

ΕΛΛΗΝΙΚΗ ΝΕΦΡΟΛΟΓΙΚΗ ΕΤΑΙΡΕΙΑ  
HELLENIC SOCIETY OF NEPHROLOGY

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Συνέδριο  
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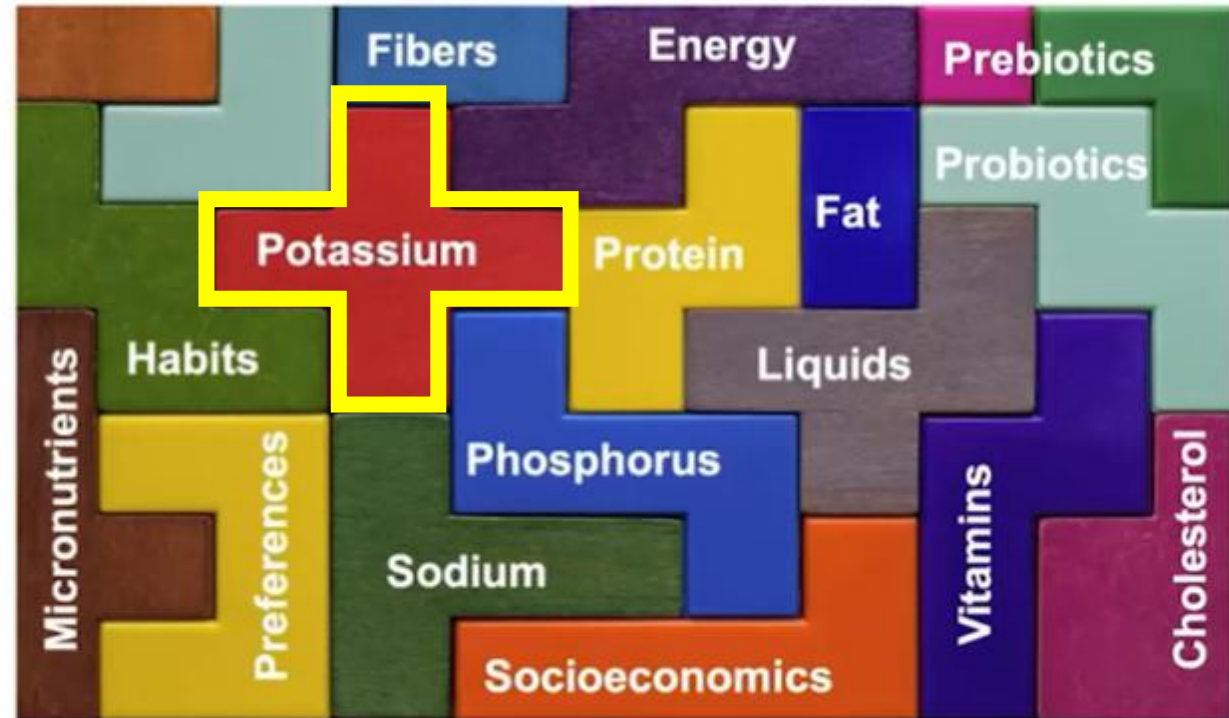
# Δίαιτα και υπερκαλιαιμία στους ασθενείς με ΧΝΝ 4ου και 5ου σταδίου

Μαρία Σμυρλή

Επικουρική Νεφρολόγος

Κλινική Νεφρολογίας και Μεταμόσχευσης Νεφρού, Ιατρική σχολή ΕΚΠΑ,  
ΓΝΑ «Λαϊκό», Αθήνα

# Διατροφικές συστάσεις σε ασθενείς με ΧΝΝ



**\*Social Determinants of Health**



Αυστηρός διατροφικός  
περιορισμός καλίου στη ΧΝΝ.  
**Τεκμηρίωση ή συνήθεια?**

# SOME EFFECTS OF POTASSIUM SALTS IN MAN \*

By NORMAN M. KEITH, M.D., ARNOLD E. OSTERBERG, Ph.D., and  
HOWARD B. BURCHELL, M.D., *Rochester, Minnesota*

The decreased urine creatinine indicates reduced glomerular filtration. The results of all seven studies reveal that a single dose of a potassium salt containing 80 to 100 mg. of potassium per kilogram of body weight may or may not have a toxic action on the kidney. Obviously such a dose is close to the toxic level for the normal kidney.

# GIORDANO-GIOVANNETTI DIET IN TERMINAL RENAL FAILURE

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UNIVERSITY DEPARTMENT OF MEDICINE,  
MANCHESTER ROYAL INFIRMARY

- αυγά
- φρούτα και λαχανικά χαμηλής περιεκτικότητας σε άζωτο,
- ανάλατο βούτυρο και λαρδί,
- φυτικά έλαια, ζάχαρη
- μέλι, καθώς και άμυλο καλαμποκιού και σιταριού.
- Δίαιτα χαμηλή σε K<sup>+</sup> ~2000mg/day, ωστόσο υπερκαλιαιμία.

TABLE I—CLINICAL FEATURES IN TERMINAL CHRONIC RENAL FAILURE IN  
40 UNSELECTED PATIENTS

Feature	Group 1 (1957-63) (Patients on standard low protein diet)	Group 2 (1964-65) (Patients on Giovannetti- type diet)
<i>Deaths</i> .. .. .	40	11
<i>Gastrointestinal symptoms:</i>	40 (100%)	0 (0%)
Nausea .. .. .	40 (100%)	0 (0%)
Anorexia* .. .. .	34 (85%)	0 (0%)
Vomiting .. .. .	32 (80%)	0 (0%)
Diarrhoea .. .. .	16 (40%)	0 (0%)
Hiccup .. .. .	9 (22%)	0 (0%)
Bloody diarrhoea/or bloody vomitus ..	9 (22%)	0 (0%)
<i>Other Symptoms:</i>		
Anæmia† .. .. .	29 (72%)	8 (72%)
Dyspnoea .. .. .	25 (62%)	3 (27%)
Drowsiness .. .. .	20 (50%)	0 (0%)
Œdema .. .. .	19 (47%)	4 (36%)
Acidotic respiration .. .. .	14 (35%)	1 (9%)
Left ventricular failure .. .. .	12 (30%)	3 (27%)
Pericarditis .. .. .	11 (27%)	2 (18%)
Epistaxis .. .. .	11 (27%)	6 (54%)
Fits .. .. .	10 (25%)	3 (27%)
Skin bleeding .. .. .	9 (22%)	2 (18%)
Twitching .. .. .	9 (22%)	2 (18%)
Metallic taste .. .. .	3 (7%)	0 (0%)
Parotitis .. .. .	1 (2%)	0 (0%)
Agitation .. .. .	0 (0%)	9 (82%)
Pigmentation .. .. .	2 (5%)	6 (54%)
Muscle bleeding .. .. .	0 (0%)	1 (9%)
Pruritus .. .. .	>4 (>10%)	1 (9%)

# Dietary Potassium Intake and Mortality in Long-term Hemodialysis Patients

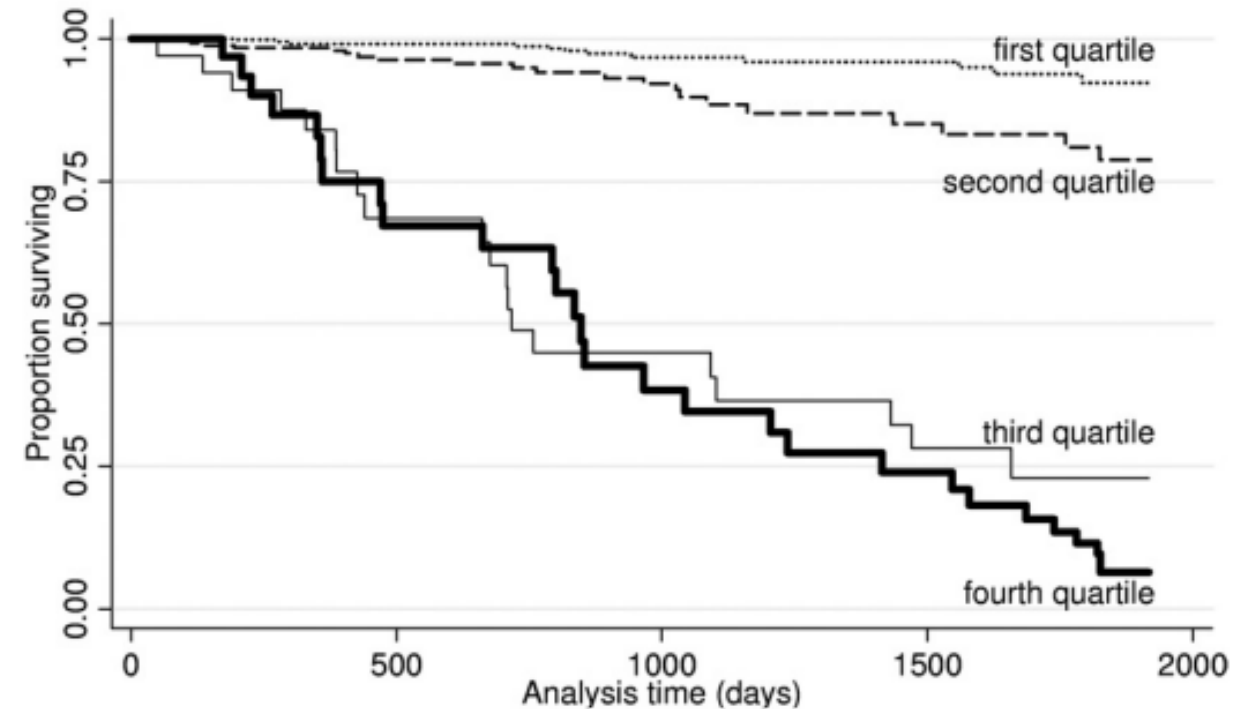
Nazanin Noori MD, PhD<sup>1,2</sup>, Kamyar Kalantar-Zadeh MD, MPH, PhD<sup>1,2,3</sup>  , Csaba P. Kovessy MD<sup>4</sup>, Sameer B. Murali MD<sup>1</sup>, Rachelle Bross RD, PhD<sup>2</sup>, Allen R. Nissenson MD<sup>3,5</sup>, Joel D. Kopple MD<sup>1,2,3</sup>

- 224 long-term HD patients from 8 dialysis clinics.
- Food Frequency Questionnaire (FFQs)
- 4 quartiles of dietary potassium (56pts/group)
- 5-year survival

increased death risk in high potassium intake  
(**HR 2.4** [95% (CI), 1.5-5.6])

## \*Limitations

Sample size, selection bias, “potassium bath”, FFQs once



## Guidelines

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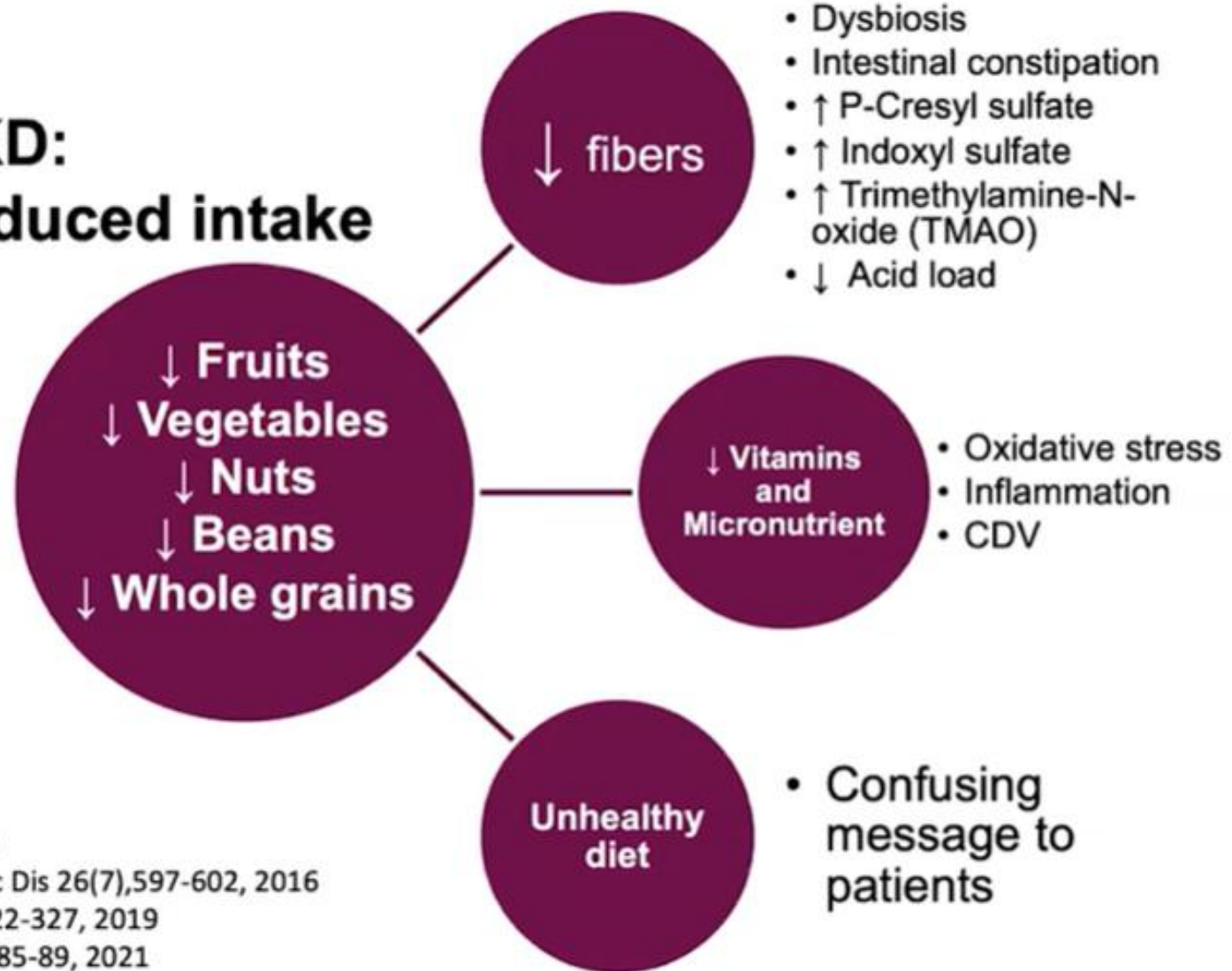
### Academy of Nutrition and Dietetics

CKD 3-5  
K<sup>+</sup> < 2.4 gr/d

### K/DOQI

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

## CKD: Diets with reduced intake



Goraya et al, CJASN 8:371, 2013

Rossi et al, Nutr Metab Cardiovasc Dis 26(7),597-602, 2016

Leining et al, J Ren Nutr 29(4):322-327, 2019

Santos et al, J Renal Nutr 31 (1):85-89, 2021

Stanford et al, J Renal Nutr 31(2):177-188, 2021

# Does dietary potassium affect outcomes in patients treated with hemodialysis?

## DIET-HD study



Maintenance hemodialysis  
n = 8,043



Europe and South America



GA2LEN food frequency questionnaire  
To measure baseline potassium intake



4.0 years  
25,890 person-years  
Median follow-up



Time-to-event and mediation analyses



The baseline potassium intake was 3.5g/ day [IQR 2.5 – 5.0]

Potassium intake



All-cause mortality  
HR 1.00 [0.95 – 1.05] per 1g/day higher intake\*



Mortality through serum potassium  
HR 1.00 [1.00 – 1.01]\*



Mortality independent of serum potassium  
HR\* 1.00 [0.96 – 1.06]\*



Serum potassium levels  
+0.03 [-0.01 to +0.07] mEq/L per 1g/day higher intake\*



Prevalence of hyperkalaemia at baseline  
OR 1.11 [0.89 – 1.37] per 1g/day higher intake\*

\*results adjusted for food intake

No association

No association

No association

No significant association

No significant association

**Conclusions** Higher dietary intake of potassium is not associated with hyperkalemia or death in patients treated with hemodialysis.

Amelie Bernier-Jean, Germaine Wong, Valeria Saglimbene, et al. *Dietary Potassium Intake and All-Cause Mortality in Adults Treated with Hemodialysis*. CJASN doi: 10.2215/CJN.08360621. Visual Abstract by Michelle Lim, MBChB, MRCP

# Does dietary potassium intake associate with hyperkalemia in patients with chronic kidney disease?

Christiane I. Ramos<sup>1</sup>, Ailema González-Ortiz<sup>2,3</sup>, Angeles Espinosa-Cuevas<sup>2</sup>, Carla M. Avesani<sup>3,4</sup>, Juan Jesus Carrero<sup>3</sup>, and Lilian Cuppari<sup>1,5</sup>

## NDD-CKD (n= 95)

K <sup>+</sup> intake	Normokalemia	Hyperkalemia
g/day	2.1 (1.8–2.8)	2.2 (1.6–2.5)
g/1000 kcal/day	1.3 (1.1–1.5)	1.3 (1.1–1.5)

## Hemodialysis (n= 117)

K <sup>+</sup> intake	Normokalemia	Hyperkalemia
g/day	1.7 (1.5–2.0)	1.6 (1.3–2.0)
g/1000 kcal/day	1.0 (0.8–1.2)	1.0 (0.8–2.0)

Parameters	OR (95% CI)	P-value
Model 1		
Dietary potassium (g/1000kcal/day)	0.59 (0.10–3.51)	0.56
eGFR (mL/min/1.73m <sup>2</sup> )	0.98 (0.93–1.04)	0.59
DM	2.97 (0.89–9.88)	0.08
Use of RAAS blockers	1.42 (0.42–4.85)	0.57
Use of sodium bicarbonate	0.33 (0.08–1.33)	0.12
Serum bicarbonate (mEq/L)	0.76 (0.63–0.91)	<0.01

Parameters	OR (95% CI)	P-value
Model 1		
Dietary potassium (g/1000kcal/day)	1.09 (0.28–4.33)	0.89
DM	4.25 (1.32–13.7)	0.02
Dialysis vintage (months)	0.97 (0.88–1.06)	0.53
BUN	1.02 (0.99–1.04)	0.18
Serum creatinine (mg/dL)	1.53 (1.26–1.87)	<0.01
MIS >6	1.43 (0.48–4.26)	0.52
BMI (kg/m <sup>2</sup> )	1.03 (0.91–1.33)	0.61
Serum bicarbonate (mEq/L)	1.14 (0.98–1.33)	0.09

# CPE Associations Between Dietary Potassium Intake From Different Food Sources and Hyperkalemia in Patients With Chronic Kidney Disease



- 285pts
- eGFR=31.2 (21.7-42.5)ml/min/1,73m<sup>2</sup>
- potassium intake:
  1. < 1,155 mg/1,000 kcals
  2. 1,155mg to 1,500 mg/1,000 kcal
  3. >1,500 mg/1,000 kcal energy
- validated diet history questionnaire
- Hyperkalemia =38 (13.3%)

**Table 3.** Multivariable Linear Regression Analysis of Serum Potassium Level and Dietary Potassium Intake From Different Food Sources in Potassium Binder Nonusers, Stratified by Renal Function

Potassium Intake	eGFR $\geq$ 30 mL/min/1.73 m <sup>2</sup> (n = 148)			eGFR <30 mL/min/1.73 m <sup>2</sup> (n = 97)		
	Regression Coefficient ( $\beta$ )*	(95% CI)*	P value	Regression Coefficient ( $\beta$ )*	(95% CI)*	P value
Total Potassium Intake	0.131	(-0.024, 0.286)	.097	0.188	(-0.062, 0.438)	.139
Potassium Intake From Food Sources						
Grains	-0.836	(-3.251, 1.580)	.495	-0.594	(-4.088, 2.901)	.736
Potatoes	0.215	(-0.500, 0.930)	.553	0.957	(0.241, 1.673)	.009
Pulses	0.986	(0.043, 1.929)	.040	0.638	(-0.483, 1.759)	.261
Green & Yellow Vegetables	0.314	(-0.096, 0.725)	.132	0.527	(-0.160, 1.213)	.131
Other Vegetables	0.448	(-0.188, 1.083)	.166	0.618	(-0.462, 1.698)	.258
Fruits	-0.325	(-0.908, 0.257)	.271	-0.135	(-1.298, 1.028)	.818
Fish	0.990	(0.209, 1.771)	.013	-0.390	(-1.262, 0.482)	.377
Meats	0.047	(-0.944, 1.038)	.925	-0.496	(-1.779, 0.786)	.444
Eggs	0.769	(-2.539, 4.076)	.647	-1.909	(-6.253, 2.435)	.385
Milk	0.087	(-0.482, 0.655)	.763	0.090	(-0.788, 0.968)	.839
Confectioneries	-0.196	(-3.298, 2.906)	.901	1.463	(-2.025, 4.951)	.407
Drinks	0.009	(-0.709, 0.726)	.981	-0.110	(-1.239, 1.018)	.846
Seasonings	1.475	(-2.984, 5.934)	.514	0.047	(-8.061, 8.156)	.991

# Διαχείριση του καλίου από το έντερο



- 90% του καλίου αποβάλλεται από τους νεφρούς.
- 10% αποβάλλεται από το έντερο, μέσω ειδικών διαύλων καλίου (BK channels) στα επιθηλιακά κύτταρα του παχέος εντέρου.
- Όταν η νεφρική λειτουργία μειώνεται, το έντερο αποκτά σημαντικότερο ρόλο στη διατήρηση της ομοιόστασης του καλίου (αύξηση έκφρασης BK)
- Σε αιμοκαθαιρόμενους ασθενείς η αποβολή καλίου από τα κόπρανα αυξάνεται περίπου κατά **30%** της και μπορεί να φτάσει έως και τα 3.000 mg/ημέρα (**~80%**)
- Η αργή εντερική κινητικότητα και η δυσκοιλιότητα:
  - ✓ **μειώνουν την αποβολή καλίου**
  - ✓ **αυξάνουν τη συσσώρευση καλίου**
  - ✓ **μπορούν να οδηγήσουν σε υπερκαλιαιμία**



2024 update

### 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.

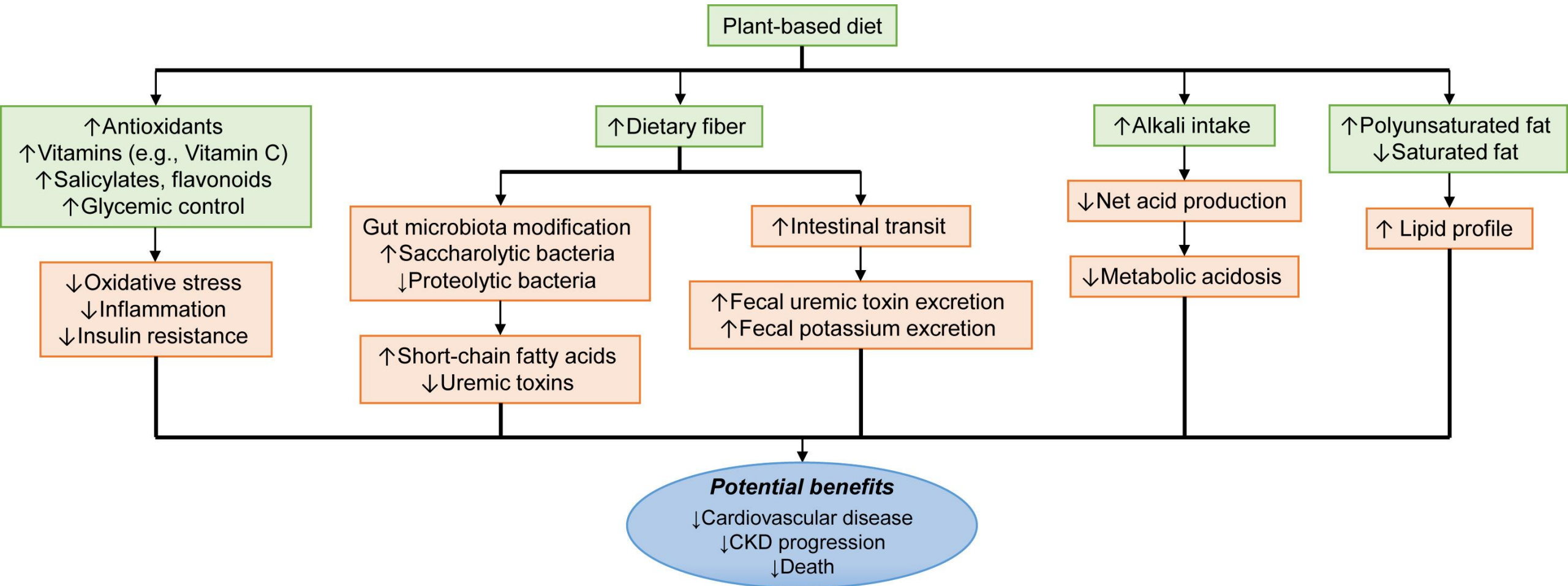
### 3.3 Diet

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 ultraprocessed foods.

Practice Point 3.3.2: Use renal dietitians or accredited nutrition providers to educate 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.



# Οφέλη της Plant-Based Diet





# Βιοδιαθεσιμότητα του καλίου της διατροφής

**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.



## 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%

**\* Πατάτες >94% βιοδιαθεσιμότητα**

# Σύγχρονη αντίληψη για τον διαιτητικό περιορισμό καλίου στη ΧΝΝ



- Dietary restriction 2000-3000mg/day
- White grains, meat, low fruits, vegetables



- Personalized potassium intake
- Whole grains, plant-based eating, high fruits and vegetables (bioavailability potassium)

Τότε

Τώρα

**Minimally processed or whole foods**



Potatoes (unless double boiled)



Tomato sauce



Dried fruits



Coconut water/ Coconut milk



Dairy products/ Soy milk  
(Limit to 1 cup/day)



Coffee (Limit to 2 cups/day)

**Processed**



Chocolate bars



Tomato-based soups



Fruit/vegetable juices



Chocolate milk



Potato chips



French fries

**Processed with potassium additives**



Salt substitutes



Processed meats/ Ham / Hot dogs



Low sodium dill pickles



Low sodium canned soups



Low Sodium V8 Juice



Breaded strips/ Nuggets

**SUPERMARKET SMARTS: READING FOOD LABELS**

**WHAT TO LOOK FOR**



Nutrition Facts	
SERVING SIZE	100g
Calories	5
180 kcal	
SERVINGS PER CONTAINER 10	
PER SERVING	
Calories	10
<b>Potassium (10% DV)</b>	
Be thirtout frog	
INSREDIANTS	10%
Focalla fo 6 leard	3%
Tlauther Parats	3%
<b>Potassium Chloride</b>	





## Precooked Chicken Breast Strips

### Examples of potassium additives:

- Potassium chloride
- Potassium lactate
- Potassium phosphate
- Potassium citrate

### Know your potassium percentages:

**Low: 3% = 100 mg or less**

**Medium: 3%–6% = 101–200 mg**

**High: 6%–9% = 201–300 mg**

**Very High: 9% = 300 mg or more**

<b>Nutrition Facts</b>	
Serving size	4 Pieces (100g)
Amount Per Serving	
<b>Calories</b>	<b>110</b>
% Daily Value*	
Total Fat 1.5g	2%
Saturated Fat 0.4g	2%
Trans Fat 0g	
Cholesterol 45mg	15%
Sodium 390mg	17%
Total Carbohydrate 1g	0%
Dietary Fiber 0g	0%
Total Sugars 0g	
Includes 0g Added Sugars	0%
<b>Protein 22g</b>	<b>44%</b>
Vitamin D 0mcg	0%
Calcium 10mg	0%
Iron 0.5mg	2%
<b>Potassium 950mg</b>	<b>20%</b>

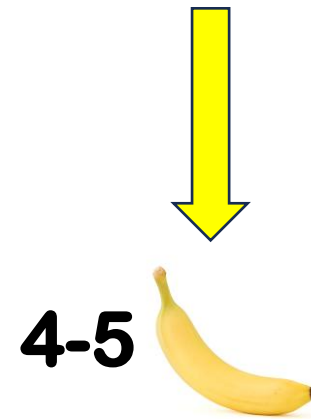
\*The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Ingredients: Chicken breast, water, **potassium lactate**, canola oil, soy protein, modified corn starch, dehydrated chicken flavour, sodium phosphate, salt, sodium diacetate, dehydrated garlic, dehydrated onion, sea salt. Contains: soy.

👉 όχι μόνο «κόβω κάλιο», αλλά «διαχειρίζομαι κάλιο»

With additives	Potassium (mg)	Additive type	Without additives	Potassium (mg)	Difference (mg)
<b>Breakfast</b>					
Toasted oats, whole grain toasted oats cereal, 30 g	200	Potassium chloride	Organic toasted oat cereal, 28 g	110	90
Almond milk, 240 g	250	Dipotassium phosphate	Almond milk, 240 g	74	176
Split top white bread, 31 g	25	Potassium iodate	Enriched premium white bread, 31 g	25	0
Spreadable butter, 14 g	0	n/a	Spreadable butter, 14 g	0	0
Creamy chilled coffee, 300 g	570	Potassium carbonate	Organic cold brew coffee with milk, 300 g	276	294
<b>Lunch</b>					
Ham sandwich			Ham sandwich		
100% whole wheat bread, 72 g	160	Potassium iodate	Market basket, 100% whole wheat bread, 86 g	110	50
Meijer cooked ham, 56 g	390	Potassium lactate	Everyday value, organic black forest ham, 56 g	190	200
Mayonnaise, 13 g	0	n/a	Mayonnaise, 13 g	0	0
Popcorn, 33 g	190	Potassium chloride	Popcorn, 28 g	77	113
Kosher dill spears, 28 g	120	Potassium chloride	Organic polish dill pickles, 28 g	20	100
Citrus salad in light syrup, 126 g	150	Potassium sorbate	Tropical fruit salad, 122 g	150	0
Low sodium, 100% vegetable juice, 240 g	931	Potassium chloride	Vegetable juice blend, 240 g	691	240
<b>Dinner</b>					
Original smoked sausage links, 76 g	510	Potassium lactate	Premium sausage, 76 g	271	239
Buttery homestyle mashed potatoes, 28 g	360	Dipotassium phosphate	Mashed potato granules, 25 g	170	190
Cut corn, 85 g	200	n/a	Cut corn, 85 g	200	0
Low-fat yogurt, 170 g	280	Potassium sorbate	Low-fat yogurt, 170 g	281	1
Swiss miss, hot cocoa mix, 16 g	380	Dipotassium phosphate	Organic drinking chocolate, 15 g	197	183
<b>Total</b>	<b>4716</b>			<b>2842</b>	<b>1874</b>

Total difference K+ intake  
**+1874 mg/day** with additives





Αν εμφανιστεί **υπερκαλιαιμία**  
μπορεί να συνδυαστούν η  
υγιεινή διατροφή και ο  
διατροφικός περιορισμός καλίου  
σε ΧΝΝ?

# Επί υπερκαλιαιμίας επιλέγω φρούτα/λαχανικά χαμηλά σε κάλιο

## Fruits



Apples



blueberries



cranberries



grapes



grapefruit



peaches



pears



pineapple



Raspberries

## Vegetable



Cauliflower



onions



peppers



radishes



summer  
squash



lettuce

# Μέθοδοι Μαγειρέματος για Μείωση Καλίου

- 1. Διπλό Βράσιμο:** Είναι η πιο αποτελεσματική μέθοδος. Βράζετε λαχανικά με υψηλό κάλιο (π.χ. πατάτες) σε άφθονο νερό, στραγγίζετε, προσθέτετε φρέσκο νερό και ξαναβράζετε. **Μειώνει το κάλιο κατά περίπου 50%.**
- 2. Απλό βράσιμο:** Λαχανικά: **59%**, Όσπρια: **78,5%**, Κρέατα: **57%**, Άλευρα: **94%**, Τυρί τσένταρ: **99%**, Φρούτα: **43%**
- 3. Ξεφλούδισμα-Κοπή σε μικρότερα κομμάτια (λωρίδες, κύβους ή φέτες).** Τα μικρότερα κομμάτια αυξάνουν την επιφάνεια επαφής, επιτρέποντας την απομάκρυνση μεγαλύτερης ποσότητας καλίου όταν τοποθετούνται στο νερό.
- 4. Μούλιασμα:** σε θερμοκρασίες ψυγείου για 12 ώρες, με αλλαγή νερού στις 4 ώρες, προσφέρει μόνο περίπου 15% μείωση της περιεκτικότητας σε κάλιο. Όταν τα φασολάκια **καταψυχθούν πρώτα** και μετά μουλιαστούν, παρατηρείται **μείωση του καλίου πάνω από 90%**.
- 5. Στραγγισμα:** Στραγγίζετε και ξεπλένετε πάντα όλα τα κονσερβοποιημένα λαχανικά και όσπρια πριν από τη χρήση.



Martínez-Pineda M et al. Reduction of potassium content of green bean pods and chard by culinary processing. Tools for chronic kidney disease. Nefrologia. 2016 Jul-Aug;36(4):427-32.

Burrowes J. et al. Changes in Potassium Content of Different Potato Varieties After Cooking. Journal of Renal Nutrition, 18, 530-534



Μήπως λοιπόν ν'  
απελευθερώσουμε τη  
διαιτητική πρόσληψη καλίου  
στη ΧΝΝ?

# Should we liberalize potassium intake in CKD? No, we should not

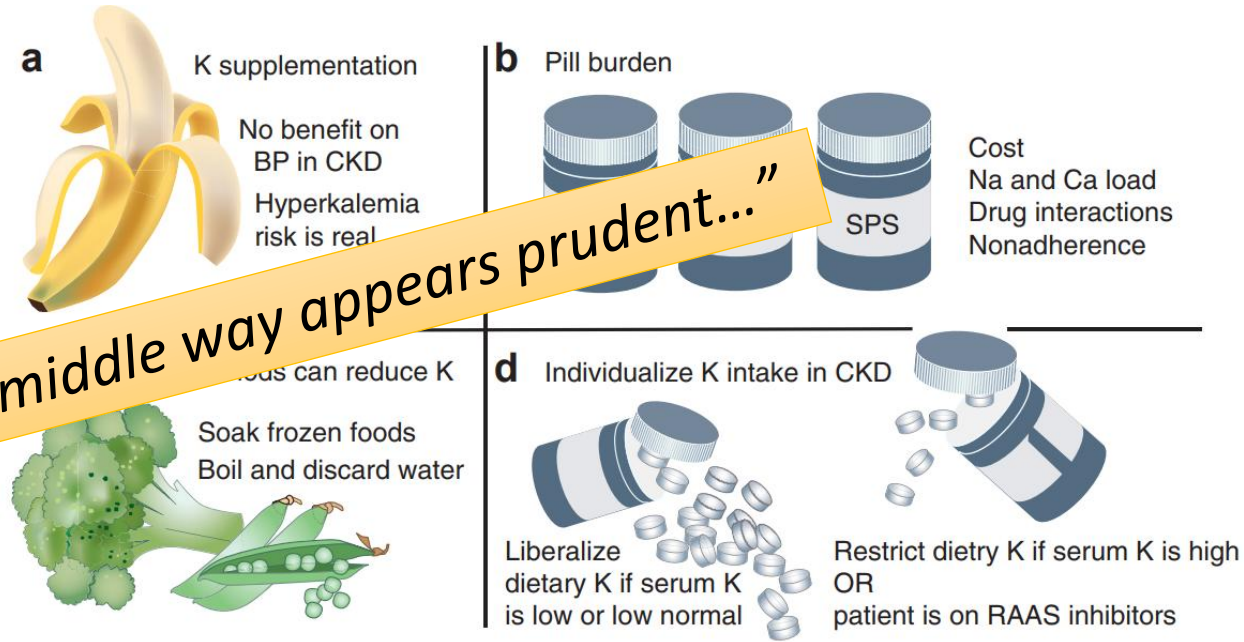


*“Liberalization of potassium intake is similarly not desirable because it has unclear health benefits in CKD.”*

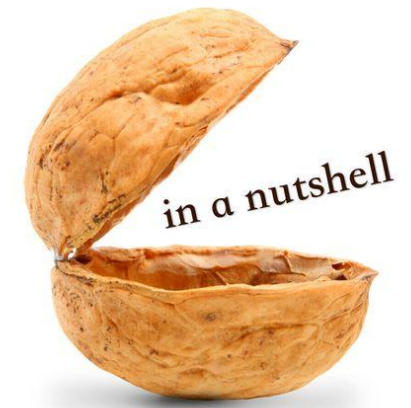
*“Use of food chemistry is a simple expedient to achieve reduction in food K levels.”*

*“...dietary K i... Too much or too little can hurt— the middle way appears prudent...”*

*“..In patients with hypokalemia or serum K levels at low normal, liberalization of K intake would be reasonable...”*



# Take-home messages



- Επαναξιολόγηση και πιο εξατομικευμένη εφαρμογή των περιορισμών καλίου.
- Η πηγή και η επεξεργασία των τροφών έχουν σημασία.
- Ενθάρρυνση αυξημένης κατανάλωσης φυτικών τροφών και μείωση ζωικών και υπερ-επεξεργασμένων τροφίμων.
- Σημαντικός ο τρόπος μαγειρέματος των τροφών
- Βασικός ο ρόλος των εξειδικευμένων κλινικών διατροφολόγων- εκπαίδευση ασθενών
- Ανάγκη για περισσότερες μελέτες σχετικά με ασφαλείς και αποτελεσματικές διατροφικές παρεμβάσεις στον πληθυσμό με ΧΝΝ.

Ευχαριστώ για την προσοχή σας

