



ΕΛΛΗΝΙΚΗ ΝΕΦΡΟΛΟΓΙΚΗ ΕΤΑΙΡΕΙΑ
HELLENIC SOCIETY OF NEPHROLOGY

25^ο Πανελλήνιο
Συνέδριο

19-21 ΙΟΥΝΙΟΥ 2024

ΝΕΦΡΟΛΟΓΙΑΣ



Διαιτητικές οδηγίες στη ΧΝΝ

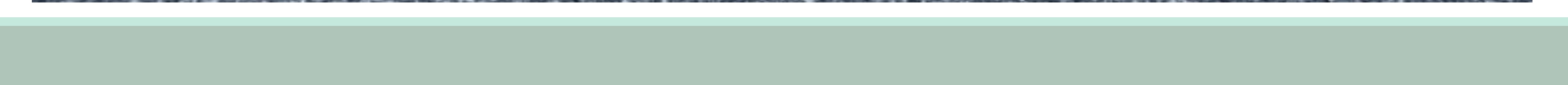
ΔΙΒΑΝΗ ΜΑΡΙΑ
MD, MSc, PhD
Επιμελήτρια Β' – Γ.Ν. Λάρισας

Αθήνα 19-21 Ιουνίου 2024

ΔΙΑΤΡΟΦΙΚΟΙ ΘΕΡΑΠΕΥΤΙΚΟΙ ΣΤΟΧΟΙ ΣΤΗ ΧΝΝ

ΣΤΟΧΟΣ

- Έλεγχος ηλεκτρολυτών και υγρών
- Αντιμετώπιση της μεταβολικής οξέωσης – ουραιμίας
- Πρόληψη ΚΔΑ νόσου και ΑΥ
- Καθυστέρηση της εξέλιξης της νεφρικής νόσου
- Πρόληψη νεφρικής οστεοδυστροφίας
- Διατήρηση ιδανικού θρεπτικού προφίλ
- Αποφυγή υποθρεψίας /υπολευκωματιναιμίας– PEW syndrome



Sodium

FDA (healthy adults): Americans eat on average about 3,4 gr Na⁺ /d

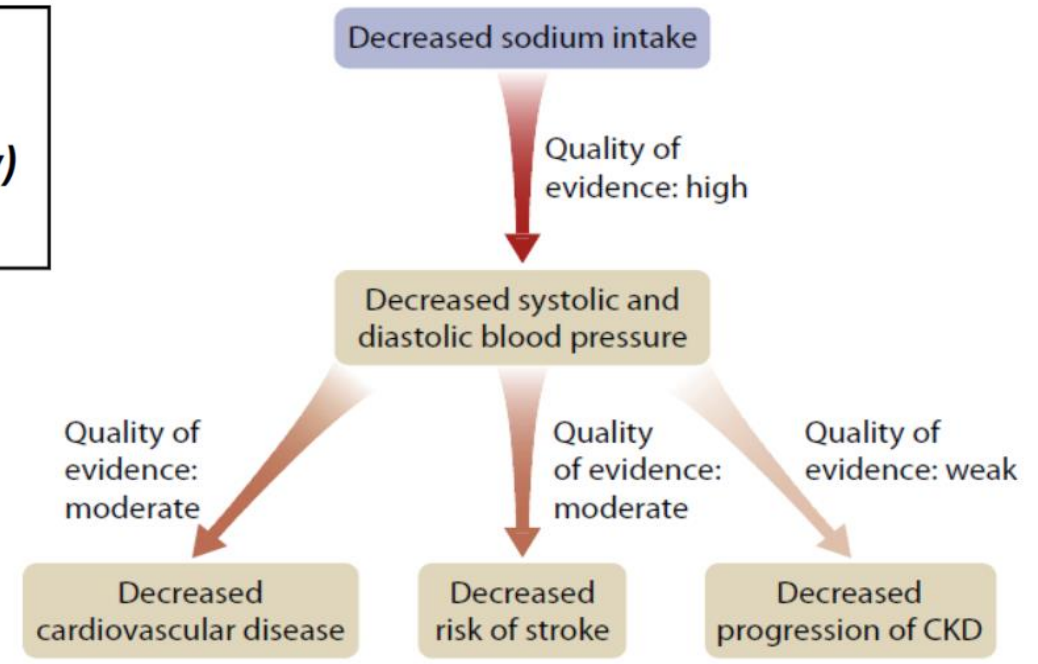
1 tsp salt = 2,3 gr Na⁺



1 g salt (NaCl) → 400 mg Na⁺
1 g Na⁺ = 43 mmol

Guidelines CKD

Recommendation 3.1.2: We suggest that sodium intake be <2 g of sodium per day (or <90 mmol of sodium per day, or <5 g of sodium chloride per day) in patients with diabetes and CKD (2C).



Effects of decreased sodium intake on various outcomes and accompanying quality of evidence.

Περιορισμός Na⁺ και AK



- Αποφυγή μεγάλης αύξησης βάρους μεταξύ των συνεδριών AK (Αποφυγή πνευμονικού οιδήματος και υποτασικών επεισοδίων κατά την AK)
- Μικρότερο Intra Dialytic Weight gain (IDW) μπορεί να επιτευχθεί ευκολότερα με οδηγίες περιορισμού του Na⁺ παρά με περιορισμό του ύδατος
- Περιορισμός του Na⁺ σε 1 gr/d με ελεύθερη κατανάλωση ύδατος οδήγησε σε μικρότερη αύξηση βάρους μεταξύ των συνεδριών AK (1.9 vs 2.8 Kg) Rigbi-Mathews JASN 1999
- Δύσκολη συμμόρφωση των ασθενών
- Απαιτούνται **4-6 εβδομάδες** για να μειωθεί ο ουδός γεύσης για το αλάτι

Προτιμούμε φρέσκα τρόφιμα

Περίπου το 40% της πρόσληψης Na+ προέρχεται από επεξεργασμένα/προπαρασκευασμένα τρόφιμα

Αποφεύγουμε την κατανάλωση:

- τουρσιά
- επεξεργασμένα
- Κονσερβοποιημένα, συσκευασμένα
- Έτοιμα δημητριακά πρωινού, μίγματα
- Αλμυρά τυριά
- Αλμυρούς ξηρούς καρπούς

Αποφύγετε τα υποκατάστατα αλατιού (χλωριούχο κάλιο)

Δώστε γεύση με μπαχαρικά, ξύδι, χυμό λεμονιού, πιπέρι

Ετικέτες!

Check the Package for Nutrient Claims

You can also check for nutrient claims on food and beverage packages to quickly identify those that may contain less sodium. Here's a guide to common claims and what they mean:

What It Says	What It Means
Salt/Sodium-Free	Less than 5 mg of sodium per serving
Very Low Sodium	35 mg of sodium or less per serving
Low Sodium	140 mg of sodium or less per serving
Reduced Sodium	At least 25% less sodium than the regular product
Light in Sodium or Lightly Salted	At least 50% less sodium than the regular product
<u>No-Salt-Added or Unsalted</u>	No salt is added during processing – but these products may not be salt/sodium-free unless stated

Potassium



Potassium

- Η χορήγηση τροφών αυξημένης περιεκτικότητας σε K^+ (και χαμηλής σε Na^+) βοηθούν στη ρύθμιση της ΑΠ
- Πέντε κουζίνες ιδρυμάτων φροντίδας ηλικιωμένων τυχαιοποιήθηκαν ώστε να χρησιμοποιούν αποκλειστικά KCl ή $NaCl$ για την παρασκευή του φαγητού
- ❖ Η καρδιαγγειακή θνητότητα σε διάστημα 31 μηνών ήταν σημαντικά μικρότερη στην ομάδα των ηλικιωμένων που κατανάλωναν KCl (O.R.=0,59)

Sodium intake and CKD

NHANES: n= 13,917, cross-sectional study, mean age: 45 y, mean GFR: 88 ml/min/1.73m²

Lowest (≤ 2116 mg/d) vs Highest (> 4267 mg/d) sodium intake

- Lowest intake: 21% ↓ risk of CKD incidence

Sodium intake, mg/day	$\leq 2,116$	2,117–3,061	3,062–4,267	$> 4,267$
Unadjusted	1.00 (ref.)	0.77 (0.66–0.90)	0.52 (0.44–0.61)	0.46 (0.40–0.53)
Model 1	1.00 (ref.)	0.84 (0.71–0.99)	0.67 (0.54–0.82)	0.77 (0.64–0.92)
Model 2	1.00 (ref.)	0.85 (0.71–1.02)	0.68 (0.55–0.85)	0.79 (0.66–0.96)

Model 1: adjusted for age, sex, race/ethnicity, BMI, diabetes and hypertension. Model 2: adjusted for covariates in model 1 plus CHF and CVD.

Potassium intake and CKD


Lowest (≤ 1700 mg/d) vs Highest (> 3342 mg/d) potassium intake

- Lowest intake: 44% ↑ risk of CKD incidence

Potassium intake, mg/day	$\leq 1,737$	1,737–2,455	2,455–3,341	$> 3,342$
Unadjusted	1.72 (1.39–2.12)	1.59 (1.30–1.94)	1.22 (1.00–1.49)	1.00 (ref.)
Model 1	1.51 (1.20–1.88)	1.21 (0.98–1.49)	1.01 (0.81–1.27)	1.00 (ref.)
Model 2	1.44 (1.16–1.79)	1.19 (0.97–1.46)	1.00 (0.80–1.24)	1.00 (ref.)

Model 1: adjusted for age, sex, race/ethnicity, BMI, diabetes and hypertension. Model 2: adjusted for covariates in model 1 plus CHF and CVD.


Potassium Bioavailability of Plant vs Non-Plant Foods



Plant-based foods

Absorption rate
50%–60%


Plant-based foods may have low absorption rate, net alkalinizing effect, and carbohydrate content encourages K⁺ shifts into intracellular space, minimizing impacts on serum K⁺



Animal-based foods

Absorption rate
70%–90%

Animal-based protein has higher absorption and net acid effect results in higher amounts of K⁺ remaining in serum



Processed foods

Absorption rate
90%

Potassium salts (often found in processed foods) absorption rate has been reported to be 90%

Table VII. Urinary excretion of sodium and potassium as a percentage of intake.

	Low bioaccessible diet	High bioaccessible diet	Low bioaccessible diet – high bioaccessible diet
Potassium	76.87 ± 2.77	96.33 ± 1.60	-19.46* ± 2.90 (-25.92, -13.00)
sodium	89.09 ± 2.87	95.62 ± 3.58	-6.53 ± 4.88 (-17.40, 4.33)

20% more potassium was absorbed in the high bioaccessible diet

EVOLUTION OF POTASSIUM RECOMMENDATIONS



- Dietary restriction (2000-3000 mg potassium per day)
- White grains, animal based meats, low fruits and vegetables intake



- Potassium intake is **individualized**
- Whole grains, plant-based eating, high fruits and vegetables intake (**bioavailable potassium**)

THEN

NOW

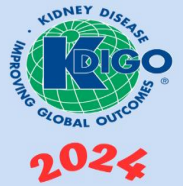
Potassium

USDA (healthy adults): mean K⁺ intake: 4.7 gr/d

Guidelines

Academy of Nutrition and Dietetics
CKD 3-5 K ⁺ < 2.4 gr/d

K/DOQI
CKD 1-2: K ⁺ > 4 gr/d CKD 3-5: K ⁺ 2-3 gr/d



3.11.5 Dietary considerations

Practice Point 3.11.5.1: Implement an individualized approach in people with CKD G3–G5 and emergent hyperkalemia that includes dietary and pharmacologic interventions and takes into consideration associated comorbidities and quality of life (QoL). Assessment and education through a renal dietitian or an accredited nutrition provider are advised.

Practice Point 3.11.5.2: Provide advice to limit the intake of foods rich in bioavailable potassium (e.g., processed foods) for people with CKD G3–G5 who have a history of hyperkalemia or as a prevention strategy during disease periods in which hyperkalemia risk may be a concern.

Academy of Nutrition and Diabetics. CKD Guideline 2010. www.andeal.org
National Kidney Foundation 2004. http://www.kidney.org/professionals/kdoqi/guidelinesupdates/doqi_nut.html
USDA Dietary Guidelines 2015-2020. <https://health.gov/dietaryguidelines/2015/guidelines/appendix-7/>

Dietary Approaches to Hyperkalemia



HFA
Heart Failure
Association
European Society of Cardiology



What to Recommend to Patients:

A Balanced Diet is Important:



Balanced diet with fruits, vegetables, legumes, whole grains (base-producing, insulin-stimulating, high fiber content: ↓ K⁺ bioavailability)



Limit processed meat (acid-producing: ↑K⁺ bioavailability)



There are no "good" and "bad" foods. Encourage portion control, promote whole foods

Food Preparation Affects K⁺ content:



Foods w/ preservatives or additives, salt substitutes, and some supplements are high in K⁺



Double boiling (discard cooking water) decreases K⁺ content



Limit ultraprocessed foods – they often contain K⁺ additives



Drying food concentrates K⁺

Other Considerations:



Control blood sugar and acidosis



Refer to dietitian for individualized nutrition care for patients with advanced CKD

Potassium Misconceptions:

Myth 1: Restricting dietary K⁺ is useful to prevent hyperkalemia

- *What we now know: Dietary K⁺ intake does not correlate well with serum K⁺ but serum K⁺ may be transiently elevated after high K⁺ meal*
- *Therefore, avoid extreme restriction of dietary K⁺*

Myth 2: Avoid fruits and vegetables – the main sources of dietary K⁺

- *What we now know: K⁺ is ubiquitous – meat, dairy, whole grains, legumes, and additives in processed foods are also significant sources²*
- *Despite K⁺ content, bioavailability varies depending on the food source*

3.11.2 Potassium exchange agents

Practice Point 3.11.2.1: Be aware of local availability or formulary restrictions with regard to the pharmacologic management of nonemergent hyperkalemia.

1. JREN 2020; 30(4): 276-285.

2. Kidney360 2020. 1 (1) 65-71.

3. AJKD Suppl 1: S1-S107.

4. JREN 2021; 31(2): 210-214.

5. <http://www.bcrenal.ca/resource-gallery/Documents/Management%20of%20Constipation%20in%20Patients%20with%20Chronic%20Kidney%20Disease.pdf>

Calcium



Guidelines

Academy of Nutrition and Dietetics	K/DOQI	KDIGO
CKD 3-5 total calcium intake ≤ 2.000 mg/d	CKD 3-5 total calcium intake ≤ 2.000 mg/d (OPINION)	No limits for dietary calcium intake

Academy of Nutrition and Diabetics. CKD Guideline 2010. www.andeal.org
National Kidney Foundation 2004. http://www.kidney.org/professionals/kdoqi/guidelinesupdates/doqi_nut.html
KDIGO 2012. http://www.kdigo.org/clinical_practice_guidelines/pdf/CKD/KDIGO_2012_CKD_GL.pdf

Balance in CKD 3-4

N=12 (6 control, 6 treatment), 48 hr inpt, 800mg vs 2.000mg Ca⁺ + diet

800 mg/dl calcium intake

- Neg to neutral calcium balance

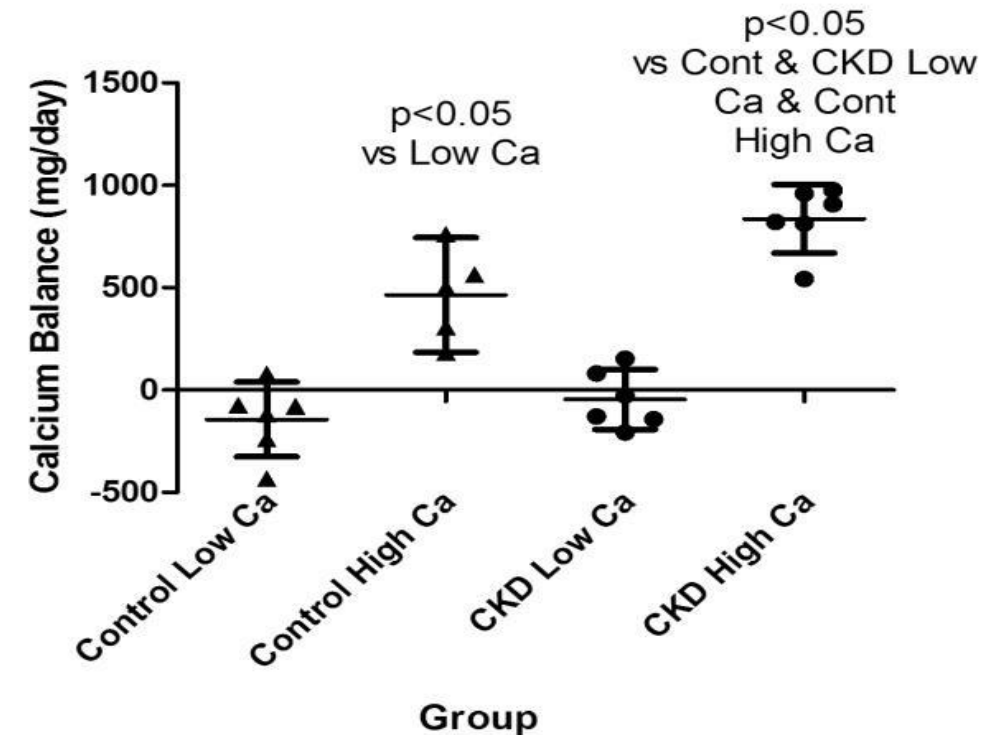
> 2.000 mg/dl calcium intake

- **Positive calcium balance** without ↓ in calcium absorption or ↑ in serum or urine calcium
- **Excess calcium deposition in tissue**



- Καλσιφύλαξη
- Οστική νόσος
- Επασβέστωση μέσου χιτώνα των αγγείων

↓
Αυξημένη θνητότητα



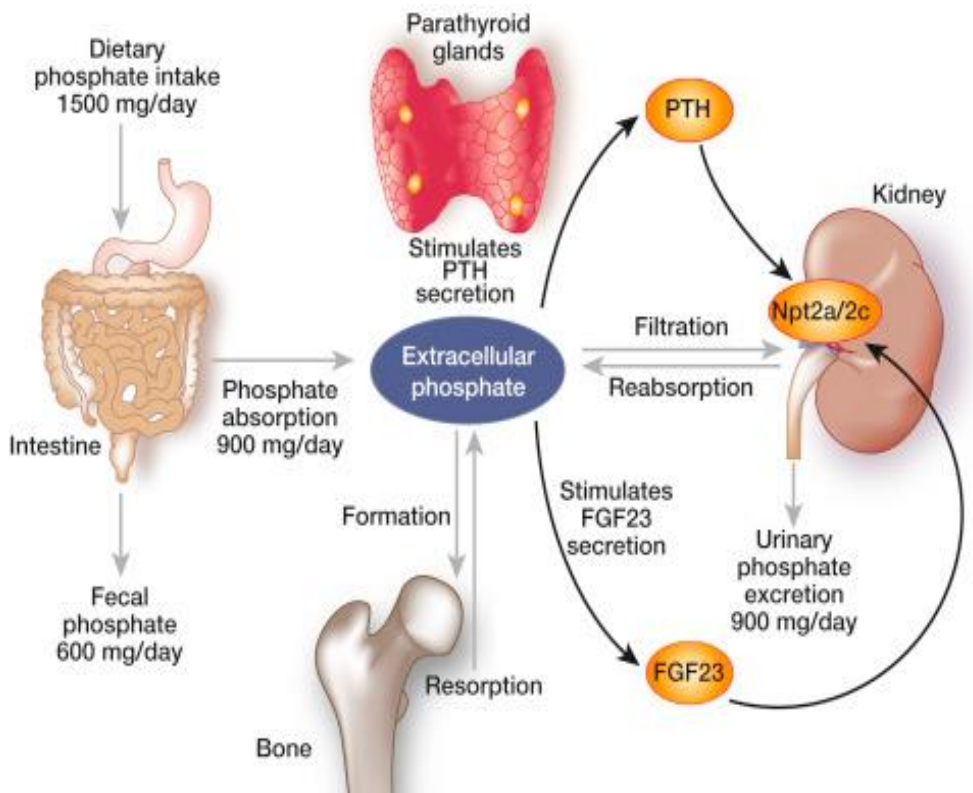
Phosphorus



Phosphorus

Serum Phosphorus and Mortality

Meta-analysis: 47 cohort studies, n=327.644



Each 1 mg/dl increase in serum phosphorus

▪ Risk of death: ↑ 18%

Phosphorus	No. of Cohorts	No. of Participants	Relative Risk (95% CI) Per Unit Increase
All-cause mortality			
Adequate adjustment	3	4651	1.35 (1.16-1.57)
Partial adjustment	10	87 694	1.16 (1.09-1.23)
All studies combined	13	92 345	1.18 (1.12-1.25)
Cardiovascular mortality			
Adequate adjustment	1	17 326	Not estimable
Partial adjustment	2	5881	1.14 (1.05-1.24)
All studies combined	3	23 207	1.10 (1.06-1.13)

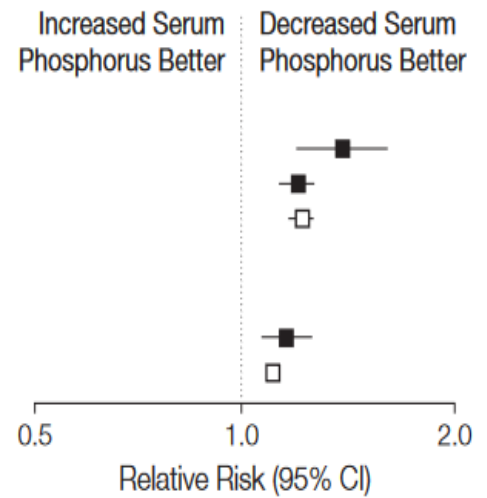


Table 54.1 Daily Nutrient Recommendations for Patients With Chronic Kidney Disease Stages 1 Through 5

Nutrient	Stages 1-4	Hemodialysis	Peritoneal Dialysis
Protein	GFR >30 mL/min/1.73 m ² : ≥0.8 g/kg/day GFR 15-29 mL/min/1.73 m ² : 0.6-0.75 g/kg/day Nephrotic syndrome: 0.8-1.0 g/kg/	≥1.2 g/kg/day with at least 50% HBV	≥1.2-1.3 g/kg/day with at least 50% HBV
Energy (if patient is <90% or >115% of median standard weight, use aBWef)	35-40 kcal/kg, depending on nutritional status and stress factors	≥60 year: 30-35 kcal/kg <60 year: 35 kcal/kg	≥60 year: 30-35 kcal/kg including dialysate calories <60 year: 35 kcal/kg including dialysate calories
Phosphorus	10-20 mg/g of protein or 600-800 mg/day	900 mg/day or <17 mg/kg/day	900 mg/day or <17 mg/kg/day
Sodium	Varies with cause of CKD; usually "no added salt" (i.e., 2-4 g/day)	2000-3000 mg/day (88-130 mmol/day)	Individualized based on physical examination; in CAPD and APD, 3000-4000 mg/day (130-175 mmol/day)
Potassium	Usually not restricted until GFR is <10 mL/min/1.73 m ²	40 mg/kg or approximately 2000-3000 mg/day (50-80 mmol/day)	Generally unrestricted with CAPD and APD: approximately 3000-4000 mg/day (80-105 mmol/day) unless serum level is increased or decreased
Fluid	As indicated by clinical status	500-1000 mL/day plus daily urine output	In CAPD and APD, approximately 2000-3000 mL/day based on clinical status; unrestricted if weight and blood pressure are controlled and residual kidney function is 2-3 L/day
Calcium	800 mg/day or as needed to maintain goal serum levels	Same as for CKD stages 1-4	Same as for CKD stages 1-4
Vitamins and minerals	RDA for vitamin B complex and C; individualize zinc, iron, calcium, and vitamin D	Vitamin C, 60-100 mg; vitamin B ₆ , 5-10 mg; folic acid, 0.8-1 mg; DRI for others; individualize zinc, calcium, iron, and vitamin D	Same as for hemodialysis

aBWef, Adjusted edema-free body weight; *APD*, automated peritoneal dialysis; *CAPD*, continuous ambulatory peritoneal dialysis; *CKD*, chronic kidney disease; *DRI*, dietary reference intake; *GFR*, glomerular filtration rate; *HBV*, high biologic value; *NAS*, no added salt; *RDA*, recommended dietary allowance.

Inorganic vs Organic Phosphorus

Inorganic phosphate

- Not protein-bound
- Directly absorbed in gut
- **80-100%** absorption
- Processed foods, precooked meals, soda

Organic phosphate

- Protein-bound
- Hydrolysed in intestine to inorganic phosphate
- **< 60 %** absorption
- Animal and plant sources

Organic phosphate

Animal-based vs Plant-based

Animal-based

- Organic phosphate in intracellular compartments
- Easily hydrolysed and absorbed
- **40-60%** absorbed by gut

Plant-based

- Organic phosphate mostly in phytic acid or phylate storage form
- Humans lack phytase → low absorption
- **10-30 %** absorbed by gut

Animal-based vs Plant-based

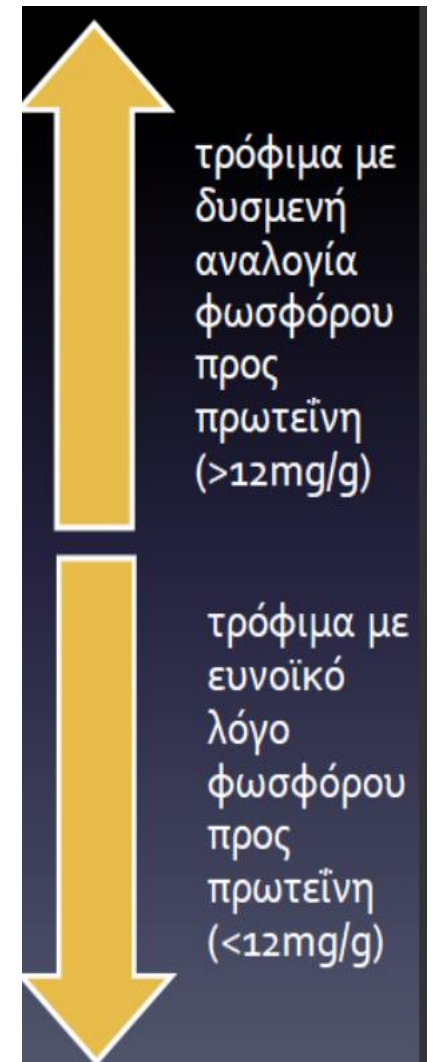
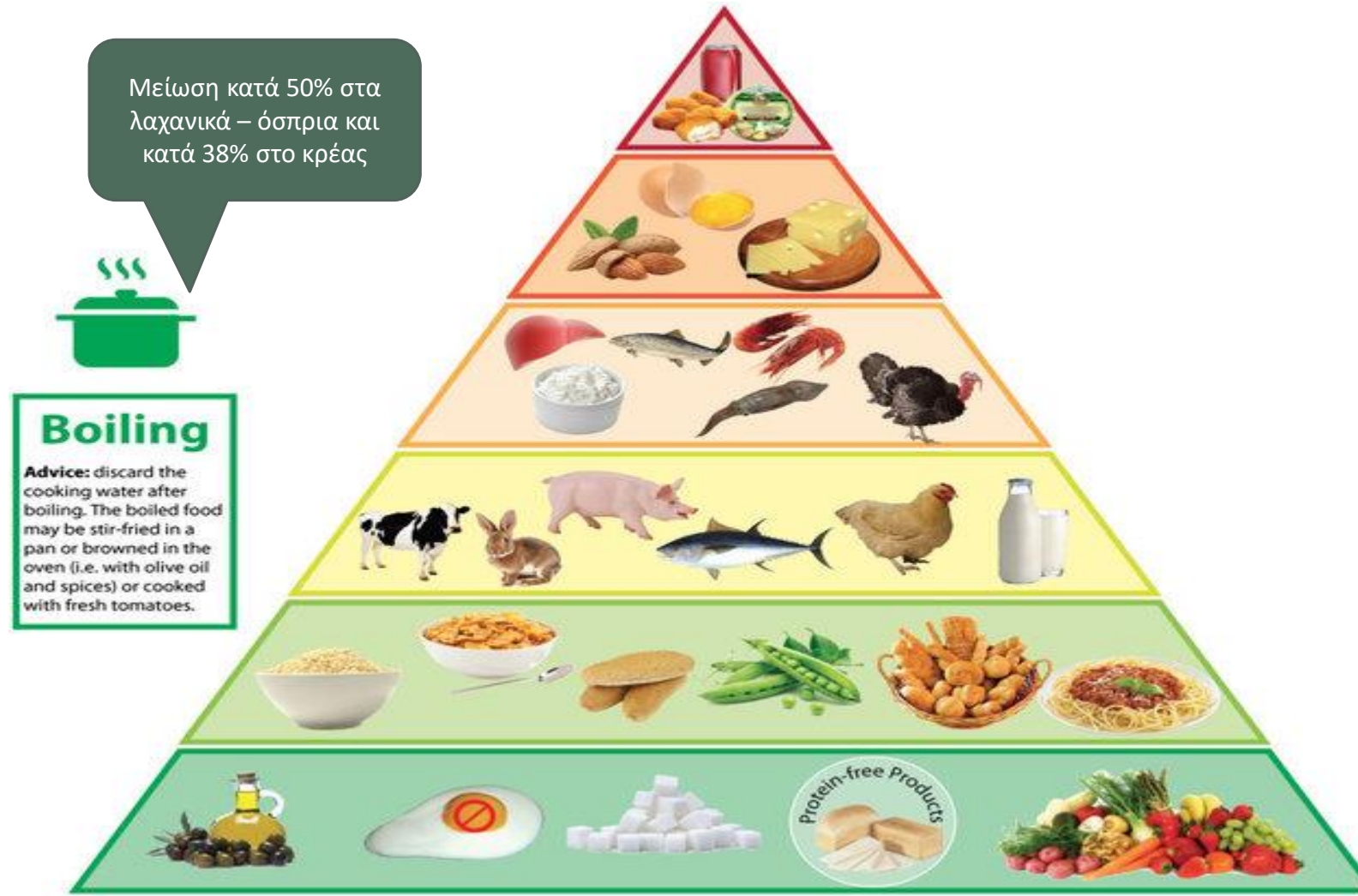
Randomised, crossover **meat vs veg. diet** (isonutrient for calories, Ca+, Na+, Phos), n=9 pts, eGFR: 32ml/min, 7 d per diet, 2-4 week washout

	Before Meat (casein) Diet	After Meat (casein) Diet	Before Vegetarian (grain) Diet	After Vegetarian (grain) Diet	<i>P</i> (paired <i>t</i> test) ^a
Average daily phosphorus intake (mg/day)		810 ± 27		795 ± 51	NS
Plasma phosphorus (mg/dl)	3.5 ± 0.6	3.7 ± 0.6	3.5 ± 0.6	3.2 ± 0.5	0.02
Plasma intact PTH (pg/ml)	58 ± 31	46 ± 29	58 ± 39	56 ± 30	0.002
Plasma FGF23 (pg/ml)	72 ± 39	101 ± 83	84 ± 65	61 ± 35	0.008
Plasma calcium (mg/dl)	9.2 ± 0.4	9.4 ± 0.7	9.3 ± 0.4	9.1 ± 0.3	NS
Creatinine clearance (ml/ min)	47 ± 16	47 ± 16	43 ± 11	44 ± 16	NS
Urine 24-hour calcium excretion (mg/24 h)	66 ± 69	77 ± 48	60 ± 59	71 ± 43	NS
Urine 24-hour phosphorus excretion (mg/24 h)	836 ± 187	583 ± 216	778 ± 190	416 ± 233	0.07
Urine 24-hour FePhosph (%)	38.0 ± 6.2	23.9 ± 5.1	38.2 ± 11.5	20.9 ± 9.9	NS



Ο ΦΩΣΦΟΡΟΣ
ΣΥΝΗΘΩΣ ΔΕΝ
ΑΝΑΦΕΡΕΤΑΙ ΣΤΙΣ
ΕΤΙΚΕΤΕΣ
ΤΡΟΦΙΜΩΝ

The phosphorus pyramid



Is it possible to control hyperphosphataemia with diet, without inducing protein malnutrition?

Απαραίτητα τα φωσφοροδεσμευτικά στο ΤΣΧΝΝ και στην ΑΚ

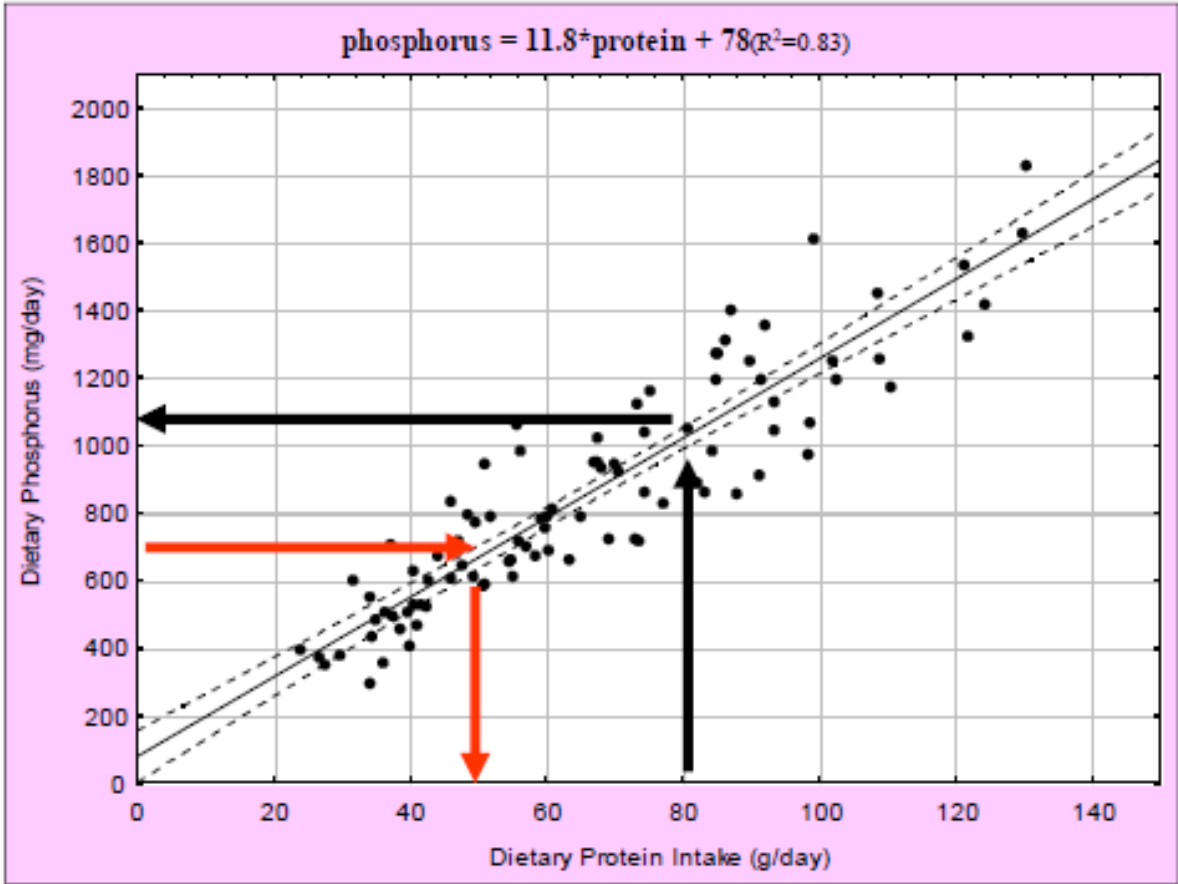
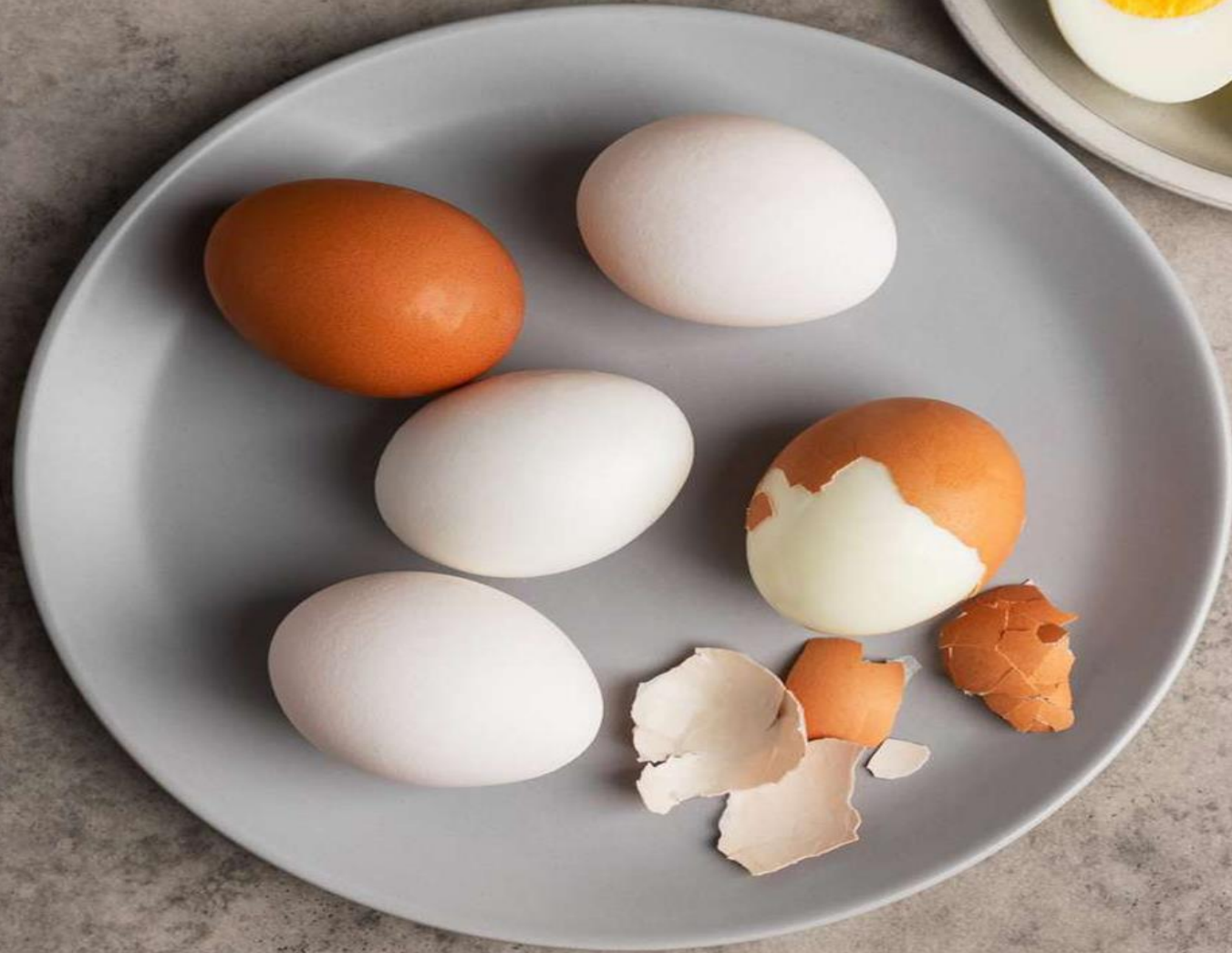
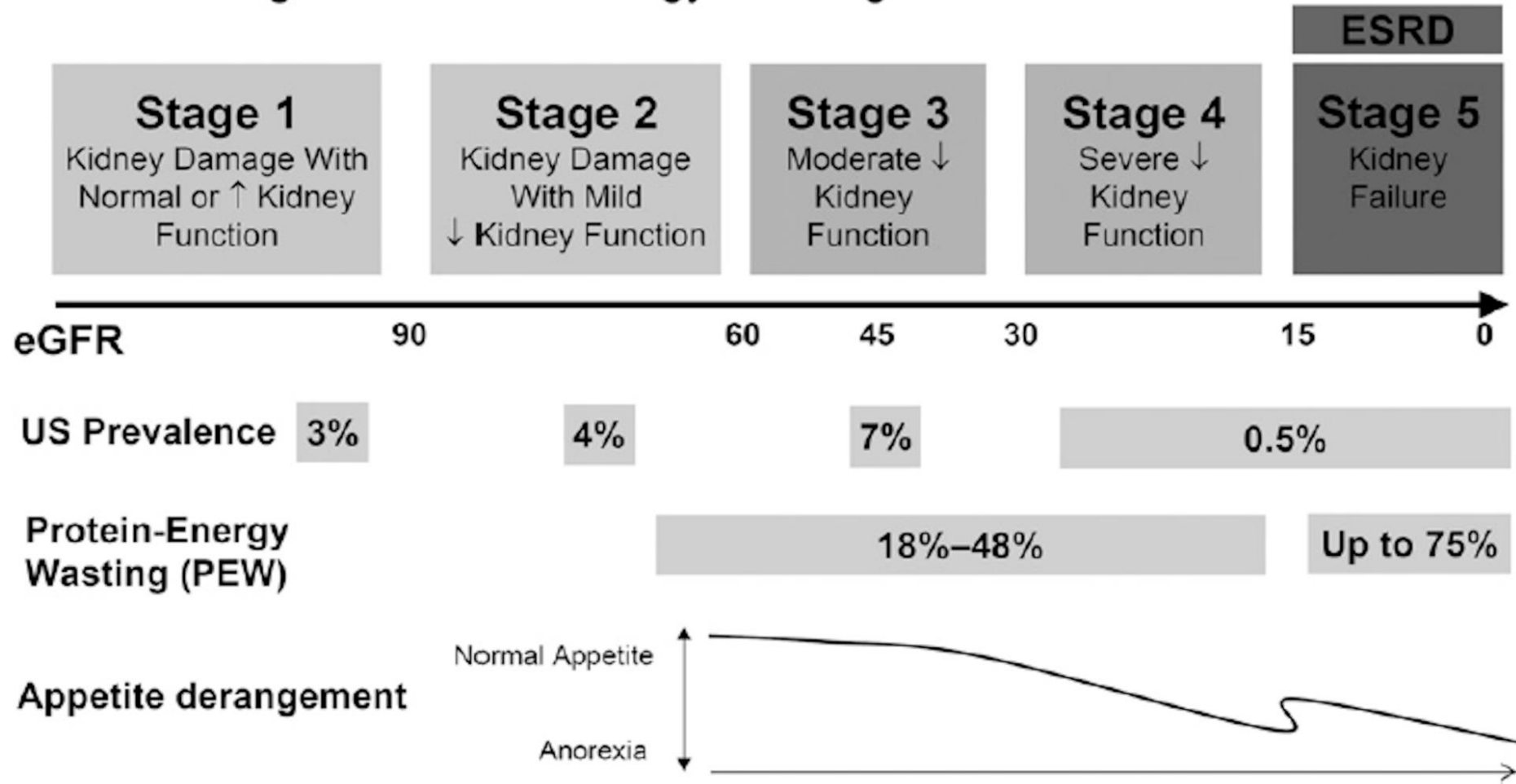


FIG. 3. Correlation between dietary protein and phosphorus content; a recommended protein intake of 1.2 g/kg/day in a 70 kg chronic dialysis patient is equivalent to 85 g/day of protein which exceeds the 800 mg/day phosphorus restriction as shown by the black arrows (adapted from reference 11).

Protein



CKD Stages & Protein-Energy Wasting



Εκτίμηση της κατάστασης θρέψης

ISRNM criteria for the clinical diagnosis of PEW in people with kidney disease¹

Category	Test
Serum chemistry	<ul style="list-style-type: none">• Serum albumin <3.8 g/dL (Bromocresol Green)• Serum prealbumin (transthyretin) <30 mg/dL (for maintenance dialysis patients only; levels may vary according to GFR level for patients with CKD stages 2–5)• Serum cholesterol <100 mg/dL
Body mass	<ul style="list-style-type: none">• BMI <23 kg/m²• Unintentional weight loss over time: 5% over 3 months or 10% over 6 months• Total body fat percentage <10%
Muscle mass	<ul style="list-style-type: none">• Muscle wasting: muscle mass reduced by 5% over 3 months or 10% over 6 months• Reduced mid-arm muscle circumference area (reduction >10% in relation to 50th percentile of reference population)• Creatinine appearance
Dietary intake	<ul style="list-style-type: none">• Unintentionally low DPI <0.80 g/kg BW/day for at least 2 months for dialysis patients or <0.6 g/kg BW/day for patients with CKD stages 2–5• Unintentionally low DEI <25 kcal/kg BW/day for at least 2 months

$$\text{Estimated protein intake} = 6.25 \times (\text{UUN} + 30 \text{ mg/kg} \times \text{BW})$$

$$\text{UN} = \text{Urea} / 2.14$$

Abbreviations: BMI=body mass index; DEI= dietary energy intake; DPI=dietary protein intake; GFR=glomerular filtration rate

At least three out of the four listed categories (and at least one test in each of the selected categories) must be satisfied for the diagnosis of kidney disease-related PEW. Optimally, each criterion should be documented on at least three occasions, preferably two to three weeks apart.

The New England Journal of Medicine

©Copyright, 1994, by the Massachusetts Medical Society

Volume 330 MARCH 31, 1994 Number 13

THE EFFECTS OF DIETARY PROTEIN RESTRICTION AND BLOOD-PRESSURE CONTROL ON THE PROGRESSION OF CHRONIC RENAL DISEASE

SAULO KLAHR, M.D., ANDREW S. LEVEY, M.D., GERALD J. BECK, PH.D., ARLENE W. CAGGIOLA, PH.D., LAWRENCE HUNSICKER, M.D., JOHN W. KUSEK, PH.D., AND GARY STRIKER, M.D., FOR THE MODIFICATION OF DIET IN RENAL DISEASE STUDY GROUP*

Table 1. Assignment of Patients to Diet and Blood-Pressure Groups in Studies 1 and 2.*

DIET†	STUDY 1 (N = 585)		STUDY 2 (N = 255)	
	MEAN ARTERIAL PRESSURE‡			
	usual	low	usual	low
	<i>no. of patients</i>			
Usual protein	145	149	—	—
Low protein	140	151	62	67
Very low protein	—	—	61	65

*Patients in study 1 had a glomerular filtration rate of 25 to 55 ml per minute per 1.73 m²; patients in study 2 had a rate of 13 to 24 ml per minute per 1.73 m².

†The usual-protein diet consisted of 1.3 g of protein and 16 to 20 mg of phosphorus per kilogram (standard body weight) per day, the low-protein diet consisted of 0.58 g of protein (≥0.35 g of protein high in essential amino acids) and 5 to 10 mg of phosphorus per kilogram per day, and the very-low-protein diet consisted of 0.28 g of protein and 4 to 9 mg of phosphorus per kilogram per day, supplemented by a keto acid–amino acid mixture (0.28 g per kilogram per day) (Ross Laboratories, Columbus, Ohio).

‡Mean arterial pressure is defined in the Methods section. The usual mean arterial pressure was ≤107 mm Hg for patients 18 to 60 years old at entry (equivalent to 140/90 mm Hg) or ≤113 mm Hg for patients ≥61 years old at entry (equivalent to 160/90 mm Hg); low mean arterial pressure was ≤92 mm Hg for patients 18 to 60 years old at entry (equivalent to 125/75 mm Hg) or ≤98 mm Hg for patients ≥61 years old at entry (equivalent to 145/75 mm Hg).

Table 3. Mean Rate of Decline in the Glomerular Filtration Rate in Study 1, According to Diet and Blood-Pressure Group.*

STUDY PERIOD AND DIET	DECLINE IN GLOMERULAR FILTRATION RATE		
	USUAL PRESSURE	LOW PRESSURE	BOTH
<i>milliliters per minute per 4 months</i>			
Base line to 4 months			
Usual protein	1.2 (0.1–2.3)	2.4 (1.4–3.5)	1.8 (1.1–2.6)
Low protein	2.6 (1.5–3.7)	4.3 (3.2–5.3)	3.4 (2.7–4.2)
Both	1.9 (1.1–2.7)	3.4 (2.6–4.1)	2.6 (2.1–3.2)
<i>milliliters per minute per year</i>			
4 Months to end			
Usual protein	4.5 (3.7–5.3)	3.3 (2.5–4.1)	3.9 (3.3–4.4)
Low protein	3.3 (2.5–4.2)	2.3 (1.5–3.0)	2.8 (2.2–3.4)
Both	3.9 (3.3–4.5)	2.8 (2.2–3.3)	3.3 (2.9–3.7)
<i>milliliters per minute per 3 years</i>			
Base line to 3 years			
Usual protein	13.1 (10.8–15.4)	11.2 (8.8–13.5)	12.1 (10.5–13.8)
Low protein	11.5 (9.1–13.9)	10.3 (8.0–12.6)	10.9 (9.2–12.5)
Both	12.3 (10.6–14.0)	10.7 (9.1–12.4)	11.5 (10.3–12.7)

-1.6 ml/min/4m

+1.1 ml/min/y

+1.2 ml/min/3y

*The means were estimated with the maximum-likelihood method for the two-slope model (with separate slopes from the final base-line visit to the fourth month of follow-up and from the fourth month of follow-up to the end of follow-up) and for the projected decline in the glomerular filtration rate from base line to three years. There were no significant interactions between the diet and blood-pressure interventions. There were significant effects of dietary and blood-pressure interventions from the final base-line visit to the fourth month of follow-up ($P = 0.004$ and $P = 0.010$, respectively) and from the fourth month to the end of follow-up ($P = 0.009$ and $P = 0.006$, respectively). The estimated decline in the glomerular filtration rate over three years did not differ significantly between the diet groups or between the blood-pressure groups. Values in parentheses indicate 95 percent confidence intervals.

Table 4. Mean Rate of Decline in the Glomerular Filtration Rate from Base Line to the End of the Study in Study 2.*

DIET	DECLINE IN GLOMERULAR FILTRATION RATE		
	USUAL PRESSURE	LOW PRESSURE	BOTH
<i>milliliters per minute per year (95% confidence interval)</i>			
Low protein	4.9 (3.8–5.9)	3.9 (3.2–4.7)	4.4 (3.7–5.1)
Very low protein	3.6 (2.8–4.4)	3.5 (2.6–4.5)	3.6 (2.9–4.2)
Both	4.2 (3.6–4.9)	3.7 (3.1–4.3)	4.0 (3.5–4.4)

+0.8ml/min/3y

*The mean rates of decline in the glomerular filtration rate, which were estimated according to the single-slope informative censoring model, did not differ significantly between the diet groups ($P = 0.07$) or between the blood-pressure groups ($P = 0.28$).

High Protein Diets May Be Harmful to Kidney Health

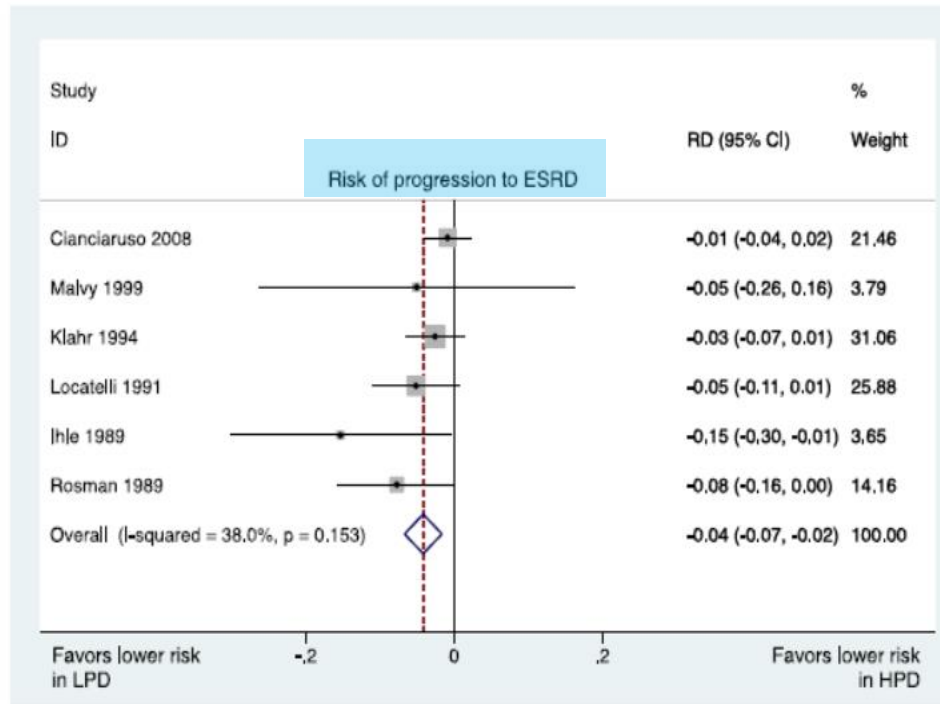
Table 1. Selected studies of high-protein and kidney function. DPI: dietary protein intake; CKD: chronic kidney disease.

Study (Year)	Cohort, [N] (Country)	Duration Of Follow Up	Findings
Esmeijer [22] (2020)	Alpha Omega Cohort (2255) (Netherlands)	41 mo	↑ DPI 0.1 g/kg/day associated with ↑ eGFR decline of -0.12 ml/min/year 3.5-fold ↑ risk of hyperfiltration. 1.3-fold ↑ faster decline ↑ DPI density associated with ↑ eGFR decline 48% ↑ risk of incident CKD in high DPI
Jhee [23] (2020)	South Korea (9226)	14 yrs	
Malhotra [24] (2018)	Jackson Heart (USA) (5301)	8 yrs	
Farhadnejad [24] (2018)	Healthy Iranian adults (1797)	6.1 yrs	

Low-protein diet for conservative management of chronic kidney disease: a systematic review and meta-analysis of controlled trials

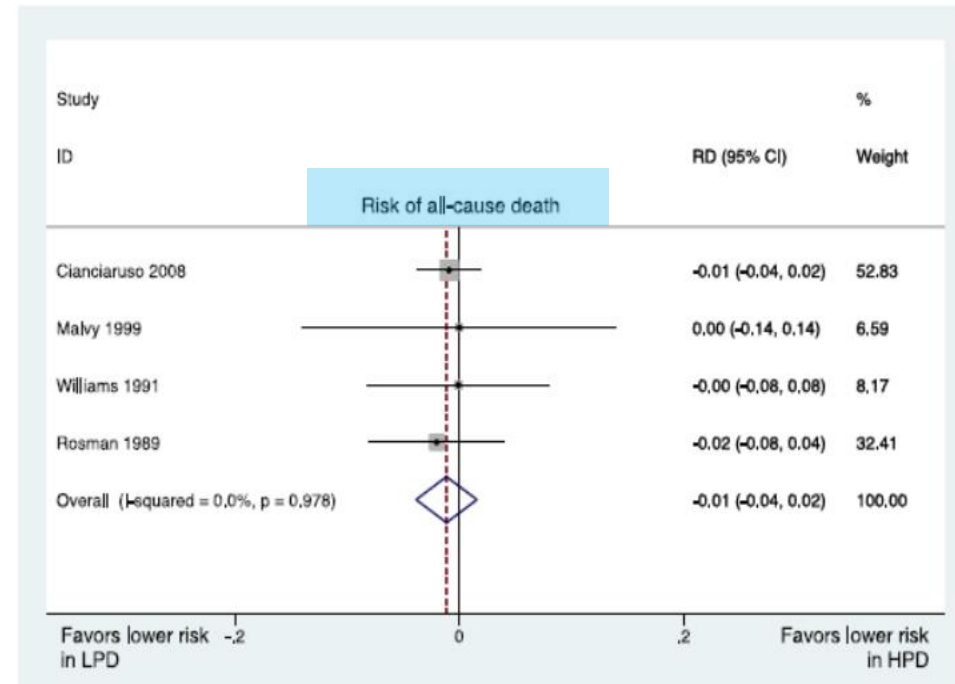
Low-protein diets (LPD: <0.8 g/kg/day) vs higher-protein diets (HPD: >0.8 g/kg/day)

A



ESRD

B

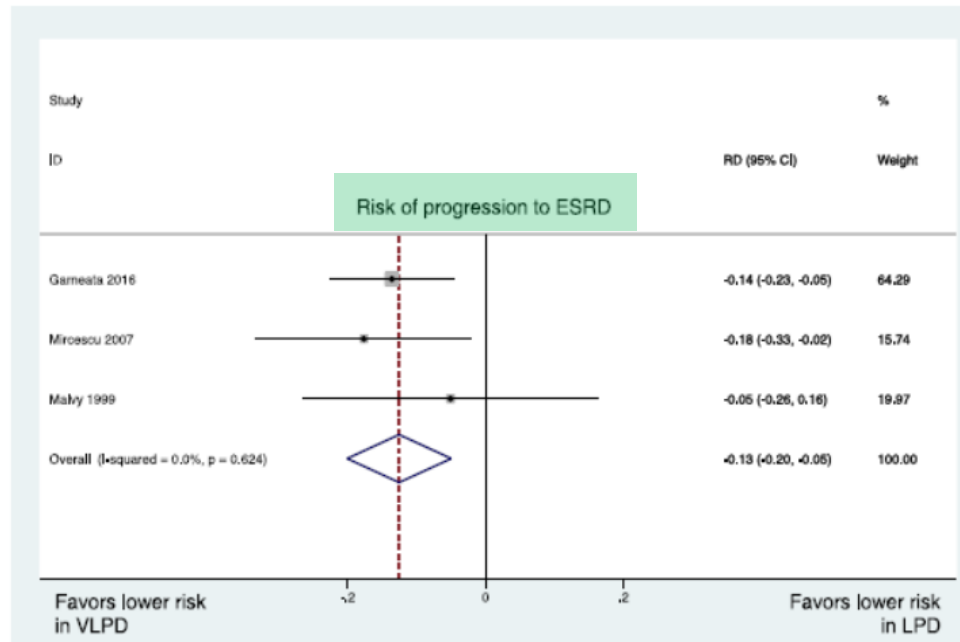


All-cause mortality

Low-protein diet for conservative management of chronic kidney disease: a systematic review and meta-analysis of controlled trials

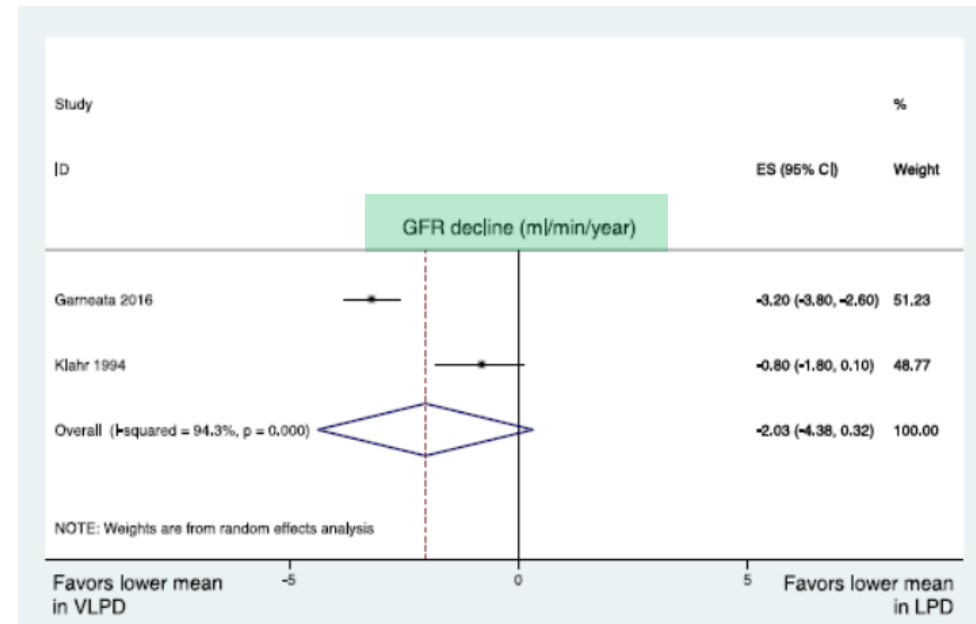
Very Low-protein diets (VLPD: < 0.4 g/kg/day) vs Low-protein diets (LPD: 0.4-0.8 g/kg/day)

A



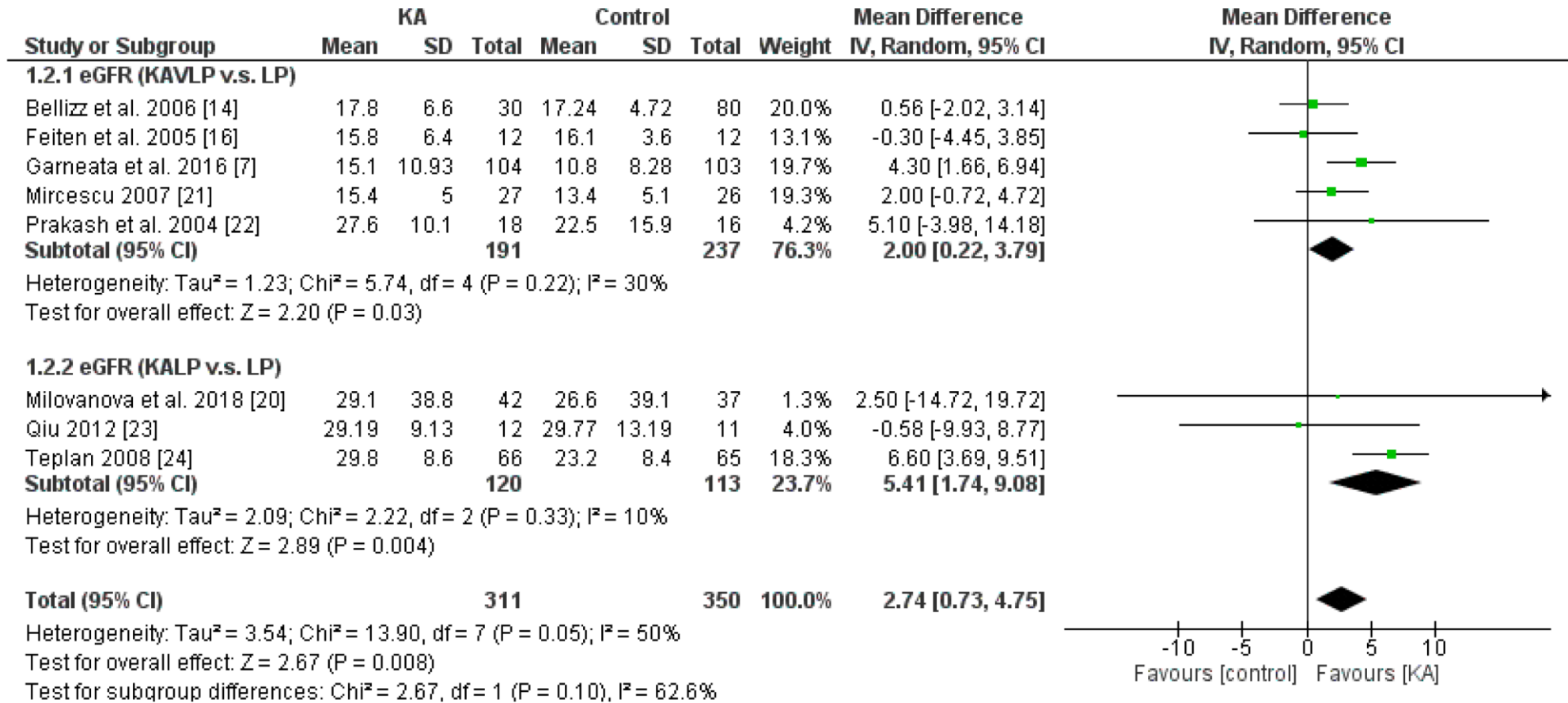
ESRD

B

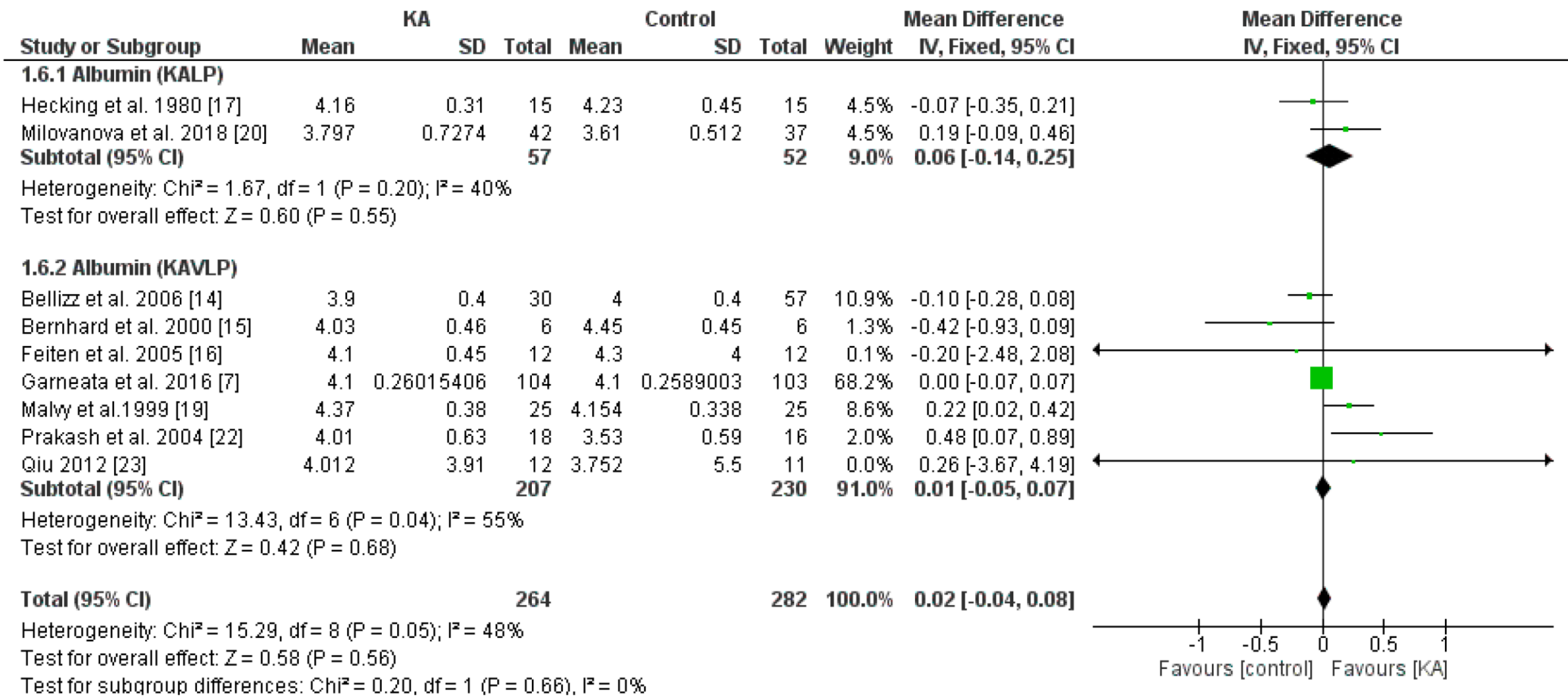


GFR decline

Article
The Effect of Ketoanalogues on Chronic Kidney Disease Deterioration: A Meta-Analysis



Forest plot of effects of ketoanalogues (KA) on estimated glomerular filtration rate (eGFR) in chronic kidney disease (CKD) patients



Forest plot of effects of KA on serum albumin in patients sub-grouped by the type of restricted protein diet

3.3.1 Protein intake

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

Practice Point 3.3.1.1: Avoid high protein intake (>1.3 g/kg body weight/d) in adults with CKD at risk of progression.

Practice Point 3.3.1.2: In adults with CKD who are willing and able, and who are at risk of kidney failure, consider prescribing, under close supervision, a very low-protein diet (0.3–0.4 g/kg body weight/d) supplemented with essential amino acids or ketoacid analogs (up to 0.6 g/kg body weight/d).

Practice Point 3.3.1.3: Do not prescribe low- or very low-protein diets in metabolically unstable people with CKD.

Recommendation 3.1.1: We suggest maintaining a protein intake of 0.8 g protein/kg (weight)/d for those with diabetes and CKD not treated with dialysis (2C).

Practice Point 3.1.2: Patients treated with hemodialysis, and particularly peritoneal dialysis, should consume between 1.0 and 1.2 g protein/kg (weight)/d.

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 ultraprocessed foods.

Protein Source matters

Nurses' Health Study, n= 1.624 pts, normal GFR or middle renal insufficiency age: 42-68, FU: 4 y

- **High intake of nondairy animal protein in woman**
(GFR: 55-80 ml/min/1.73m²)
- Significantly **greater ↓ GFR per 10 g ↑ nondairy animal protein intake**
(-1.21 ml/min/1.73m²)

Multi-Ethnic Study of Atherosclerosis (MESA), cross-sectional, n= 5.042 pts, age: 45-84, no CVD, DM

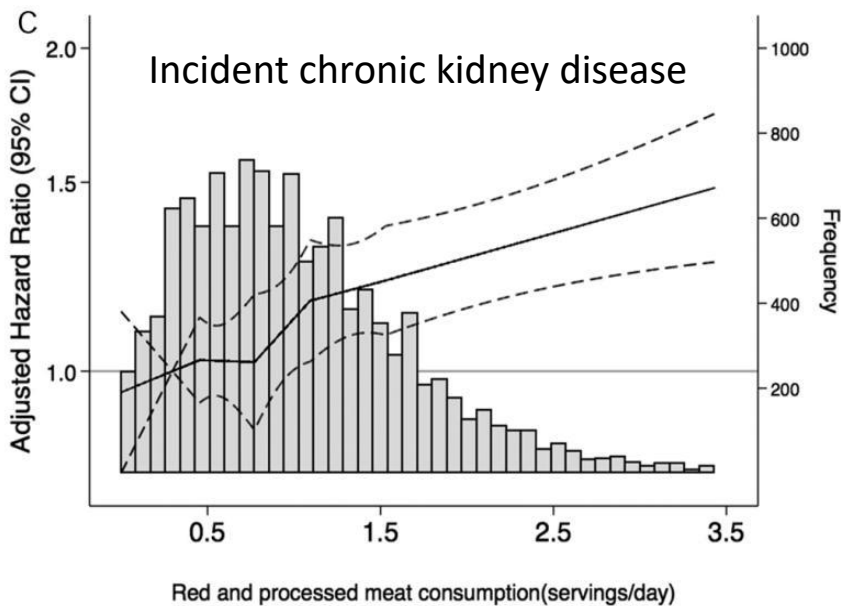
- **Total nondairy animal food vs other**
 - **↑ 11 %** Albumin/Cr ratio
- **↑ whole grains, fruits, vegetables, low-fat dairy**
 - **↓ 20 %** Albumin/Cr ratio

Protein

Red meat and **CKD**

ARIC study, n= 11.952 pts, age: 44-66 y, eGFR > 60 ml/min

- Highest **vs** lowest red meat intake
- **↑ 23%** in CKD risk



Red meat and **ESRD**

Singapore Chinese Health Study, prospective, n= 63.257 pts, age: 45-74 y, FU: 15 yrs

- Highest **vs** lowest total protein
- **↑ 24 %** ESRD risk
- Highest **vs** lowest red meat intake
- **↑ 40 %** ESRD risk
- Substituting 1 serving red meat with other protein: **max ↓ 62.4%** the risk
- Intake of poultry, fish, eggs, dairy
- **No association**

Soy Protein

Randomised, crossover trial, n= 14 pts with type 2 DM, 0.8 gr/Kg protein
70% animal + 30% vegetable **vs** 35% animal + 35% soy + 30% vegetable

➤ Soy protein consumption

- **↓ Urinary urea nitrogen**
(-0.9 +/- 0.8 vs. 0.2 +/- 0.6 mg/dL, respectively, SD; P < .001)
- **↓ Proteinuria**
(-78 +/- 37 vs. 42 +/- 39 mg/day, respectively, SD; P < .001)
- **↓ Sodium**
(-2 +/- 0.04 vs. 2.0 +/- 0.06 mg/dL, respectively, SD; P < .01)
- **↓ Serum phosphorus**
(-0.03 +/- 0.2 vs. 0.2 +/- 0.3 mg/dL, respectively, SD; P < .01)

Fiber, CKD and all-cause Mortality

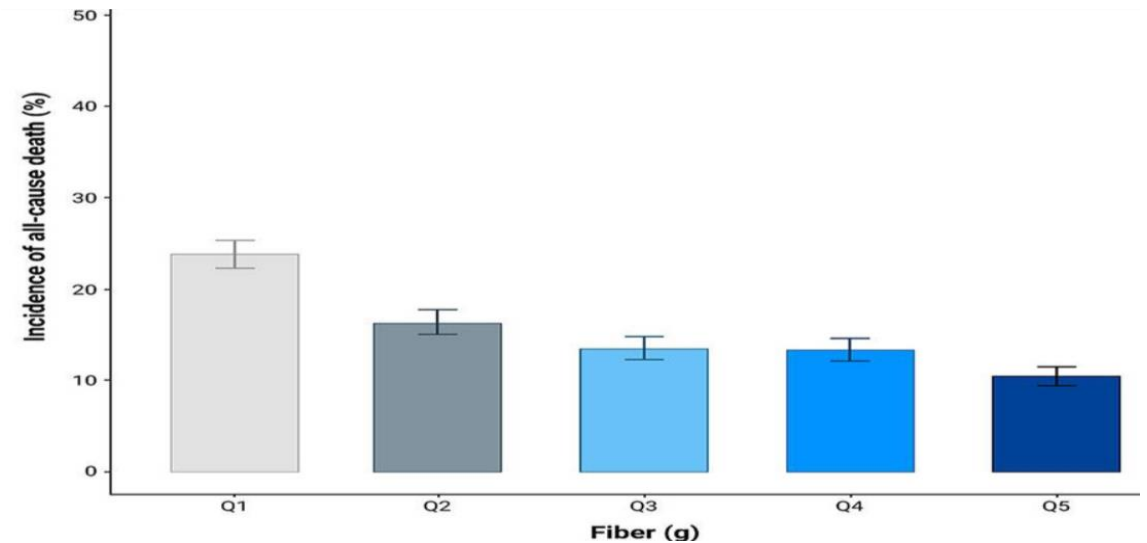
Korean Genome and Epidemiology Study, n= 3.892 pts, mean age: 63 y, GFR < 60 ml/min, FU: 10 y
mean dietary fiber intake was 5.1 ± 2.6 g/day
Q1, > Q2, > Q3, > Q4 & > Q5

Every 1 gr/d ↑ in dietary fiber

- ↓ 8% in all-cause mortality
- ↓ 9% in CVD mortality

Small increments in fiber intake (10 y FU)

↓ 37% in CKD in all-cause mortality



CKD 3: 95.5 %
CKD 4: 3.1 %
CKD 5: 1.4 %

There were significant association between dietary fiber intake and all-cause mortality only in CKD stage 3, female, and BMI <25 kg/m².



Sugar

• DM & prediabetes

↑ incidence of microalbuminuria in prediabetics patients

• Non Diabetes ?

The association between impaired fasting glucose (IFG) and albuminuria **is not well established**

➤ n=1.694 without known diabetes (from non-diabetic Chinese community-based cohort), UACR≥30 mg/g , FU: 4 y
↑ **71% the risk** of incident albuminuria for every **18 mg/dl increase of FBG level**

➤ n=496, without Diabetes history (HbA1c: 6-6.4%), mean age: 72, 75 gr glucose - oral glucose tolerance test (OGTT)
1 h PG (prediabetes levels) → 3 times increased risk for albuminuria

➤ n= 2.600, age ≥ 50 y, GFR < 60 ml/min, FU: 5 y (Highest sugar intake (169gr/d) **vs** lowest sugar intake (86.2 gr/d)
↑ **55 % risk** of CKD incidence

Sugar

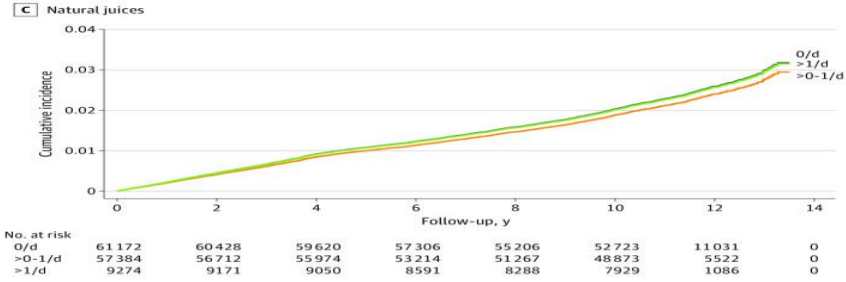
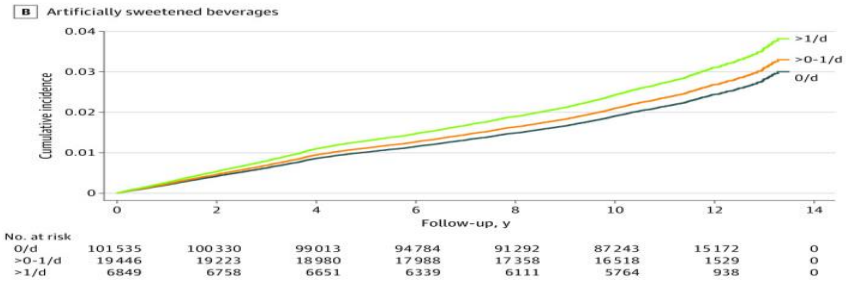
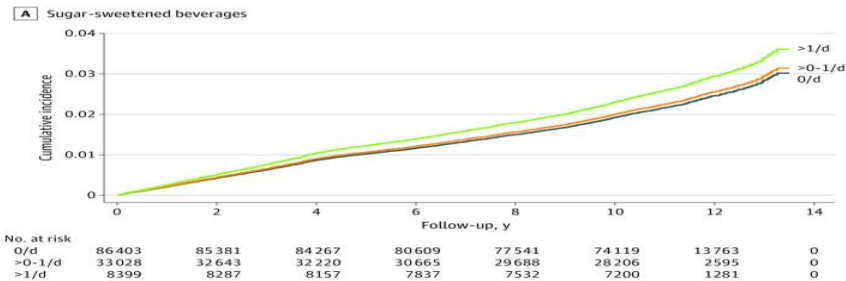
Sweetened Beverage Intake and Incident of CKD

n= 127.830 adults without CKD, (prospective, population-based cohort study , UK Biobank Study), mean age:55 y, FU: 10 y

- More than **1 serving per day** of sugar-sweetened beverages consumption **↑ 17.8% risk of incident CKD**

- Artificially sweetened beverages → **No difference** risk of CKD

- Replacing **1 serving per day** of sugar-sweetened beverage with natural juice or water → **reduced risk of CKD**



Adjusted Survival Curves for Incident Chronic Kidney Disease According to Category of Beverage and Level of Intake

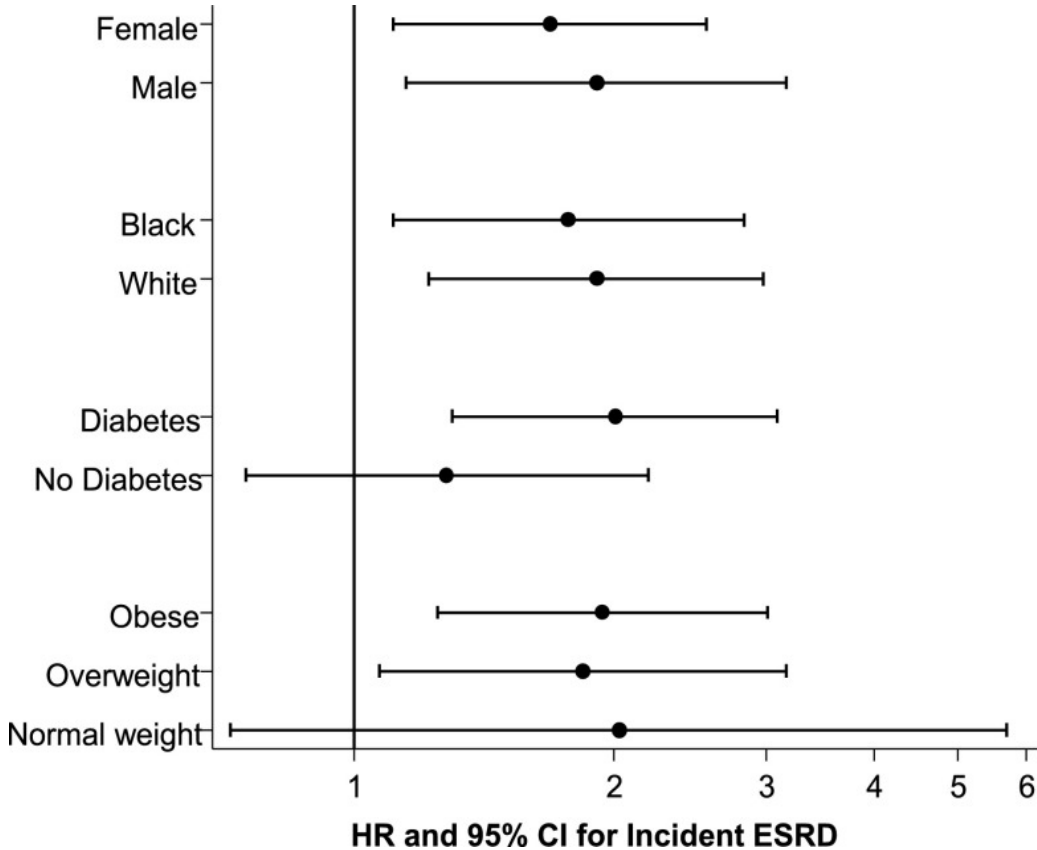
Sugar

Diet soda consumption is associated with impaired glucose metabolism, diabetes, and metabolic syndrome

Diet soda and ESRD Risk ?

ARIC study, n= 15.368, mean FU: 23 y

- 1 glass/wk vs 7 glasses/wk
- ↑ 83 % risk of ESRD



DASH diet

MEDITERRANEAN diet

PLANT based diet

ARIC study, n= 14.882, mean FU: 23 y

Northern Manhattan Study, prospective, multiethnic, observational, n= 900, mean FU: 7 y, mean GFR: 83 ml/min

A study, n= 14.686, FU: 23 y

Low
SCORE
risk

(adjusted for smoking, potassium intake, baseline hypertension, and antihypertensive medication use)

Caution !

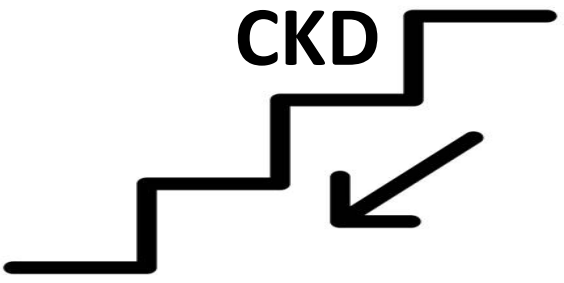
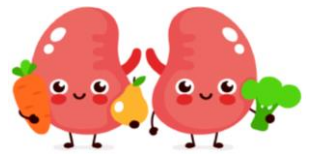
Diets rich in fruits and vegetables may not be appropriate for patients with advanced CKD or Hemodialysis

reference to:
plant based diet ↓ 6% incidence

plant based diet ↓ incidence

refined plant based diet ↑ 11% CKD incidence

(refined grains, juices, sweets/desserts)



what are other words for individualise?

individualize, personalize, personalise, separate, differentiate, individualized, personalised, personalized



EAT SMART

Thank You!

