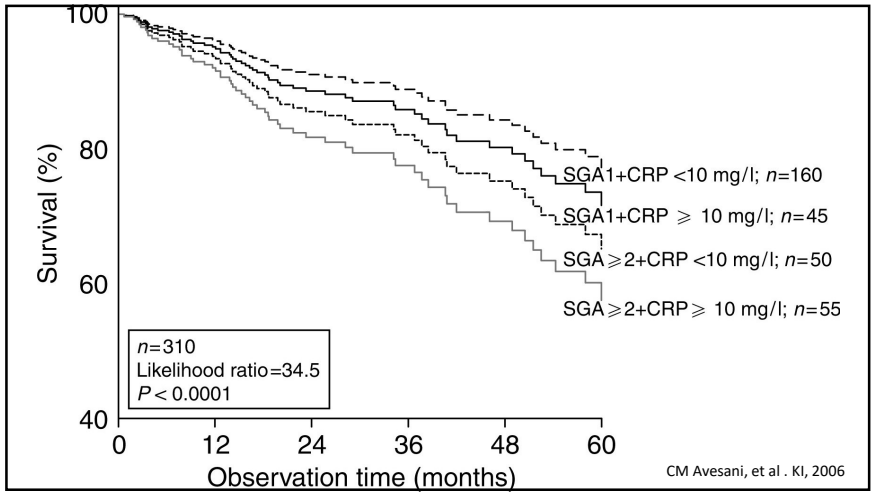
>30% muscle loss
- **Risk of death**
- **Pneumonia**

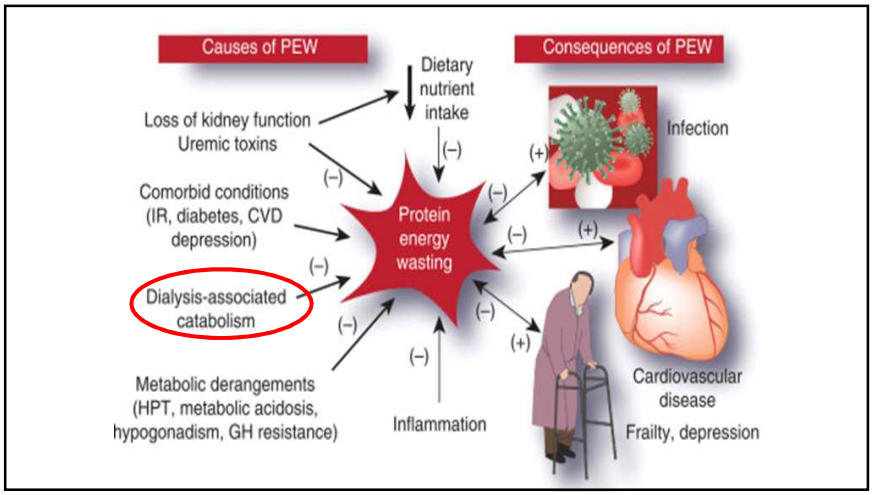


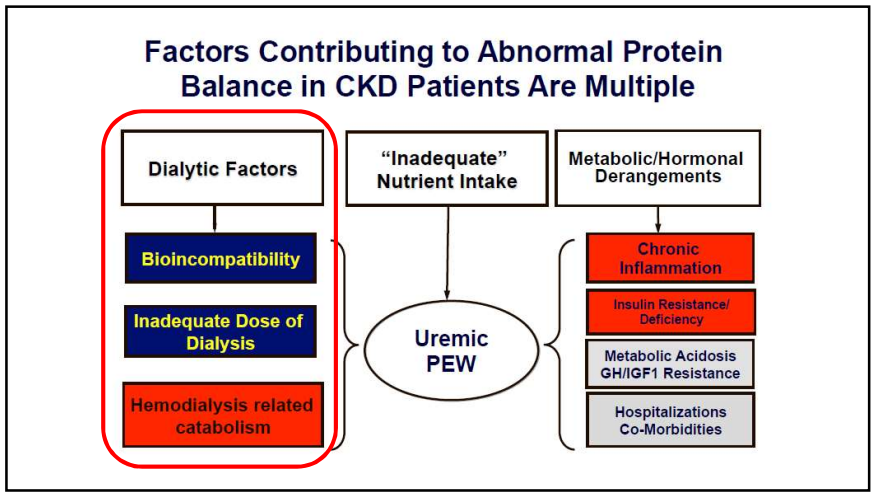


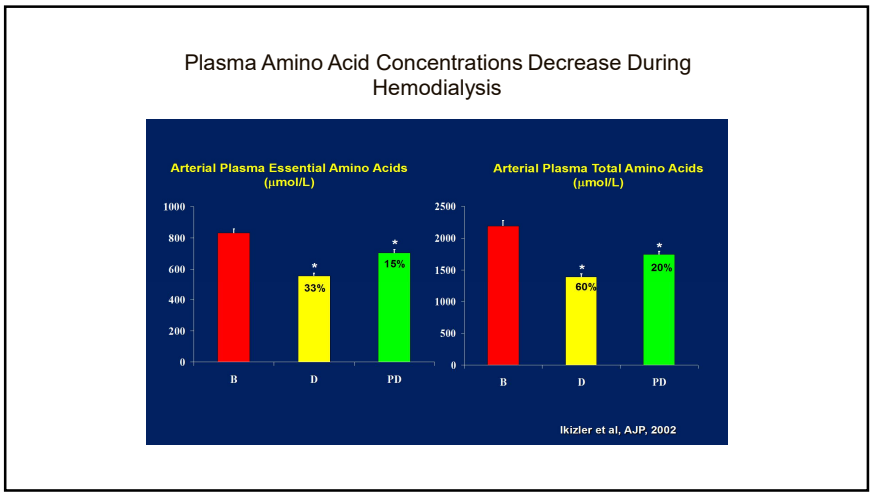
Metabolic Effects of Inflammation



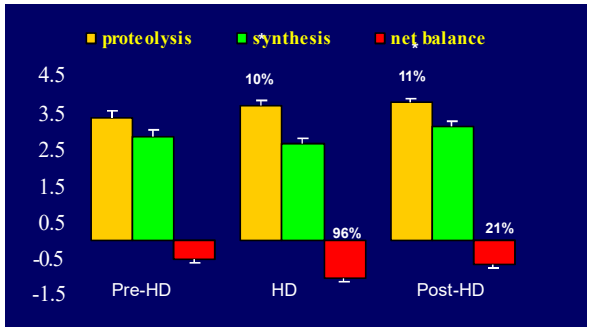

100
80
60
40
Survival (%)
0
12
24
36
48
60
Observation time (months)
SGA1+CRP <10 mg/l; n=160
SGA1+CRP ⩾ 10 mg/l; n=45
SGA⩾2+CRP <10 mg/l; n=50
SGA⩾2+CRP⩾ 10 mg/l; n=55
n=310
Likelihood ratio=34.5
P < 0.0001
CM Avesani, et al . KI, 2006


Causes of PEW
Consequences of PEW
Dietary nutrient intake
Loss of kidney function
Uremic toxins
Comorbid conditions
(IR, diabetes, CVD depression)
Dialysis-associated catabolism
Metabolic derangements
(HPT, metabolic acidosis, hypogonadism, GH resistance)
Protein energy wasting
Inflammation
Infection
Cardiovascular disease
Frailty, depression


Factors Contributing to Abnormal Protein Balance in CKD Patients Are Multiple
Dialytic Factors
Bioincompatibility
Inadequate Dose of Dialysis
Hemodialysis related catabolism
"Inadequate" Nutrient Intake
Metabolic/Hormonal Derangements
Uremic PEW
Chronic Inflammation
Insulin Resistance/ Deficiency
Metabolic Acidosis GH/IGF1 Resistance
Hospitalizations Co-Morbidities

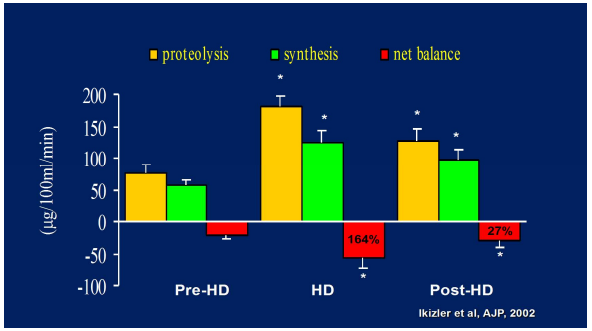

Plasma Amino Acid Concentrations Decrease During Hemodialysis
Arterial Plasma Essential Amino Acids (μmol/L)
Arterial Plasma Total Amino Acids (μmol/L)
1000
800
600
400
200
0
2500
2000
1500
1000
500
0
33%
15%
60%
20%
B
D
PD
Ikizler et al, AJP, 2002

Hemodialysis Causes Net Whole-body Protein Loss



Ikizler et al, AJP, 2002

Hemodialysis Causes Net Skeletal Muscle Protein Loss



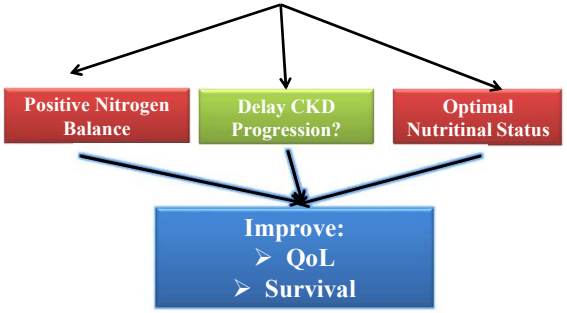
Intradialytic Protein Consumption May Benefit HD Patients

- **Acute protein loss may occur both during and immediately after dialysis** treatment due in part to inflammation, adding up to a **loss of lean muscle mass from 1 to 3 kg/year**.

Tomayko, EJ, et al. *Journal of Renal Nutrition*, May 2015;

MANAGEMENT

Goals
Nutritional intervention in CKD/Dialysis



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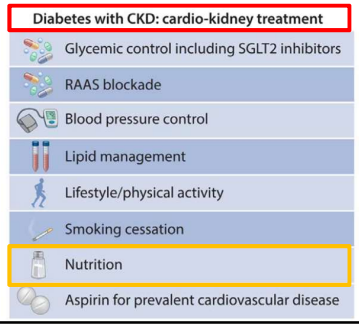
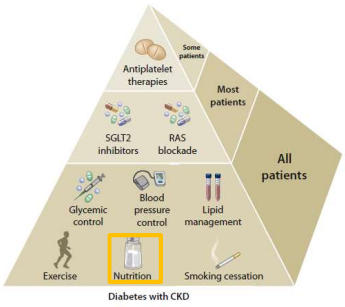
KDIGO 2020 CLINICAL PRACTICE GUIDELINE FOR
DIABETES MANAGEMENT IN CHRONIC KIDNEY DISEASE

KDIGO Clinical Practice Guideline on Diabetes Management in Chronic Kidney Disease OCT 2020

Kidney–Heart Risk Factor Management

1.1 Comprehensive diabetes and CKD management
Practice Point 1.1.1: Patients with **diabetes and chronic kidney disease (CKD) should be treated with a comprehensive strategy** to reduce risks of kidney disease progression and cardiovascular disease





NUTRITION

- Recommendation 3.1.1. We suggest **maintaining protein intake of 0.8 g protein/kg(weight)/day** for those with diabetes and non-dialysis CKD *(2C)*.
- Practice Point 3.1.1. Patients with diabetes and CKD should consume a **diet high in vegetables, fruits, whole grains, fiber, legumes, plant-based proteins, unsaturated fats, & nuts** and **lower in processed meats, refined carbohydrates, & sweetened beverages.**

- *WHO recommends: protein intake of 0.8 g/kg/d for healthy people.*
- *Neither lower nor higher protein intake appears beneficial, and each is associated with potential harms*

KDIGO Clinical Practice Guideline on Diabetes Management in Chronic Kidney Disease 2020

ADA & KDIGO CONCENSUS 2022 ON NUTRITION for PATIENTS WITH T2DM & CKD

Both guidelines recommend

- **Individualized & balanced diets** that are **high in vegetables, fruits, & whole grains** but are **low in refined carbohydrates & sugar-sweetened beverages**
- **Low-sodium diet** (KDIGO <2000 mg/day, ADA 1500 to <2300 mg/day), largely **to control BP & reduce cardiovascular risk.**
- **Targeting a dietary protein intake of 0.8 g/kg/day (** same intake recommended by the WHO for the general population). Higher protein intakes confer **theoretical** risk of enhancing kidney function decline.

American Diabetes Association. ***Standards of Medical Care in Diabetes—2022.*** *Diabetes Care.* 2022; **45**: S1-S264
Kidney Disease: Improving Global Outcomes (KDIGO) Diabetes Work Group **KDIGO 2022 Clinical Practice Guideline for Diabetes Management in Chronic Kidney Disease.** *Kidney Int.* 2022; **102**: S1-S123

ADA & KDIGO CONCENSUS 2022 ON NUTRITION for PATIENTS WITH T2DM & CKD

KDIGO performed a **systematic review** of randomized trials and found **no conclusive evidence** that r**estriction of dietary protein to levels <0.8 g/kg/day improves kidney or other health outcomes** among people with diabetes and/or CKD

- *WHO recommends: protein intake of 0.8 g/kg/d for healthy people.*
- *Neither lower nor higher protein intake appears beneficial, and each is associated with potential harms*

American Diabetes Association. ***Standards of Medical Care in Diabetes—2022.*** *Diabetes Care.* 2022; **45**: S1-S264
Kidney Disease: Improving Global Outcomes (KDIGO) Diabetes Work Group **KDIGO 2022 Clinical Practice Guideline for Diabetes Management in Chronic Kidney Disease.** *Kidney Int.* 2022; **102**: S1-S123

NUTRITION: Why protein intake of 0.8 g ?

- Patients who are in **advanced CKD** may naturally **decrease their oral intake → malnutrition**.
- Limiting protein intake < 0.8 g/kg/d in a person with diabetes, who also may have been counseled to limit carbohydrates, fat, and alcohol →↓ caloric content of the diet → significant weight loss →↓ quality of life
- **Protein intake** on a diabetic diet is **especially crucial to avoid episodes of hypoglycemia**

KDIGO Clinical Practice Guideline on Diabetes Management in Chronic Kidney Disease 2020

NUTRITION: Why Plant-based protein ?

Observational studies:

- High consumption of red and processed meat is associated with increased risk of CKD progression & mortality,
- **Plant-based protein, fruits & vegetable intake were associated with decline in progression of kidney disease**

KDIGO Clinical Practice Guideline on Diabetes Management in Chronic Kidney Disease 2020

NUTRITION

- Dietary recommendations should take into account individual nutrition needs (age, weight, physical activity, and comorbidities),
- **Higher protein diet at early stages to allow for a reduction of carbohydrates to better manage their diabetes.**

KDIGO Clinical Practice Guideline on Diabetes Management in Chronic Kidney Disease 2020

NUTRITION

Nutrition therapy can decrease HbA1c levels at levels similar to, or better than, antihyperglycemic medications.

KDIGO Clinical Practice Guideline on Diabetes Management in Chronic Kidney Disease 2020

Effect of Dietary Proteins and Amino Acids on the Immune System

- **Amino acids: key regulators of various pathological and physiological processes, including immune responses**
  - Important role in (+) immune response + ↓ over-reaction (inflammation and autoimmunity)
  - Regulate the activation of T and B lymphocytes, macrophages, NK cells,
  - Production of antibodies & cytokines.
  - Glutamine, arginine, tryptophan, cystine/cysteine, glutamate, histidine, and **branched-chain amino acids** are **important for immune function**.
-

Ali Chaari et al(2020). *Public Health,* 27 August 2020 | https://doi.org/10.3389/fpubh.2020.00476

Interventions to Prevent and/or Treat Protein Energy Wasting In Advanced Chronic Kidney Disease

- ✓ *Nutritional Supplementation*
  - ✓ *Oral supplementation*
  - ✓ *Intradialytic parenteral nutrition (IDPN)*
- ✓ Exercise
- ✓ Anabolic Hormones
- ✓ Other targets:
  - ✓ *Insulin resistance/DM*
  - ✓ *Inflammation*

Optimal Nutrition for Dialysis Patients

The etiology of Uremic Protein Energy Wasting Syndrome is multi-factorial (as in most chronic disease states)

↓ dietary intake + *HD-associated catabolism* + Inflammation + Insulin resistance -> wasting in CHD patients -> ↑ mortality and morbidity

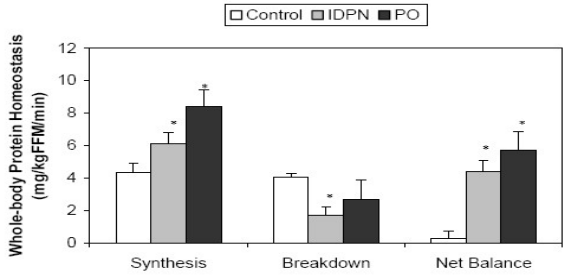
Nutritional Interventions -> convenient and safe;

IDPN and Oral supplements can partially reverse the HD-induced catabolism (primarily by replenishing the amino acid pool).

Observational studies indicate survival benefit in dialysis patients receiving intradialytic nutritional supplementation

Intradialytic Nutrition (Oral or Parenteral)

Leads to Robust Whole-Body Protein Anabolism

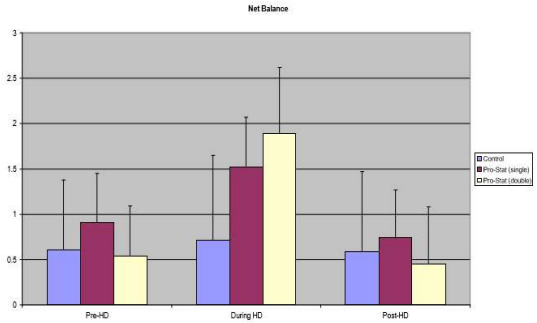


* P<0.05 versus Control, # P<0.05 versus PO

J Am Soc Nephrol 17: 3149–3157, 2006.

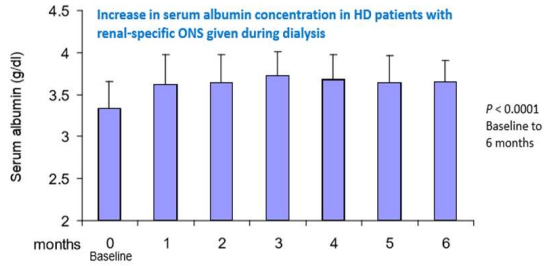
Oral Protein Supplementation Alone Improves Anabolism in a Dose-Dependent Manner in Chronic Hemodialysis Patients

Mary B. Sundell, RD,* Kerri L. Cavanaugh, MD, MHS,* Pingsheng Wu, PhD, MS,† Ayumi Shintani, PhD, MPH,† Raymond M. Hakim, MD, PhD,*‡ and T. Alp Ikizler, MD*



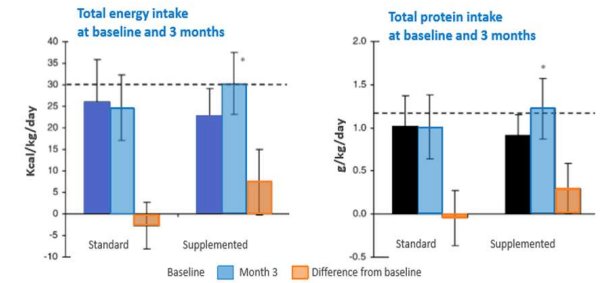
Journal of Renal Nutrition, Vol 19, No 5 (September), 2009: pp 412–421

Serum albumin, prealbumin, and SGA scores increase with renal-specific ONS



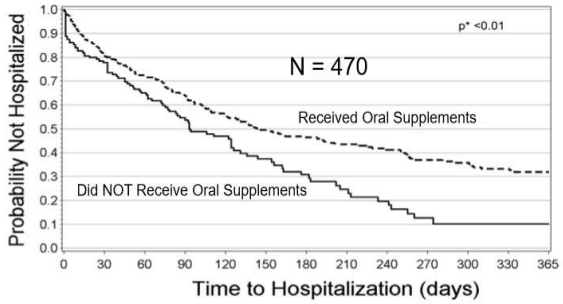
Caglar K, et al. Kidney Int. 2002;62:1054-1059.

Renal-specific ONS increased intake energy and protein intake



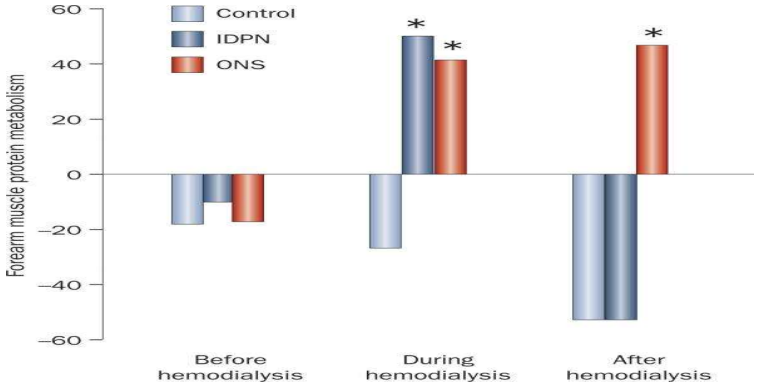
Fouque D, et al. *Nephrol Dial Transplant.* 2008;23:2902-2910.

Receipt of Oral Supplements is Associated with Improved Hospitalization in MHD Patients



Cheu C et al. CJASN 2012

Diets and enteral supplements for improving outcomes in CKD



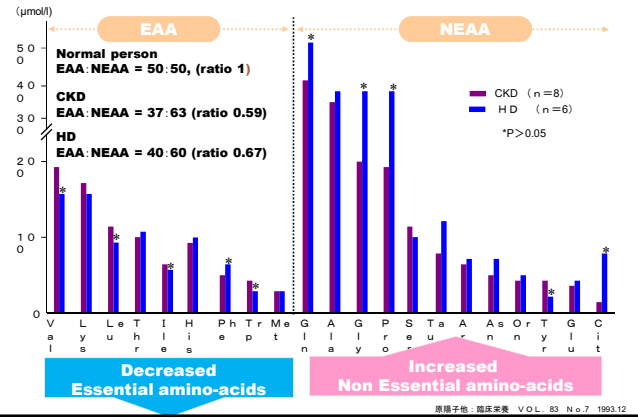
Ikizler TA.Clin J Am Soc Nephrol. 2013 Dec;8(12):2174-82. doi: 10.2215/CJN.04630513. Epub 2013 Aug

Key Aspects in Nutritional Management of COVID-19 Patients

- Besides **quantity, the quality of proteins (protein with high biologic value)** is also an **important factor** with regard to the **relationship of this macronutrient with immune system.**

Fernández-Quintela A, et al.(2020) Key aspects in nutritional management of COVID-19 patients. Journal of clinical medicine. 2020 Aug;9(8):2589.

Aminogram of CKD (plasma)



原晴子他：臨床栄養 VOL. 83 No.7 1993.12

Nutrient Needs of CKD Patients as Defined by ESPEN Guidelines*

Condition	Protein (Essential and Non-essential Amino Acids)	Macronutrients Energy (non-protein calories)
Non-dialysis CKD patients		
GFR = 25-70 mL/min	0.55-0.60[b] (2/3 HBV)	30-40 kcal/kg/d[a]
GFR < 25 mL/min	0.55-0.60 (2/3 HBV) or 0.28+EAA or EAA+KA	
Hemodialysis	1.2-1.4 (>50% HBV)	35 kcal/kg/day
CAPD	1.2-1.5 (>50% HBV)	-

GFR = glomerular filtration rate; HBV = high biological value; EAA = essential amino acids; KA = ketoanalogues. CAPD=Continuous ambulatory peritoneal dialysis.
[a]Adapted to catabolism levels and to individual needs in case of underweight or obesity.
[b]Adjust as necessary for obese patients.
Cano NJ, et al. *Clin Nutr.* 2009;28(4):401–414.

WHICH AMINO ACID FOMULAR IS SUITABLE FOR KIDNEY FAILURE?

ESPEN

Table 3
Recommendations for protein supply in adult patients with non-dialysis CKD (g/kg/day).[45,123]

	ESPEN	NKF
GFR = 25–70 ml/min	0.55–0.60 (2/3 HBV)	–
GFR < 25 ml/min	0.55–0.60 (2/3 HBV) or 0.28 + EAA or EAA + KA[a]	0.60 or 0.75 (intolerance or inadequate energy intake)

ESPEN, European Society for Clinical Nutrition and Metabolism; NKF, National Kidney Foundation; EAA, essential amino acids; GFR, glomerular filtration rate; HBV, high biological value; KA, ketoanalogues.

Recommend solution with high biological value amino acid: ≥ 50%

National Kidney Foundation®

Table 5
Recommendations for protein and energy supply in adult patients on routine hemodialysis and CAPD.[12,13]

	ESPEN	NKF	EBPG-ERA[a]
Protein intake, g/kg/day			
Hemodialysis	1.2–1.4 (>50% HBV)	1.2 (>50% HBV)	≥1.1
CAPD	1.2–1.5 (>50% HBV)	1.2–1.3 (>50% HBV)	–
Energy intake, kcal/kg/day			
Hemodialysis	35	<60 y: 35	30–40, adjusted to age, gender and activity
CAPD[a]		<60 y: 30	–

ESPEN: European Society of Parenteral and Enteral Nutrition. NKF: National Kidney Foundation. CAPD: chronic ambulatory peritoneal dialysis.
[a] Including energy supply (glucose) from dialysis.

N.J.M. Cano *et al.*, ESPEN Guidelines on Parenteral Nutrition: Adult Renal Failure, *Clinical Nutrition 28* (2009) 401–414.

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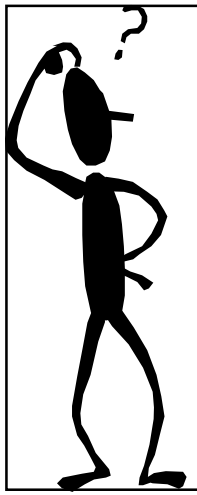
Key Aspects in Nutritional Management of COVID-19 Patients

- **Proteins of high biological value** (those present in eggs, lean meat, fish, & dairy) **containing all the essential amino acids may exert an anti-inflammatory effect**.
- In addition, some amino acids, such as **arginine & glutamine are well known for their ability to modulate the immune system**

Fernández-Quintela A, Milton-Laskibar I, Trepiana J, Gómez-Zorita S, Kajarabille N, Léniz A, González M, Portillo MP. Key aspects in nutritional management of COVID-19 patients. Journal of clinical medicine. 2020



Protein Synthesis

Requires 20 Amino Acids

ESSENTIAL (Cannot be synthesized in the body; must be supplied from the diet)

- **Leucine**
- **Valine**
- **Isoleucine**
- **Methionine**
- **Tryptophan**
- **Lysine**
- **Threonine**
- **Phenylalanine**
- **Histidine**

Provided from out-of-body sources

NON-ESSENTIAL (Can be synthesized through intermediary metabolism)

- Alanine
- Aspartic Acid
- Cysteine
- Serine
- Asparagine
- Tyrosine
- Glutamic Acid
- Glycine
- Proline

CONDITIONALLY ESSENTIAL (During hypermetabolic catabolism)

- Glutamine
- Arginine

Borum PR. Nutrient metabolism. In *The Science and Practice of Nutrition Support. A Case-Based Core Curriculum.* Silver Spring, MD, *ASPEN* 2001; pp 17-30.

Nutritional Therapy in COVID-19 Patients

Protein needs:

- **Higher** due to the **protein catabolism driven by inflammatory mediators**.
- **1 g protein/kg body weight/day in older people**
- **1.3 g protein/kg body weight/day**
- Other authors: ↑ **1.5 g protein/kg body weight/day**,
- **Increased supply of branched chain amino acids (up to 50% in polymorbid medical inpatients)**, in order **to prevent muscle loss and to strength respiratory muscles**
- Amounts **individually adjusted** with regard to **nutritional status, disease status, & tolerance.**

Caccialanza, R.; et al. Early nutritional supplementation in non-critically ill patients hospitalized for the 2019 novel coronavirus disease (COVID-19): Rationale and feasibility of a shared pragmatic protocol. *Nutrition* **2020**, *74*, 110835, doi:10.1016/j.nut.2020.110835.- Gomes, F.; et al(2019). Association of nutritional support with clinical outcomes among medical inpatients who are malnourished or at nutritional risk: An updated systematic review and meta-analysis. *JAMA Netw. Open* **2019**, *2*, e1915138, doi:10.1001/jamanetworkopen.2019.15138. - Romano, L.; et al. Short Report-Medical nutrition therapy for critically ill patients with COVID- 19. *Eur. Rev. Med. Pharmacol. Sci.* **2020**, *24*, 4035–4039. - Volkert, D.; et al. ESPEN guideline on clinical nutrition and hydration in geriatrics. *Clin. Nutr.* **2019**, *38*, 10–47.

Abnormal plasma BCAA

↓

Disturbances in organ AA exchanges

↓

Organ dysfunction.

Lue Cynober et al. *J. Nutr. January 2006 vol. 136 no. 1 299S-307S*

Abnormal plasma BCAA

↓

Disturbances in organ AA exchanges

↓

Organ dysfunction.

↓

BCAA supplements

↓

Improve plasma AA, nutritional status & Organ function

Lue Cynober et al. *J. Nutr. January 2006 vol. 136 no. 1 299S-307S*

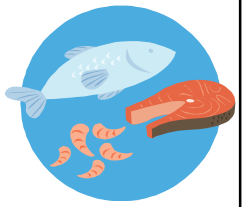
Protein Problem in CKD/DIALYSIS patients

People having dialysis treatment should include "high quality" protein foods in the diet.

Foods containing protein used easily by the body & should be **eaten at least twice per day**.

- **Meat**
- **Chicken**
- **Fish**
- Eggs
- **Milk and dairy food**
- Nuts, beans, veggies, and cereal foods, but in lower amounts.

➢ **Anorexia/Appetite**
➢ **↑↑ PHOSPHATE**



✓ **When GFR < 10ml/min → CKD Pts themselves ↓protein intake < 0,6g/kg/day.**

Characteristic

-Essential Amino Acids for Renal Failure- AMIYU® Granules

- **Improvement clinical symptom and the delay of disease aggravation.**
- **Decreased blood urea nitrogen and the ratio of blood urea nitrogen/serum creatinine.**
- **Increased total protein and albumin.**
- **Increased red blood cells and hemoglobin.**
- **Elevated hematocrit level and improving anemia.**

Content

Active Ingredients	Content per 2.1236mg EAA per sachet
L-isoleucine	203.9 mg
L-leucine	320.3 mg
L-lysine hydrochloride	291.0 mg
L-methionine	320.3 mg
L-phenylalanine	320.3 mg
L-threonine	145.7 mg
L-tryptophan	72.9 mg
L-valine	233.0 mg
L-histidine hydrochloride	216.2 mg
Amino acids total	2123.6 mg

PROSOURCE (No Sugar)

EAAs	Non-EAAs
1. Histidine 2.1g	1. Alanine 3.7g
2. Isoleucine 8g	2. **Arginine 2.6g**
3. Leucine 9.7g5.	3. Aspartic acid 9.3g
4. Lysine 8.6g	4. Cystine 2.1g
5. Methionine 2.2g	5. **Glutamic acid 16,9g**
6. Phenylalanine 3.3g	6. Glycine 1.9g
7. Threonine 6.1g	7. Proline 6.7g
8. Trytophan 1.5g	8. Serine 5.1g
9. Valine 5.6g	9. Tyrosine 3.4g

No sugar, No Odor
No containing gluten
No photphorus, No Potassium, No carbohydrate, Easily dissolved in water, coffee, fruit juice, soupng mô chất lỏng như: **nước ép, cà phê, cháo, soup, other milks**.
Tiêu chuẩn **chất lượng axit amin PDCAAS100**

RENAMENT (with sugar)

- **Low Potassium**
- **Low Sodium**
- **Low Photphorus**

ONCE Dialyze®

Các chất	Phân bố năng lượng	Thành phần	g./ONCE Dialyze 100 g.
Protein	18%	Calcium Caseinate	8,52
		Sodium Caseinate	6,46
		Đạm Whey phân lập	6,25
Carbohydrates	42%	Maltodextrin	17,01
		Isomaltulose	28,11
		Fibersol-2	2,81
		Fructooligosaccharide	3,44
Chất béo	40%	Dầu cải	5,00
		Dầu cây rum	2,50
		MCT oil	6,56
		Dầu cám gạo	6,50
Vitamin			0,08
Khoáng chất			1,18

KDOQI CLINICAL PRACTICE GUIDELINE FOR NUTRITION IN CKD: 2020 UPDATE

Oral Protein-Energy Supplementation

- 4.1.1 In adults with **CKD 3-5D (2D) or posttransplantation** (OPINION) at risk of or with protein-energy wasting, we suggest a **minimum of a 3-month trial of oral nutritional supplements to improve nutritional status** if dietary counseling alone does not achieve sufficient energy and protein intake to meet nutritional requirements.

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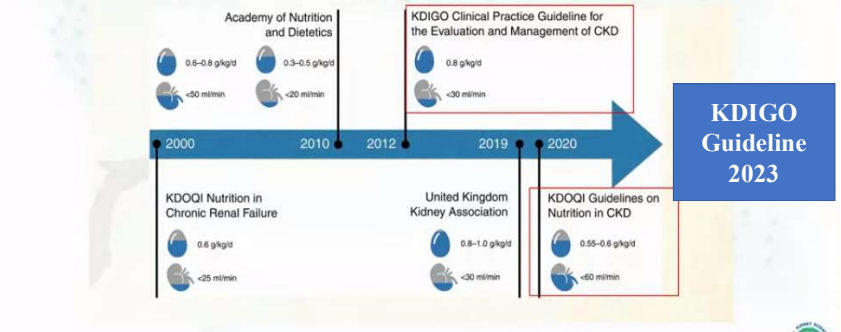
OLD GUIDELINES PROTEIN RESTRICTION IN CKD



ERA-EDTA CONGRESS, JUN 15-18, 2023, MILAN. ITALY

Obeid et al, Kidney 360, 2022

KDIGO (July 2023)

3.3. Diet

Practice Point 3.3.1: Advise people with CKD to adopt healthy and diverse diets with a higher consumption of plant-based foods compared to animal-based foods and a lower consumption of ultra-processed foods.

Practice Point 3.3.2: Use registered dieticians or accredited nutrition providers to provide information for people with CKD about dietary adaptations regarding sodium, phosphorus, potassium, and protein intake, tailored to their individual needs, and severity of CKD and other comorbid conditions, where available.

3.3.1. Protein intake

Recommendation 3.3.1.1: We suggest maintaining a protein intake of 0.8 g/kg/day in adults with CKD G3–G5 (2C).

Practice Point 3.3.1.1: Do not restrict protein intake in adults with sarcopenia, cachexia, or conditions that result in undernutrition.

Practice Point 3.3.1.2: Avoid high protein intake (>1.3 g/kg/day) in adults with CKD at risk of progression.