Φυτικές δίαιτες για ασθενείς με ΧΝΝ (Μεσογειακή διατροφή)

…μα Πράσινη Νεφρολογική άποψη

Οικονομάκη Δώρα
Νεφρολόγος, Επιμ.Β
ΓΝΑ «ο Ευαγγελισμός»

Chronic Kidney Disease Epidemiology

#NephJC

2017 850 million with CKD

Prevalence: 11.1%

In 2017 prevalence of CKD was...

2x diabetes

422 million

20x cancer

42 million

20x HIV/AIDS

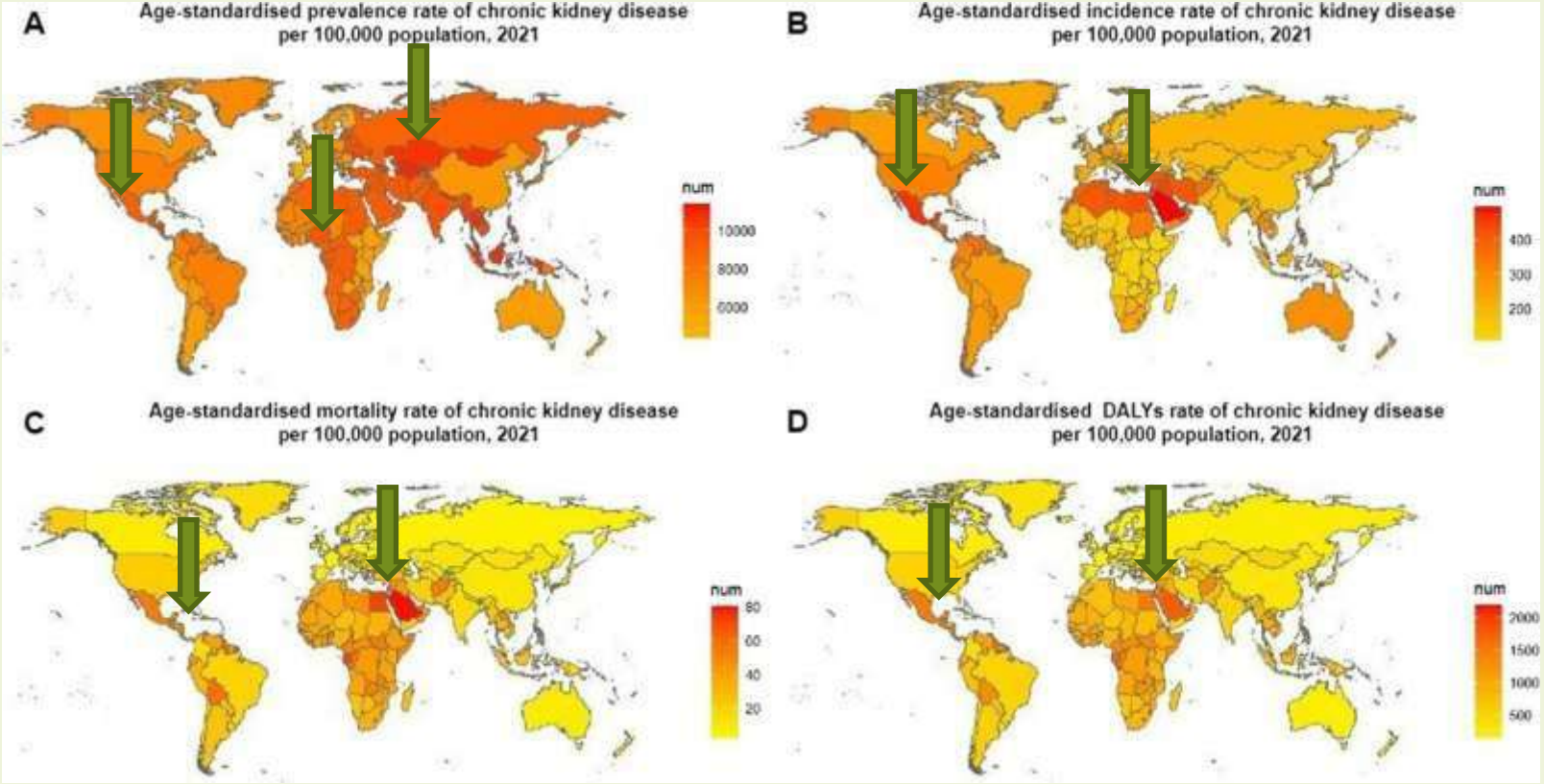
36.7 million

CKD emergent cause of death

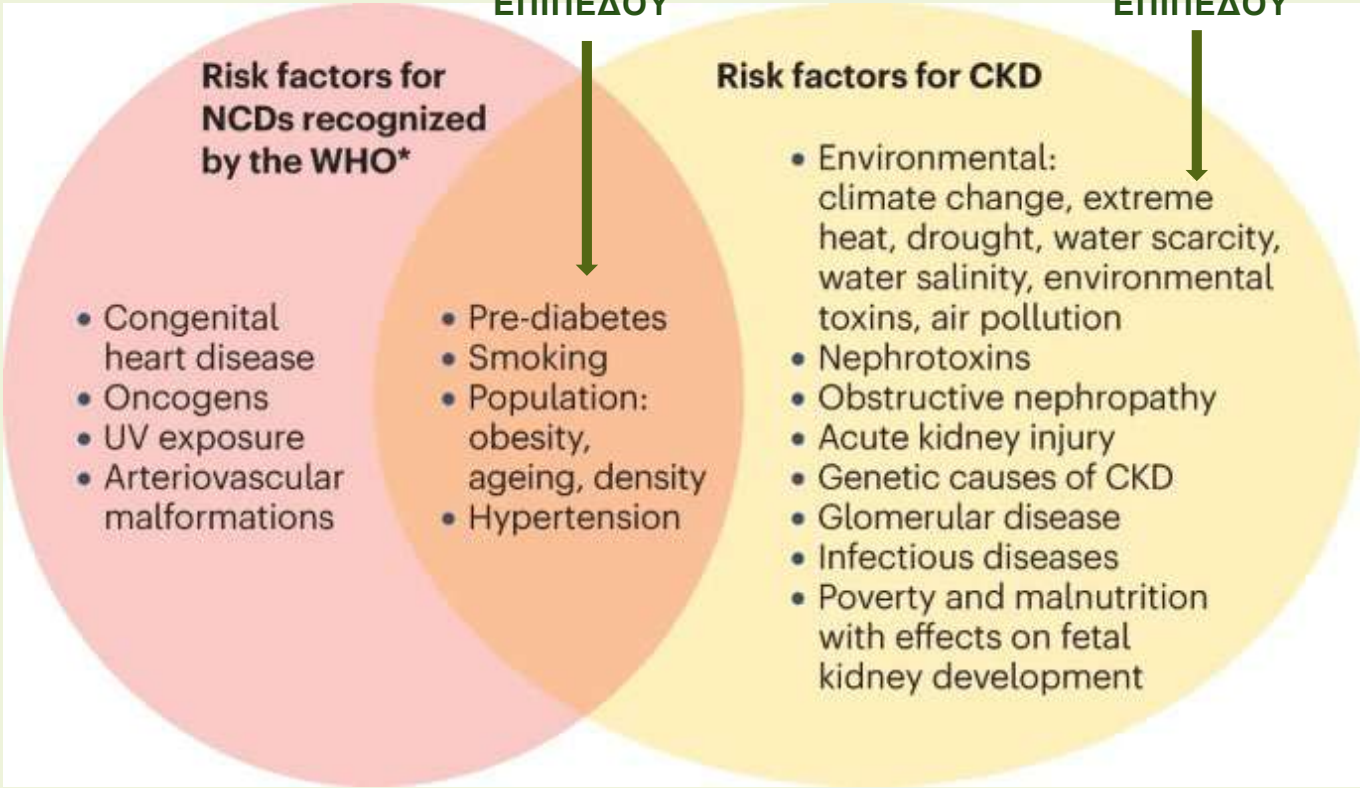
- 1990: 19th cause of death
- 2019: 11th cause of death
- 2040: 5th cause of death

Jager K et al, Kidney Int, 2019
Foreman KJ et al, Lancet, 2018

Visual Abstract by Cristina Popa, @NephroSeeker



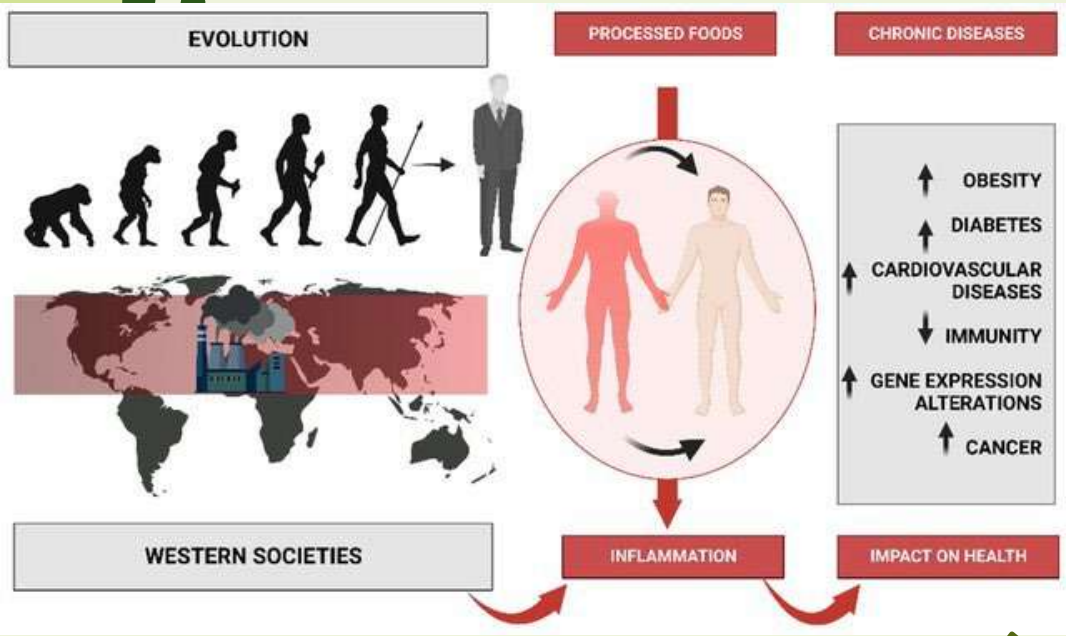
Impact of chronic kidney disease escalates around the world,by Megan Burgasser, University of Cincinnati (2025)



Francis A, et al; International Society of Nephrology. Chronic kidney disease and the global public health agenda: an international consensus. Nat Rev Nephrol. 2024

….hemodynamic disorders

….metabolic disorders



CHRONIC KIDNEY DISEASE

- **SODIUM OVERLOAD**
- **VOLUME OVERLOAD**
- **HYPERKALEMIA**
- **HYPERPHOSPHATEMIA**
- **METABOLIC ACIDOSIS**
- **HORMONE REGULATION**

Top 10 Takeaways for Nephrologists on the Management of People with CKD

KDIGO #NephJC

1 Comprehensive treatment strategy

- Lifestyle: Healthy diet and Physical activity
- Stop tobacco products

2 Adopting a healthy and diverse diet

- Prefer plant-based foods over animal-based foods
- Avoid ultra-processed foods

3 Individualize BP control

- Target office BP: SBP <120mmHg
- Less intensive strategy in frailty, high risk of falls, low life expectancy

4 Renin-angiotensin-system Inhibitors (RASi) and SGLT2i

- In all CKD with moderate and severe albuminuria with/without diabetes
- CKD and heart failure – SGLT2i irrespective of albuminuria

5 Acute changes in eGFR after RASi

- Initial dips in eGFR expected after initiation of RAS1/SGLT2i
- An eGFR fall of ≥30%: Warrants evaluation

6 Cardiovascular disease

- Estimate 10-year CVD risk using validated tool → preventive strategy
- Imaging/ invasive strategies using contrast media: not contraindicated in all

7 Thorough medication review

- Validated eGFR equations using serum creatinine for drug dosing
- Limits over-the counter and herbal remedies

8 Discontinuation and restart of medications

- Clear plan of restarting SGLT2i/RASi while discontinuing
- Re-initiation of SGLTi/RASi: Required to avoid harm

9 Symptom control in CKD

- Patient-centered management: Symptom assessment and redirecting treatment
- Effective communication and shared decision making

10 Advanced care planning

- Future health care plans: Discussed and jointly agreed with patient and caregivers
- Appropriate supportive care

KDIGO 2024 Clinical Practice Guidelines for the Evaluation and Management of Chronic Kidney Disease

VA by: Vamsidhar Veeranki @Vamsidhar V17

Διατροφή και ΧΝΝ

01. **Διατήρηση καλής θρεπτικής κατάστασης**

02. **Καθυστέρηση προόδου ΧΝΝ**

03. **Περιβαντολλογική ευθύνη**

ΜΕΣΟΓΕΙΑΚΗ ΔΙΑΤΡΟΦΗ

n=19,446

Participants enrolled in the *Seguimiento Universidad de Navarra* SUN cohort

(7,416 men & 12,030 women)

136-item food frequency questionnaire → 9-item Mediterranean Diet score (MDS)

17-item physical activity questionnaire → 8-item Physical Activity (PA) score

Modifiable Lifestyle (MDS & PA) Risk Factors on All-cause Mortality

277 deaths

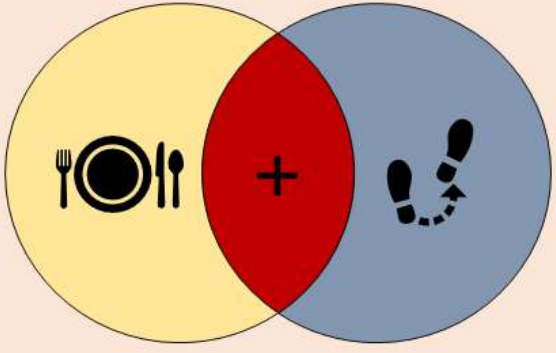
Several studies have shown that a poor quality diet increases the risk of mortality.

Q1 vs Q4 MDS:
HR = 1.70 (1.10 – 2.62)

Several studies have shown that low physical activity increases the risk of mortality.

Low vs High PA:
HR = 1.32 (1.02 – 1.70)

There is a current research gap in studying the complexity of combined lifestyle factors beyond isolated behaviors. A comprehensive interaction analysis on both multiplicative and additive scales provides key insight on the nature and impact of joint effects.



Q1 MDS-high PA vs Q4 MDS-low PA:
HR = 2.31 (1.33 – 4.01)

Synergistic effect increases mortality risk across MDS/PA risk factor combinations

Hershey MS, et al. The Mediterranean diet and physical activity: better together than apart for the prevention of premature mortality. Br J Nutr. 2022

01

Διατήρηση
καλής θρεπτικής
κατάστασης

Nutrient	Stage of CKD		
	1-2	1-4	3-4
Sodium (g/d)		<2.3	
Total fat* (% of calories)		<30	
Saturated fat (% of calories)		<10	
Cholesterol (mg/d)		<200	
Carbohydrate (% of calories)		50-60	
Protein (g/kg/d, % of calories)			
No diabetes	1.4 (~18)		0.6-0.8 (~8-10)
Diabetes	0.8 (~10)		0.6-0.8 (~8-10)
Phosphorus (g/d)	1.7		0.8-1.0
Potassium (g/d)	>4		2.4

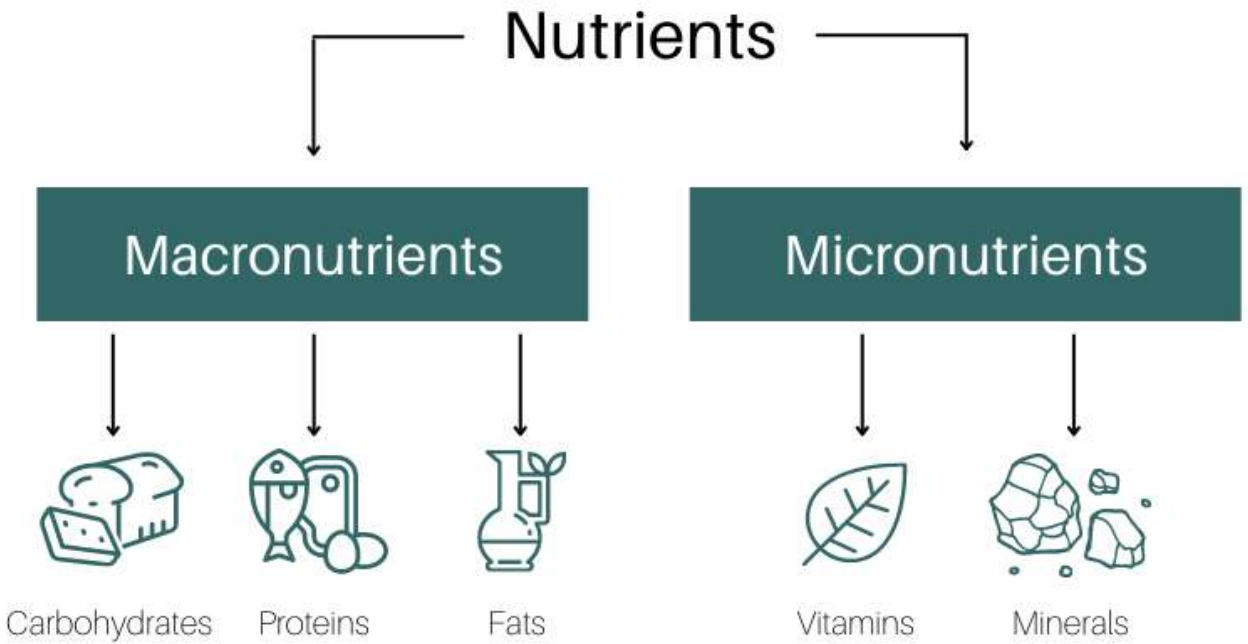
Note: Adapted from the DASH diet and NKF-KDOQI™ CPGs for Hypertension and Antihypertensive Agents in CKD, modified for diabetes and stages of CKD.[5,199]

*Adjust so total calories from protein, fat, and carbohydrate are 100%. Emphasize such whole-food sources as fresh vegetables, whole grains, nuts, legumes, low-fat or nonfat dairy products, canola oil, olive oil, cold-water fish, and poultry.

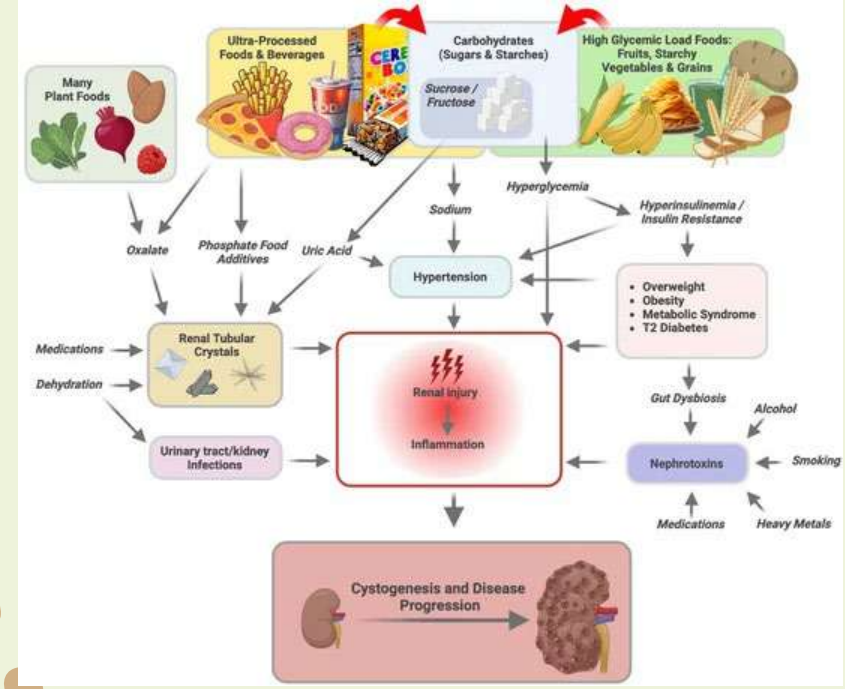
D'Alessandro C, Giannese D, Panichi V, Cupisti A. Mediterranean Dietary Pattern Adjusted for CKD Patients: The MedRen Diet. Nutrients. 2023

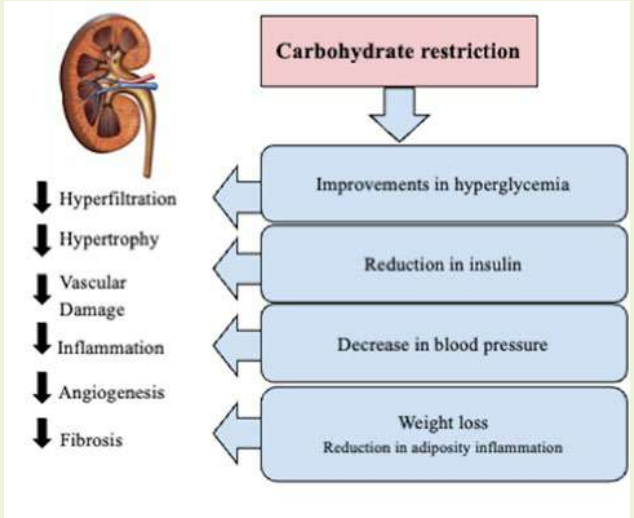
02

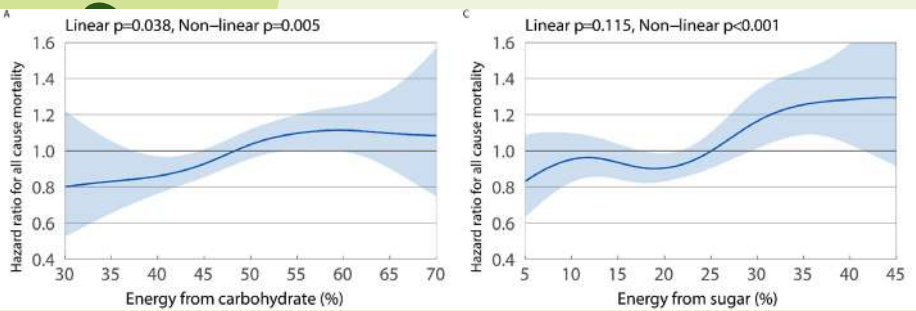
Καθυστέρηση προόδου ΧΝΝ

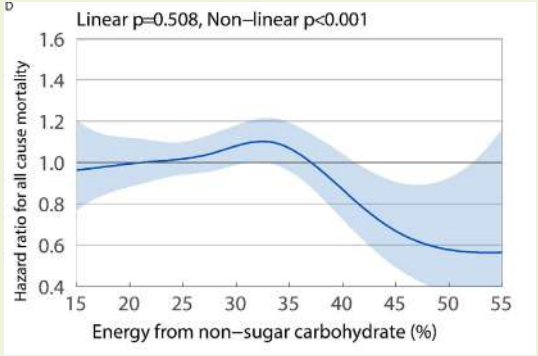

Nutrients
Macronutrients
Micronutrients
Carbohydrates
Proteins
Fats
Vitamins
Minerals

ΥΔΑΤΑΝΘΡΑΚΕΣ









- Total 3683 US adult CKD patients 20 years or older from the National Health and Nutrition Examination Survey (NHANES, 2003–2014)
- Automated Multiple Pass Method (AMPM)

The mortality risk was lower in participants who had:

- ✓ 30%-45% energy from carbohydrate
- ✓ 5%-20% energy from sugar
- ✓ 40-50% energy from non-sugar carbohydrate

Ren, Q., Zhou, Y., Luo, H., Chen, G., Han, Y., Zheng, K., … Li, X. (2023). Associations of low-carbohydrate with mortality in chronic kidney disease. Renal Failure

MEDITERRANEAN DIET
CARBS SOURCES

@Mediterranean.meal.plan

Beans and Lentils

Quinoa

Buckwheat

Potatoes

Plain kefir

Corn

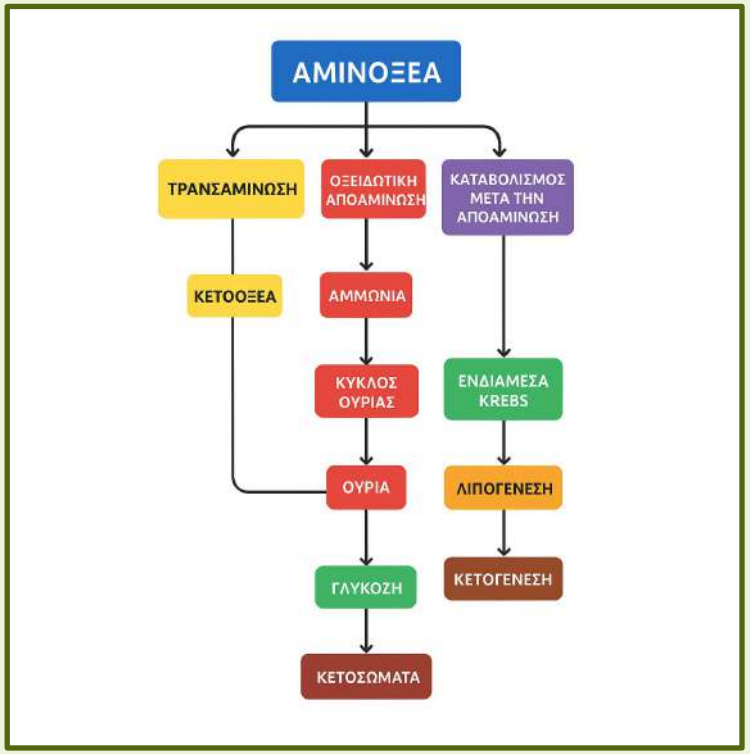
Fruits

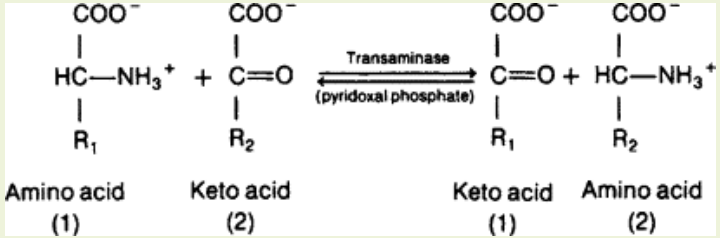
Whole Grain

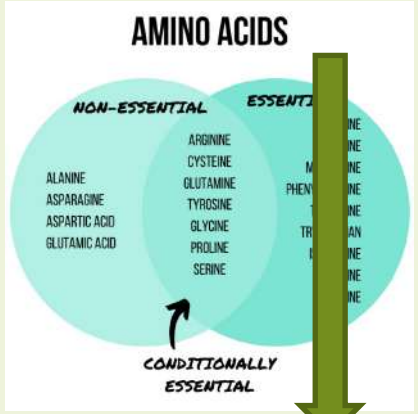
Sweet Potatoes

Whole and sprouts grain bagels, bread, english muffins, pasta and wraps

ΠΡΩΤΕΙΝΕΣ

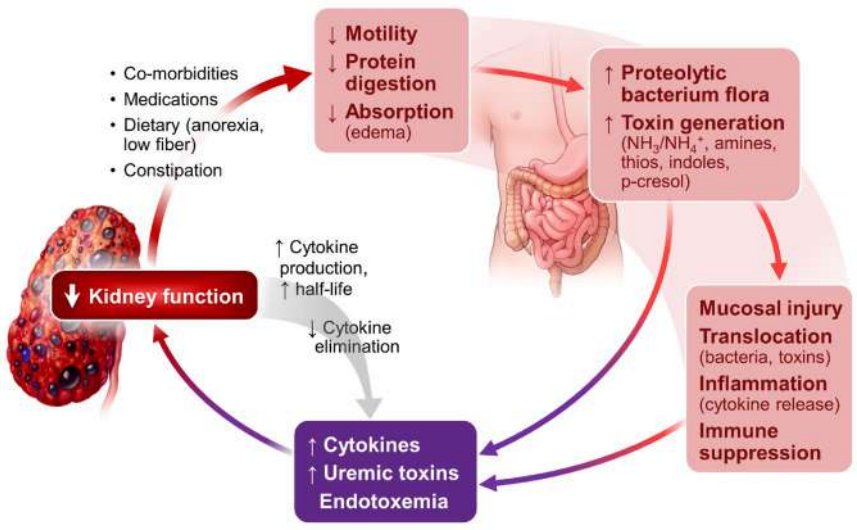


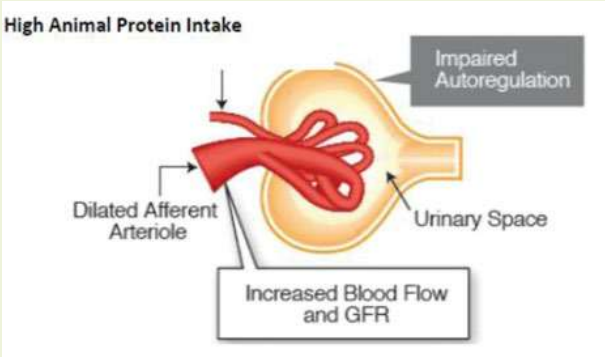


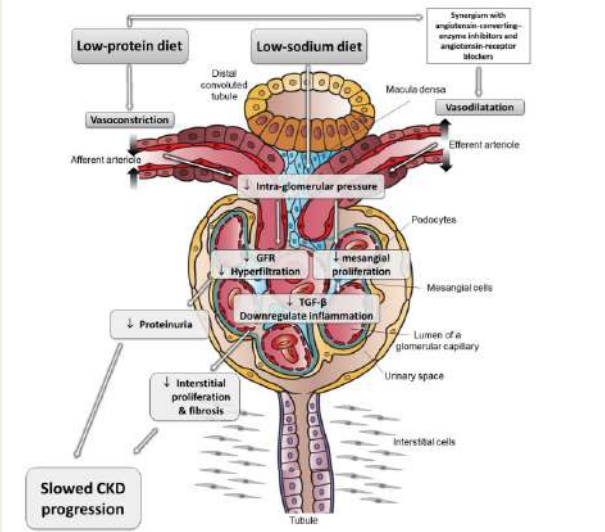


more protein is degraded than is synthesized, so more nitrogen is excreted than is ingested

Low- protein diet


• Co-morbidities
• Medications
• Dietary (anorexia, low fiber)
• Constipation
↓ Motility
↓ Protein digestion
↓ Absorption
(edema)
↑ Proteolytic bacterium flora
↑ Toxin generation
(NH_3/NH_4^+, amines, thios, indoles, p-cresol)
↓ Kidney function
↑ Cytokine production, ↑ half-life
↓ Cytokine elimination
Mucosal injury
Translocation
(bacteria, toxins)
Inflammation
(cytokine release)
Immune suppression
↑ Cytokines
↑ Uremic toxins
Endotoxemia

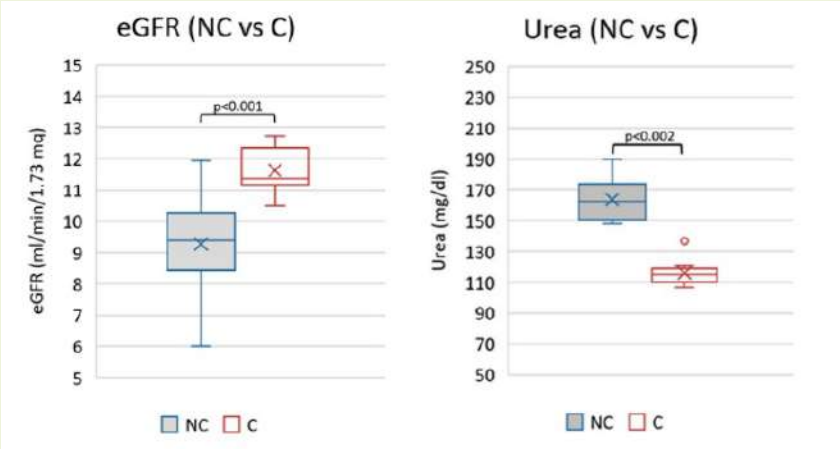

High Animal Protein Intake
Impaired Autoregulation
Dilated Afferent Arteriole
Urinary Space
Increased Blood Flow and GFR

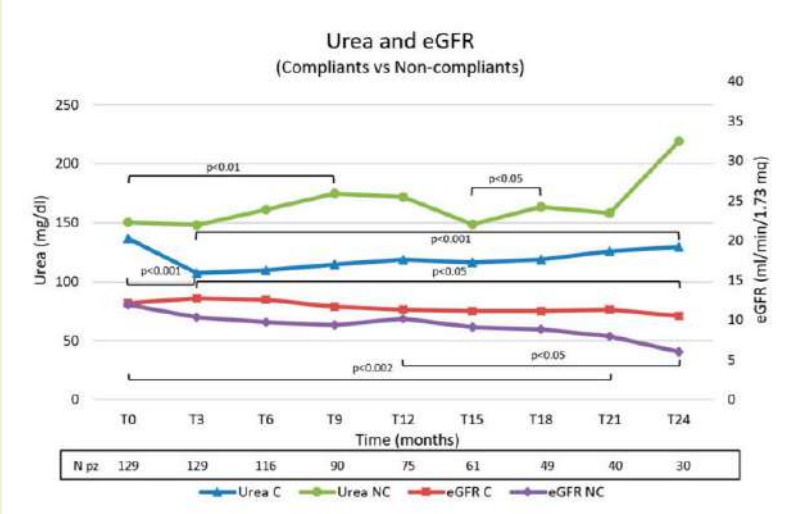

Low-protein diet
Low-sodium diet
Synergism with angiotensin-converting-enzyme inhibitors and angiotensin-receptor blockers
Distal convoluted tubule
Macula densa
Vasoconstriction
Vasodilatation
Afferent arteriole
Efferent arteriole
↓ Intra-glomerular pressure
Podocytes
↓ GFR
↓ Hyperfiltration
↓ mesangial proliferation
Mesangial cells
↓ TGF-β
Downregulate inflammation
↓ Proteinuria
Lumen of a glomerular capillary
Urinary space
↓ Interstitial proliferation & fibrosis
Interstitial cells
Slowed CKD progression
Tubule

Article

Supplemented Very Low Protein Diet (sVLPD) in Patients with Advanced Chronic Renal Failure: Clinical and Economic Benefits

Sofia Cecchi [1,*], Silvio Di Stante [2,*], Sara Belcastro [2], Veronica Bertuzzi [2], Assunta Cardillo [2], Laura Diotallevi [2], Xhensila Grabocka [2], Hrissa Kulurianu [2], Mauro Martello [2], Valentina Nastasi [2], Osmy Paci Della Costanza [2], Francesca Pizzolante [2] and Marina Di Luca [2]





High Dietary Intake of Vegetable Protein is Associated with Lower Prevalence of Renal Function Impairment: Results of the Dutch DIALECT-1 Cohort

Study Cohort

N = 420 patients with diabetes mellitus type 2
- ≥ 18 years
- No renal replacement therapy

Protein Intake

Food Frequency Questionnaire
- Gender-specific tertiles of animal and vegetable protein intake

Renal Outcome

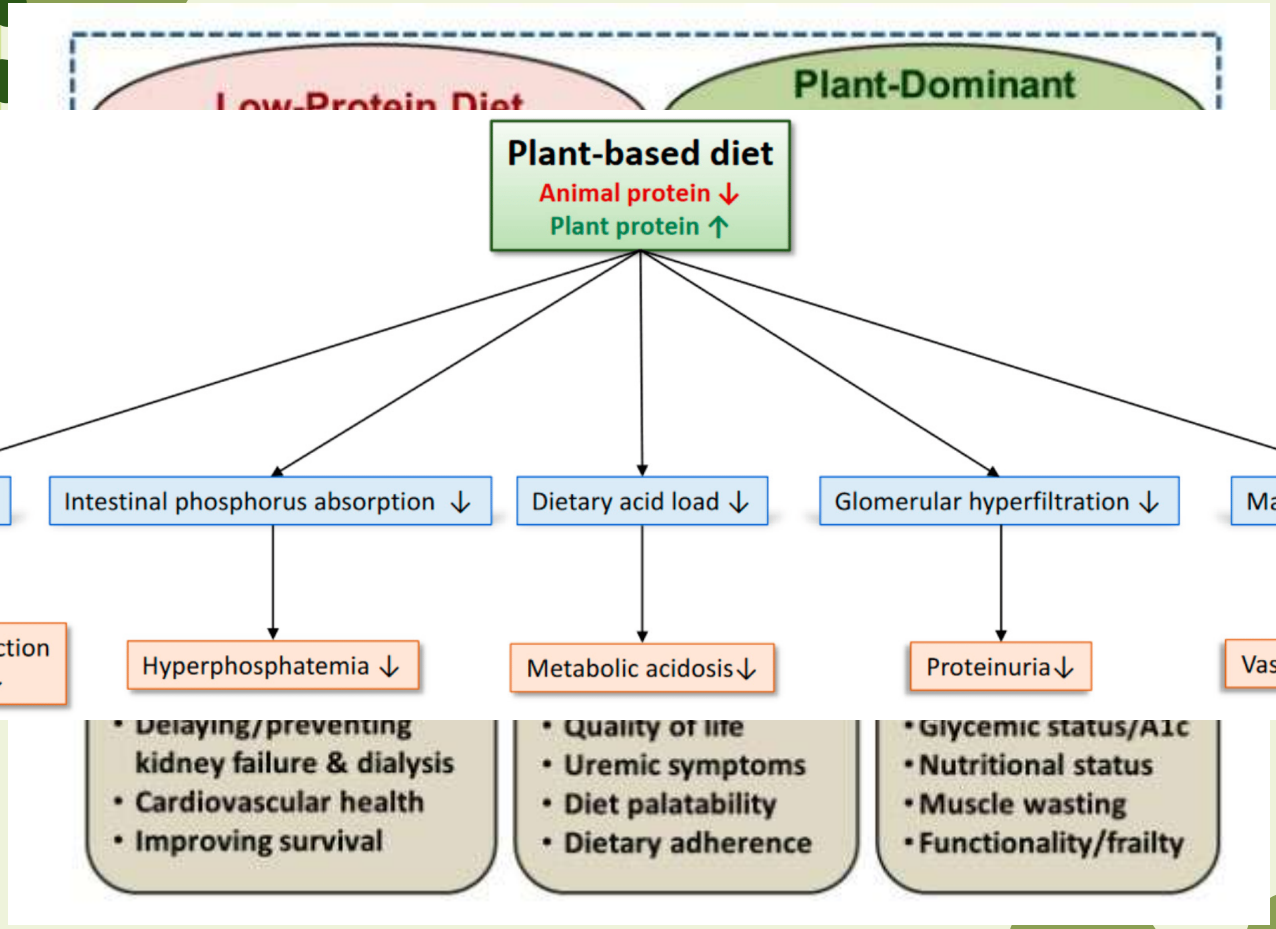
Renal Function Impairment
- eGFR <60 ml/min/1.73m^2
- N = 99 cases

Animal protein	Vegetable protein
	
Highest tertile: N = 36 cases	**Highest tertile: N = 23 cases**
Prevalence ratio: 1.06 (0.56-1.99) p = 0.87	Prevalence ratio: 0.47 (0.23-0.98) p = 0.04

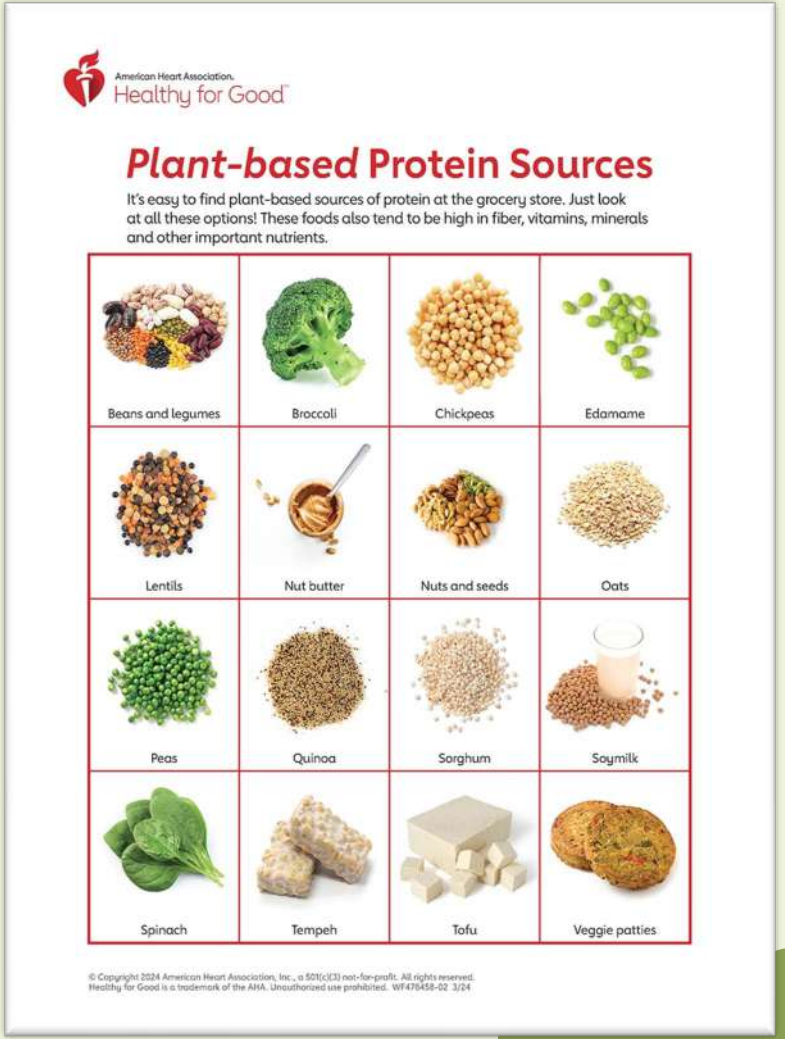
CONCLUSION:
Higher intake of vegetable protein was associated with a 53% lower prevalence of renal function impairment.

KI REPORTS
KIReports.org

Oosterwijk, *Kid Inter Rep.* 2019


Low-Protein Diet
Plant-Dominant
Plant-based diet
Animal protein ↓
Plant protein ↑
Fiber intake ↑
Intestinal phosphorus absorption ↓
Dietary acid load ↓
Glomerular hyperfiltration ↓
Magnesium intake ↑
Gut dysbiosis correction
Uremic toxins↓
Hyperphosphatemia ↓
Metabolic acidosis↓
Proteinuria↓
Vascular calcification↓
• Delaying/preventing kidney failure & dialysis
• Cardiovascular health
• Improving survival
• Quality of life
• Uremic symptoms
• Diet palatability
• Dietary adherence
• Glycemic status/A1c
• Nutritional status
• Muscle wasting
• Functionality/frailty

ΦΥΤΙΚΕΣ ΠΗΓΕΣ ΠΡΩΤΕΙΝΗΣ



American Heart Association.
Healthy for Good™

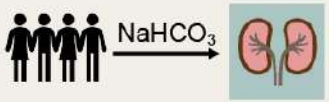
Plant-based Protein Sources

It's easy to find plant-based sources of protein at the grocery store. Just look at all these options! These foods also tend to be high in fiber, vitamins, minerals and other important nutrients.

Beans and legumes	Broccoli	Chickpeas	Edamame
Lentils	Nut butter	Nuts and seeds	Oats
Peas	Quinoa	Sorghum	Soymilk
Spinach	Tempeh	Tofu	Veggie patties

Alkali Supplementation as a Therapeutic in Chronic Kidney Disease: What Mediates Protection?

Alkali slows GFR decline



- Sodium bicarbonate ($NaHCO_3$) treatment has been shown to slow GFR decline in patients with chronic kidney disease (CKD).
- Animal models of CKD have also demonstrated a protective effect of alkali on GFR decline.
- The beneficial effect of $NaHCO_3$ on slowing GFR decline may occur even in patients without metabolic acidosis.

What mechanism(s) are responsible for this protective effect of alkali in CKD?

Renal Compensatory Mechanisms

1. ↓ Interstitial NH_4^+ → ↓ Renal Inflammation
2. ↓ Interstitial/cellular $[H^+]$ → ↓ Nephron Loss
3. ↓ Tubular H^+ secretion

Extra-Renal Mechanisms

1. ↑ Cholinergic anti-inflammatory pathway → ↓ Renal Inflammation
2. ↑ Serum HCO_3^- /pH → Improved Blood Glucose Control

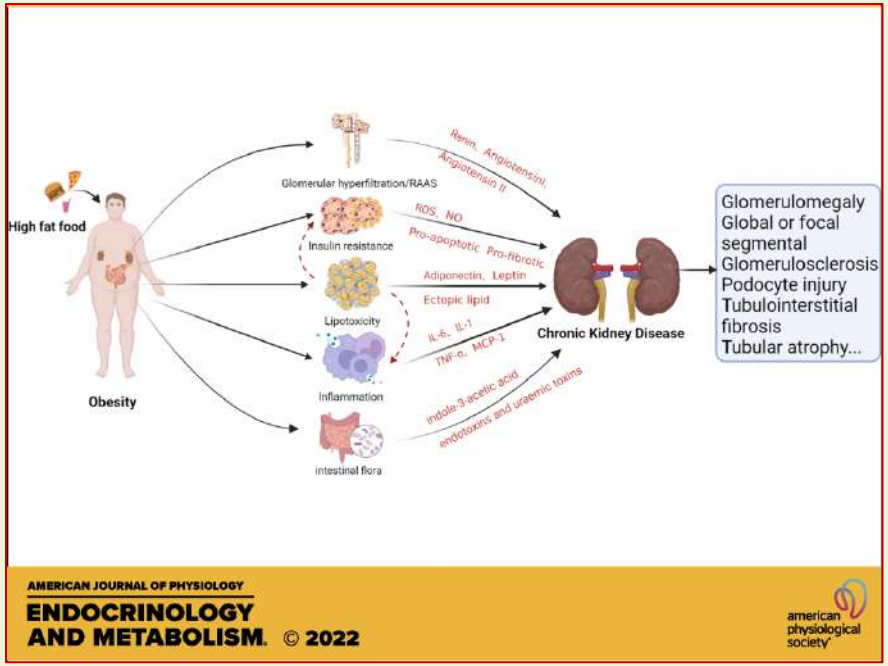
Implications for Future Research

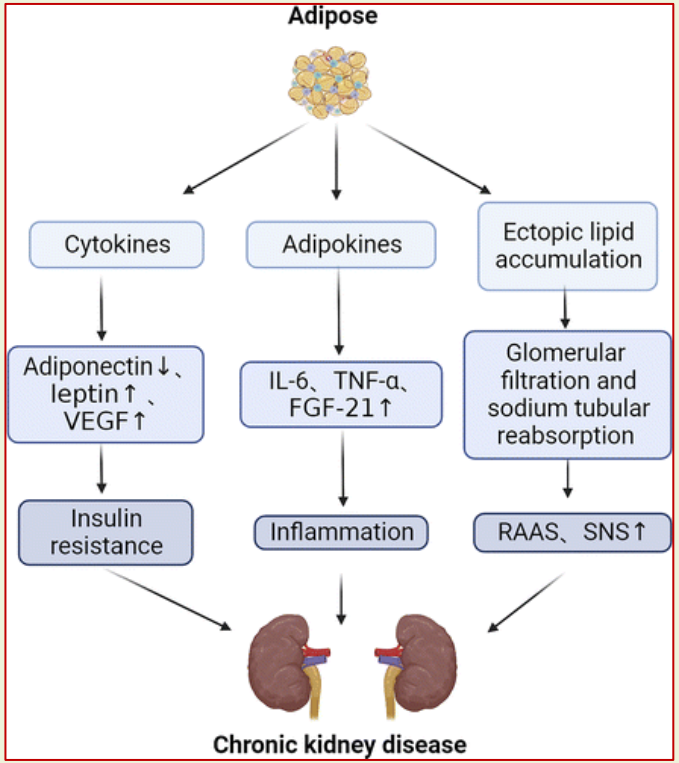
- Animal studies can provide answers to specific research questions.
- Impact future clinical trial design, saving time and decreasing cost.
- Future clinical trials can further elucidate beneficial mechanism.
- Identify patients who would benefit most from $NaHCO_3$.

AMERICAN JOURNAL OF PHYSIOLOGY
RENAL PHYSIOLOGY

american physiological society

ЛІПН





Obesity and chronic kidney disease Zongmiao Jiang, et al. American Journal of Physiology-Endocrinology and Metabolism 2023

Plasma Levels of Polyunsaturated Fatty Acids and Adverse Kidney Outcomes

Setting & Participants	Exposures & Outcomes	Results
Prospective observational cohort study **UK Biobank Study** **Polyunsaturated fatty acids (PUFA) levels measured between 2007-2010** **Median follow-up: 12 years**	**Exposures** Quartiles of percentage of plasma PUFA, omega-3 fatty acid (FA), omega-6 FA, docosahexaenoic acid (DHA), and linoleic acid relative to total FA **Outcomes** Cohort 1: incident CKD Cohort 2: incident kidney failure requiring replacement therapy (KFRT)	**Cohort 1: N = 73,419 participants without CKD**

PUFA	Incident CKD	Adjusted HR (95% CI)	*P*
Q1	**1,145** (6.2%)	**Reference**	
Q1	**859** (4.7%)	**0.83** (0.75-0.92)	**0.001**
Q3	**751** (4.1%)	**0.85** (0.76-0.96)	**0.007**
Q4	**534** (2.9%)	**0.71** (0.62-0.82)	**<0.001**

Cohort 2: N = 6,735 participants with CKD

Total PUFA levels were not associated with incident KFRT, but higher quartiles of DHA were associated with lower risk of KFRT (P for trend = 0.008)

CONCLUSION: Among individuals without CKD, higher plasma PUFA levels and all four PUFA components were associated with a lower risk of incident CKD. In individuals with CKD, only the omega-3 component of PUFA, DHA, was associated with a lower risk of KFRT.

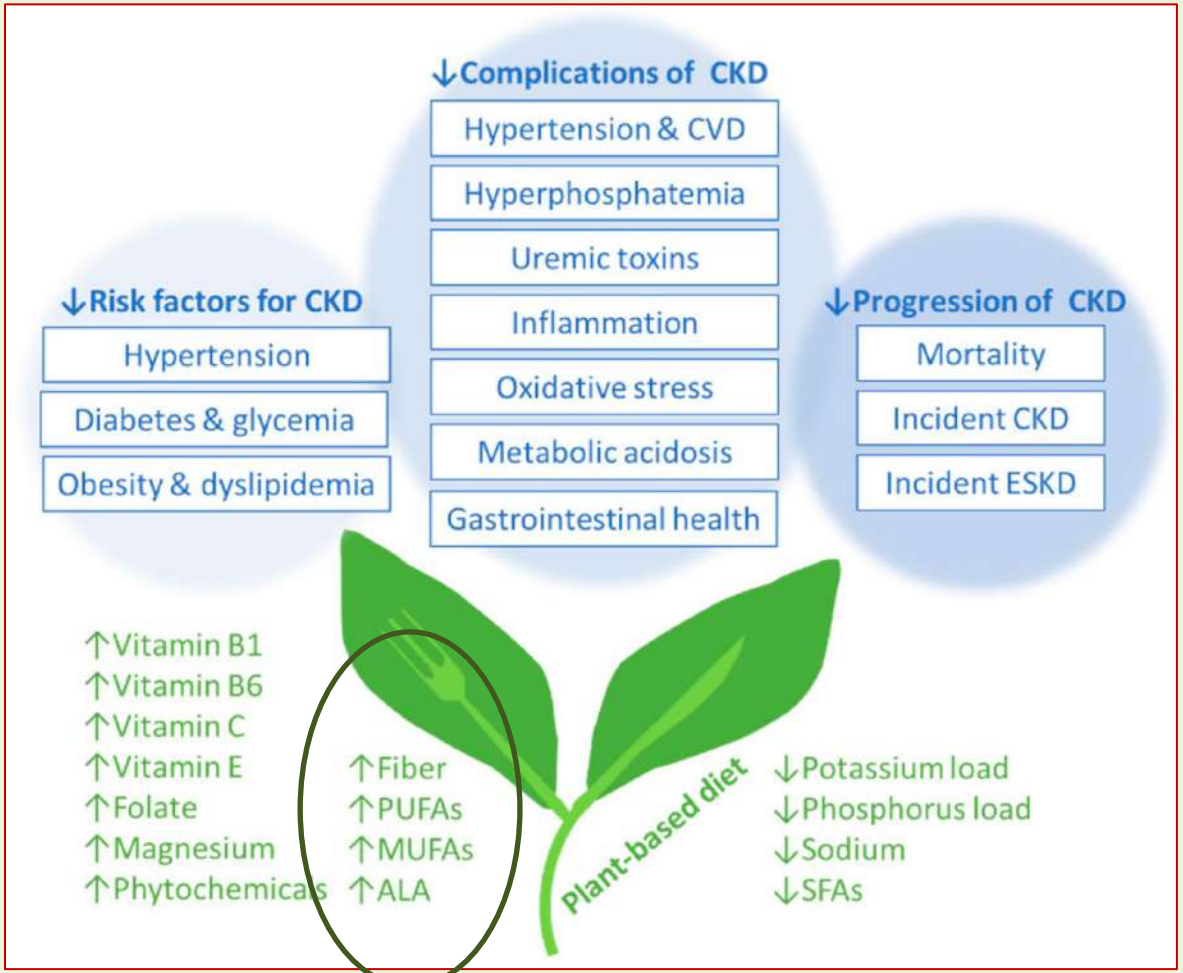
Hee Byung Koh, Hyung Woo Kim, Young Su Joo, et al

@AJKDonline | DOI: 10.1053/j.ajkd.2023.12.020

AJKD

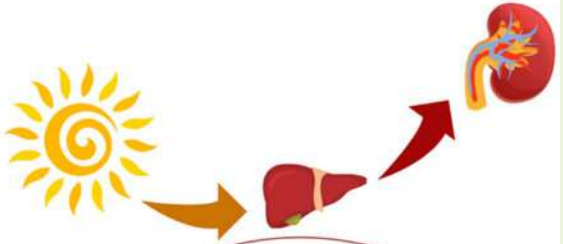
Table 1. Types and sources of dietary fat

Saturated fat ('bad fat')	Unsaturated fat ('good fat')
Full-fat dairy products	Polyunsaturated fat:
Meat and meat products (sausages, pies)	Sunflower
Biscuits, cakes and pastries	Soya
Chocolate	Corn/safflower oil
Butter, ghee and lard	Soft spread margarines
Coconut milk/cream	Oily fish and fish oils
Coconut/palm oils	
	Monounsaturated fat:
	Olive and rapeseed oil
	Avocado
	Nuts


↓Complications of CKD
Hypertension & CVD
Hyperphosphatemia
Uremic toxins
Inflammation
Oxidative stress
Metabolic acidosis
Gastrointestinal health
↓Risk factors for CKD
Hypertension
Diabetes & glycemia
Obesity & dyslipidemia
↓Progression of CKD
Mortality
Incident CKD
Incident ESKD
↑Vitamin B1
↑Vitamin B6
↑Vitamin C
↑Vitamin E
↑Folate
↑Magnesium
↑Phytochemicals
↑Fiber
↑PUFAs
↑MUFAs
↑ALA
Plant-based diet
↓Potassium load
↓Phosphorus load
↓Sodium
↓SFAs

ΒΙΤΑΜΙΝΕΣ και ΧΝΝ

VITAMIN DEFICIENCY IN HD PATIENTS



Vitamin C

- Dietary restrictions
- Removal during HD treatment
- Gastrointestinal symptoms

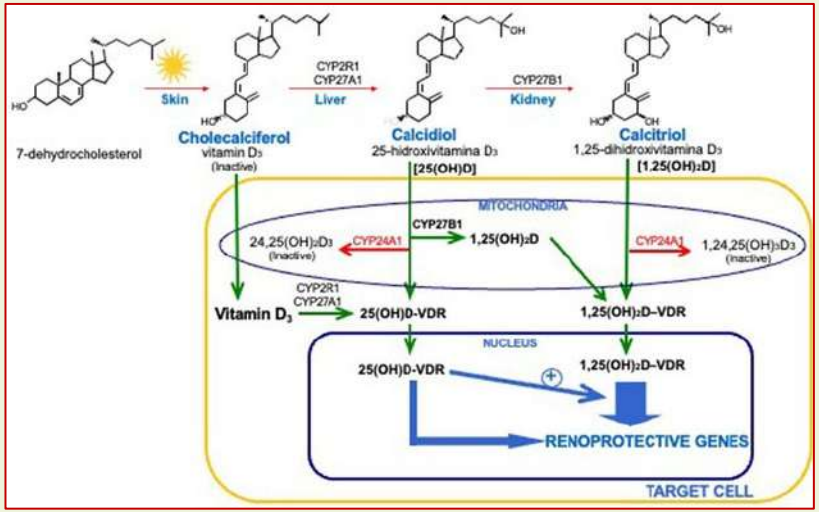
B-group vitamins

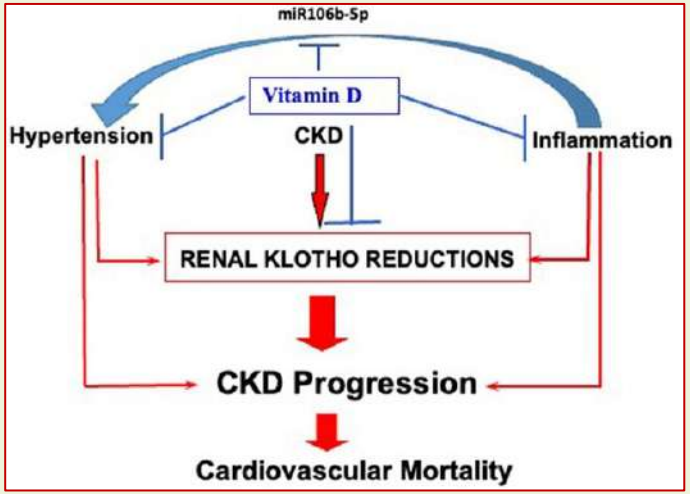
- Polypharmacy
- Dietary restrictions
- Removal during HD treatment
-Uremic gastropathy

Vitamin D

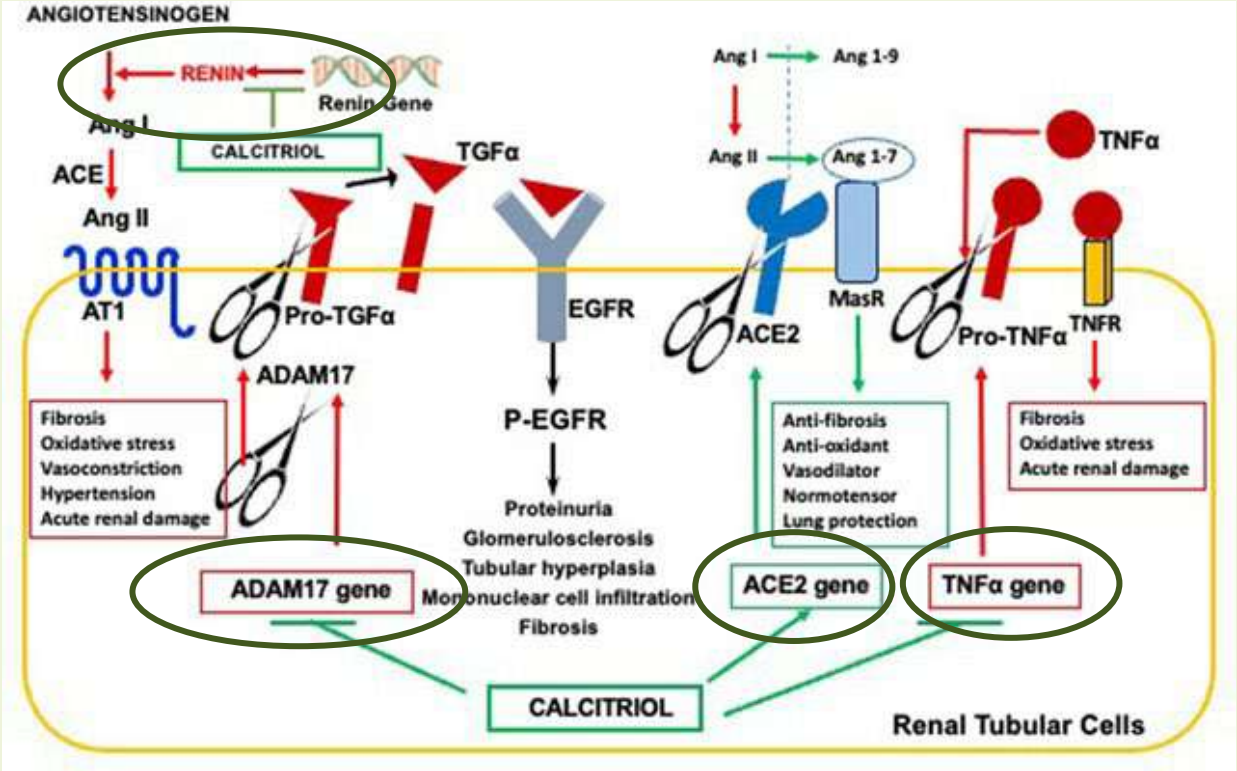
- ↓ Activity of 1-α-hydroxylase
- ↑ Vitamin D inactivation
- ↓ Sun exposure
- Unbalanced diet

Βιταμίνη D



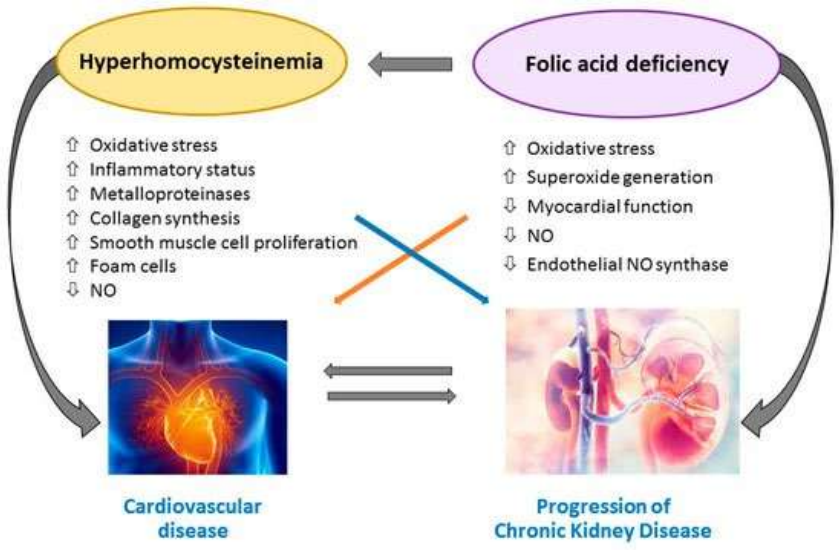


Dusso, Adriana & Bauerle, Kevin & Bernal-Mizrachi, Carlos. (2021). Non-classical Vitamin D Actions for Renal Protection. Frontiers in Medicine.



Dusso, Adriana & Bauerle, Kevin & Bernal-Mizrachi, Carlos. (2021). Non-classical Vitamin D Actions for Renal Protection. Frontiers in Medicine.

Σύμπλεγμα βιτ Β



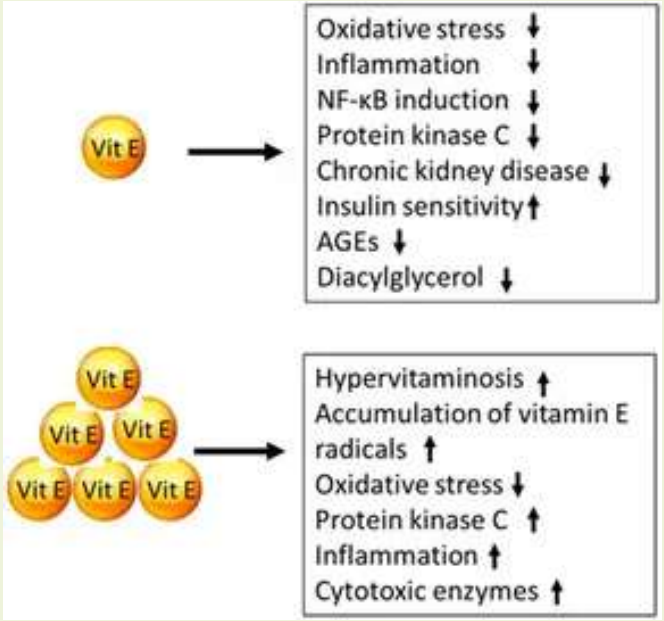
Vitamin B Complex

Folic Acid (Vitamin B9): Lowers homocysteine levels, which may reduce cardiovascular risks associated with CKD.

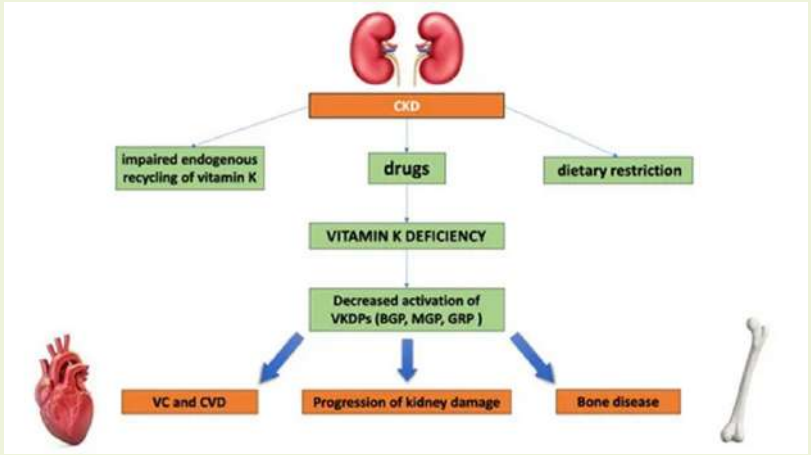
Vitamin B6 (Pyridoxine): Helps address anemia and protein metabolism issues in CKD patients.

Vitamin B12: Works synergistically with folic acid to manage homocysteine levels.

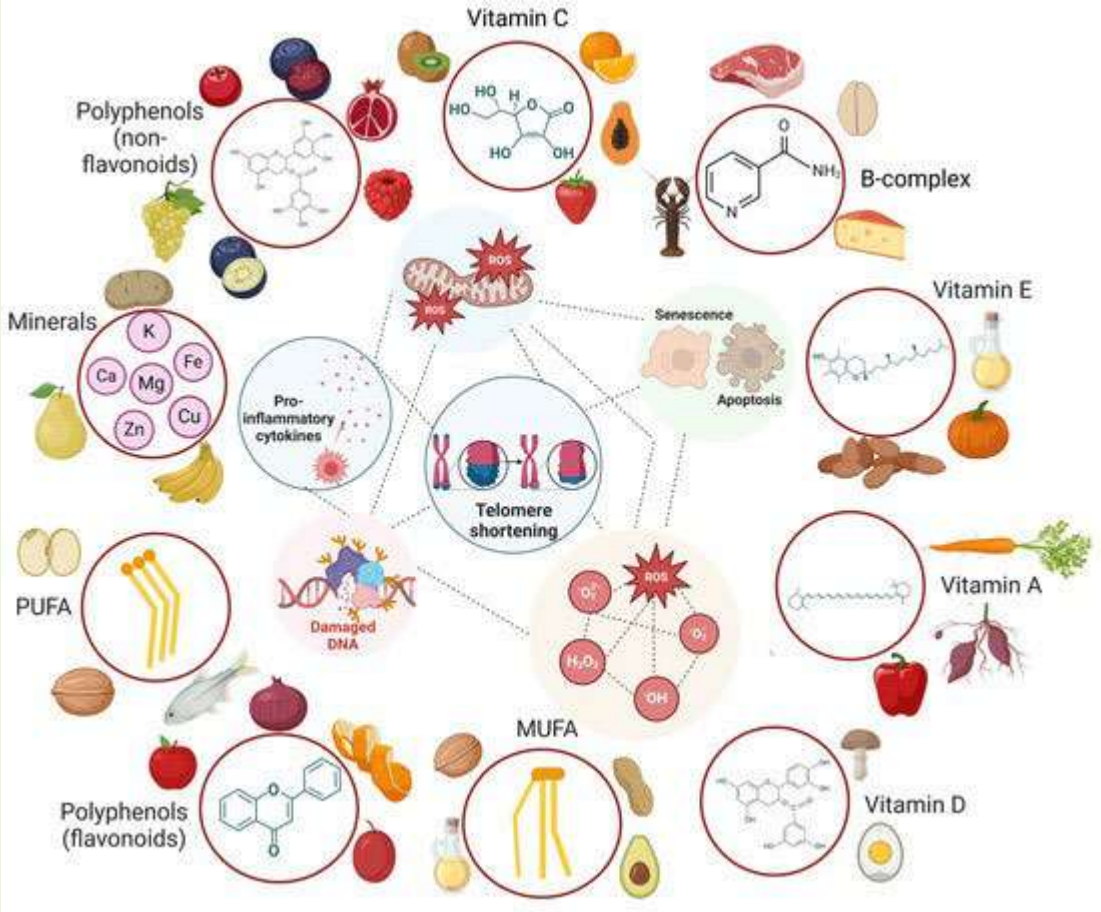
Βιταμίνη Ε



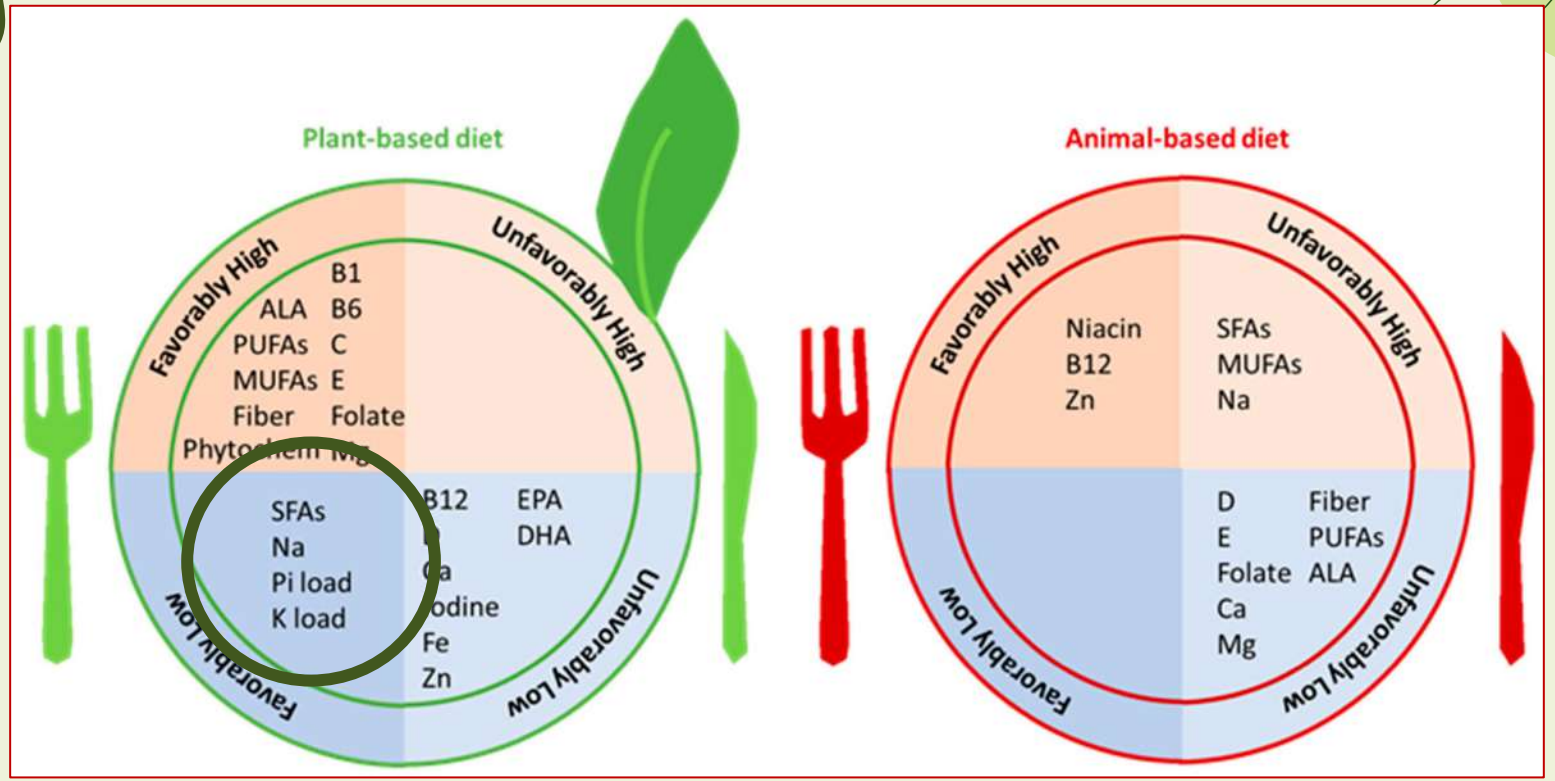
Βιταμίνη Κ



Baltusnikiene A, Staneviciene I and Jansen E (2023) Beneficial and adverse effects of vitamin E on the kidney. Front. Physiol.



Baliou S, Ioannou P, Apetroaei MM, Vakonaki E, Fragkiadaki P, Kirithras E, Tzatzarakis MN, Arsene AL, Docea AO, Tsatsakis A. The Impact of the Mediterranean Diet on Telomere Biology: Implications for Disease Management-A Narrative Review. Nutrients. 2024



Narasaki, Y.; Kalantar-Zadeh, K.; Rhee, C.M.; Brunori, G.; Zarantonello, D. Vegetarian Nutrition in Chronic Kidney Disease. Nutrients 2024
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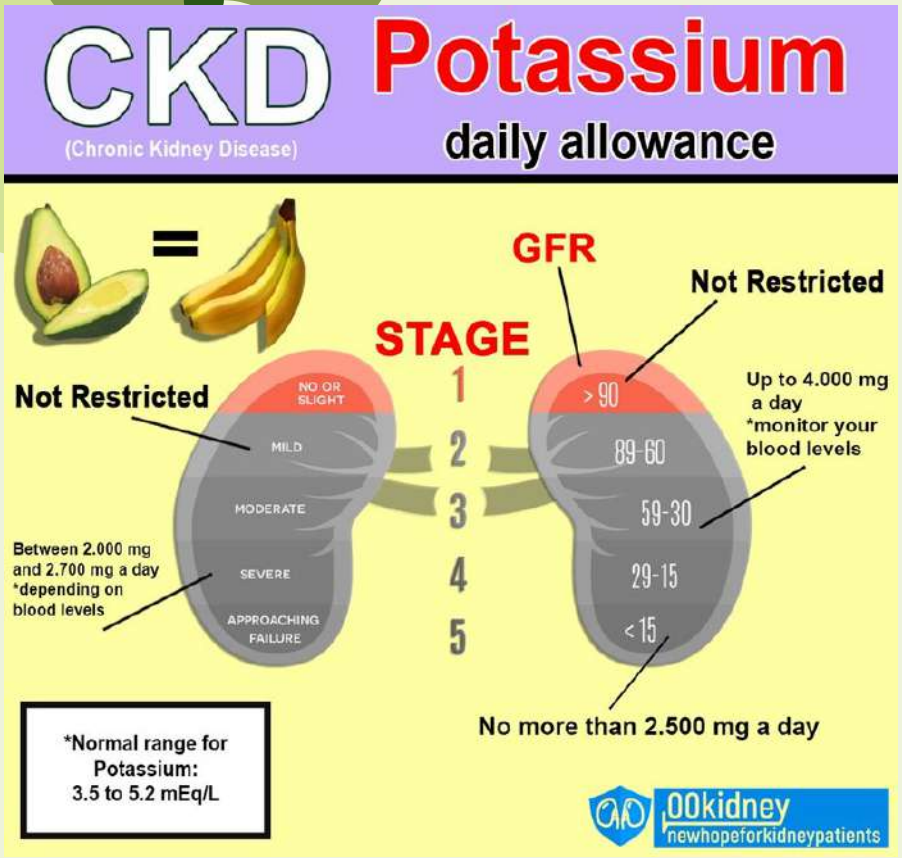
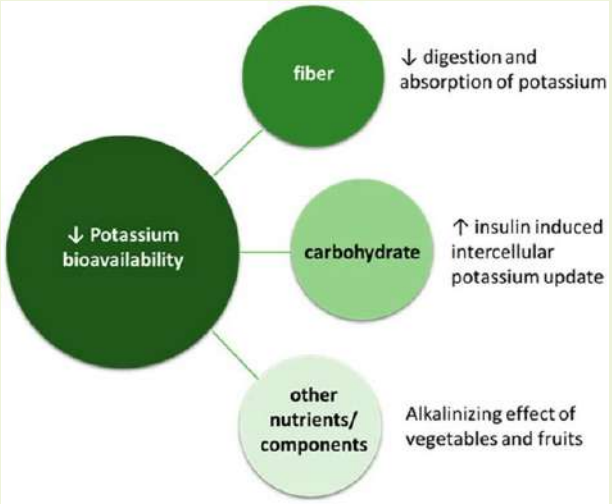
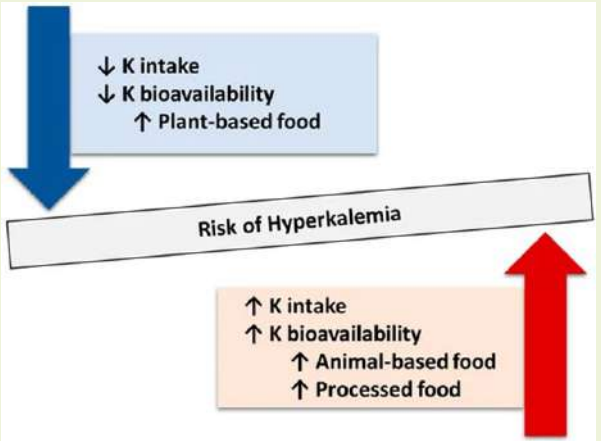






Narasaki, Y.; Kalantar-Zadeh, K.; Rhee, C.M.; Brunori, G.; Zarantonello, D. Vegetarian Nutrition in Chronic Kidney Disease. Nutrients 2024

Estimated potassium intake and the progression of chronic kidney disease

This study aimed to investigate the relationship between estimated potassium intake and CKD progression.

Methods

Longitudinal cohort
4,314 CKD patients; Fukuoka, Japan
Enrollment: 2013–2017
Follow-up: 5 years

Exposure:
Estimated potassium intake

Primary endpoint: CKD progression

Results

LOWER estimated potassium intake

CKD progression
N=1,490

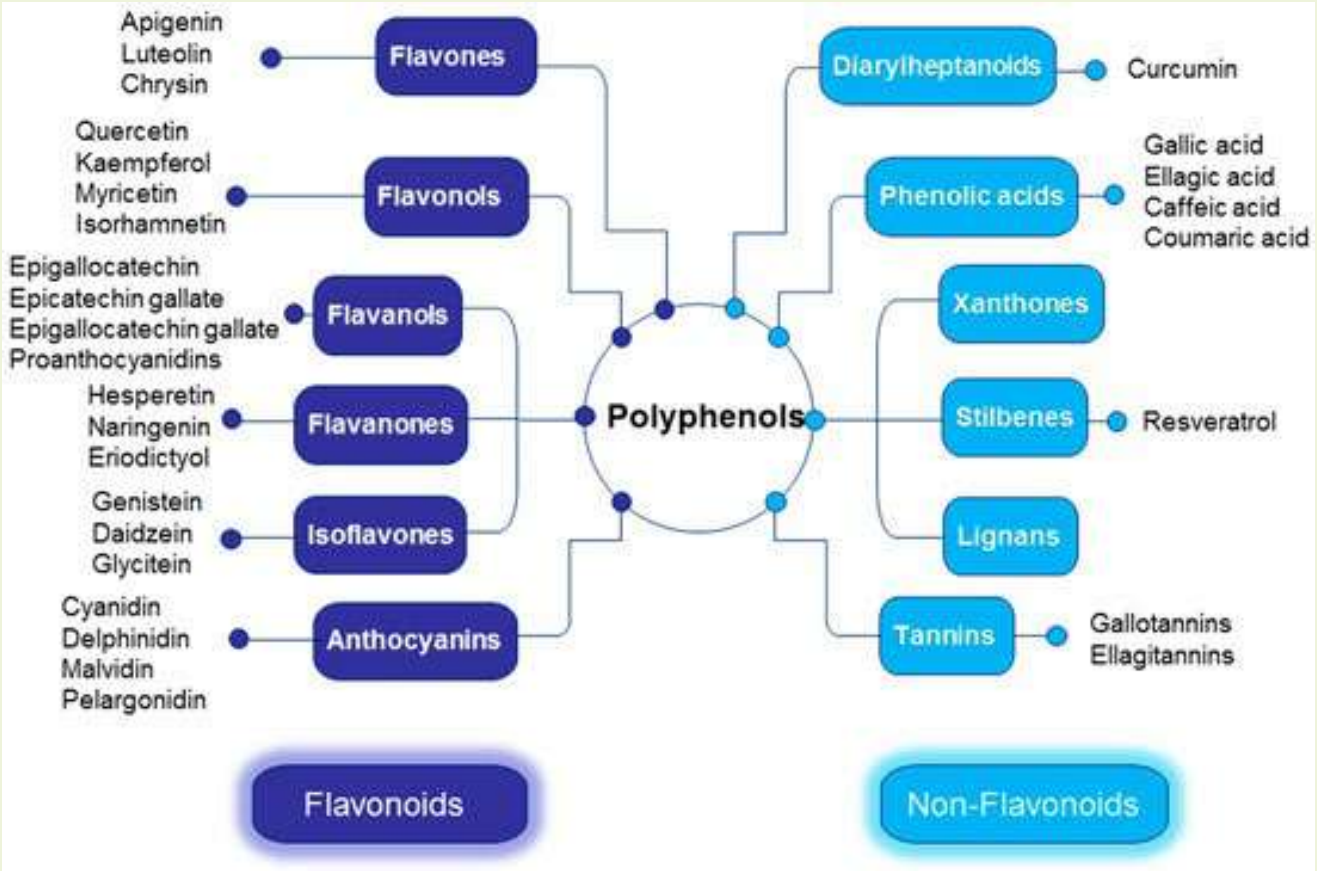
HR* 1.10
(95% CI: 1.03–1.19)

*Adjusted HR (95% CI) per 1 SD decrease in potassium intake

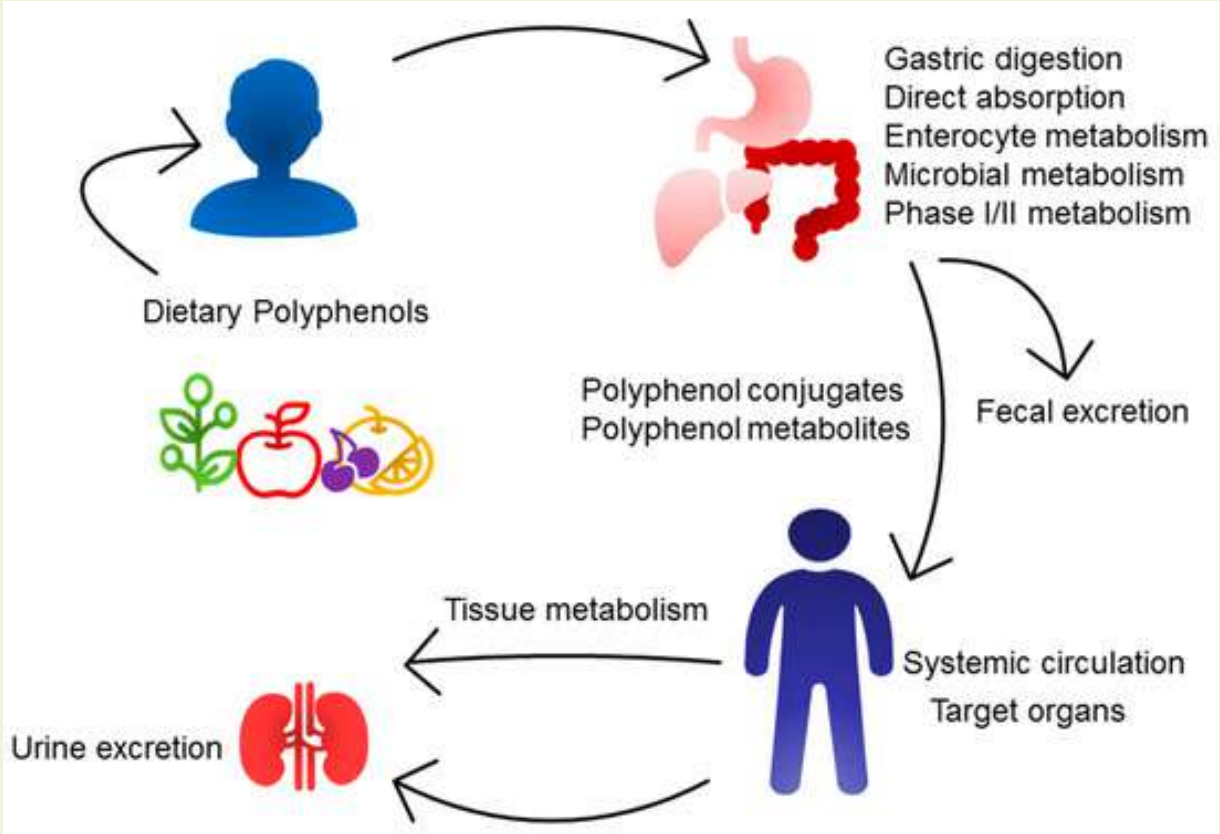
Suenaga, T. *et al.*
NDT (2024)
@NDTSocial

Lower estimated potassium intake is associated with the progression of CKD in patients with CKD. We recommend adequate potassium intake, taking care not to cause serious adverse events.

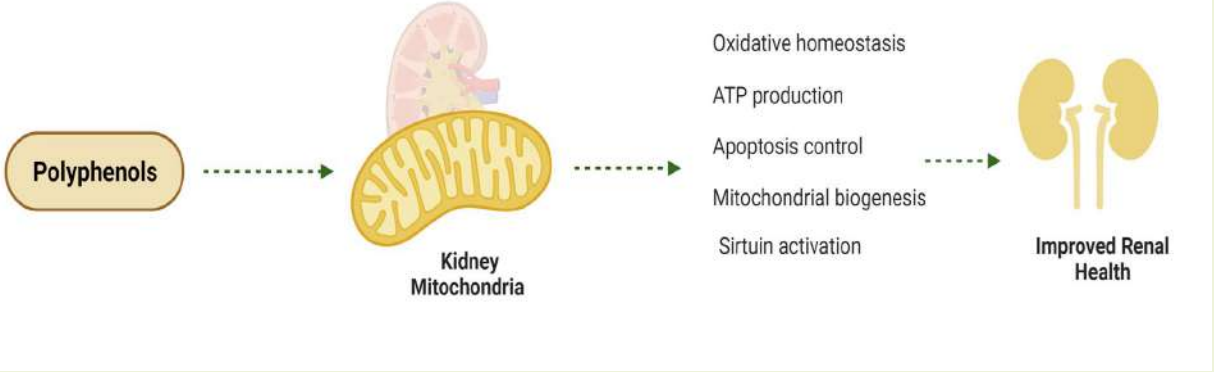
Πολυφαινόλες



Tain YL, Hsu CN. Maternal Polyphenols and Offspring Cardiovascular-Kidney-Metabolic Health. Nutrients. 2024



Di Daniele N, Noce A, Vidiri MF, Moriconi E, Marrone G, Annicchiarico-Petruzzelli M, D'Urso G, Tesauro M, Rovella V, De Lorenzo A. Impact of Mediterranean diet on metabolic syndrome, cancer and longevity. Oncotarget. 2017

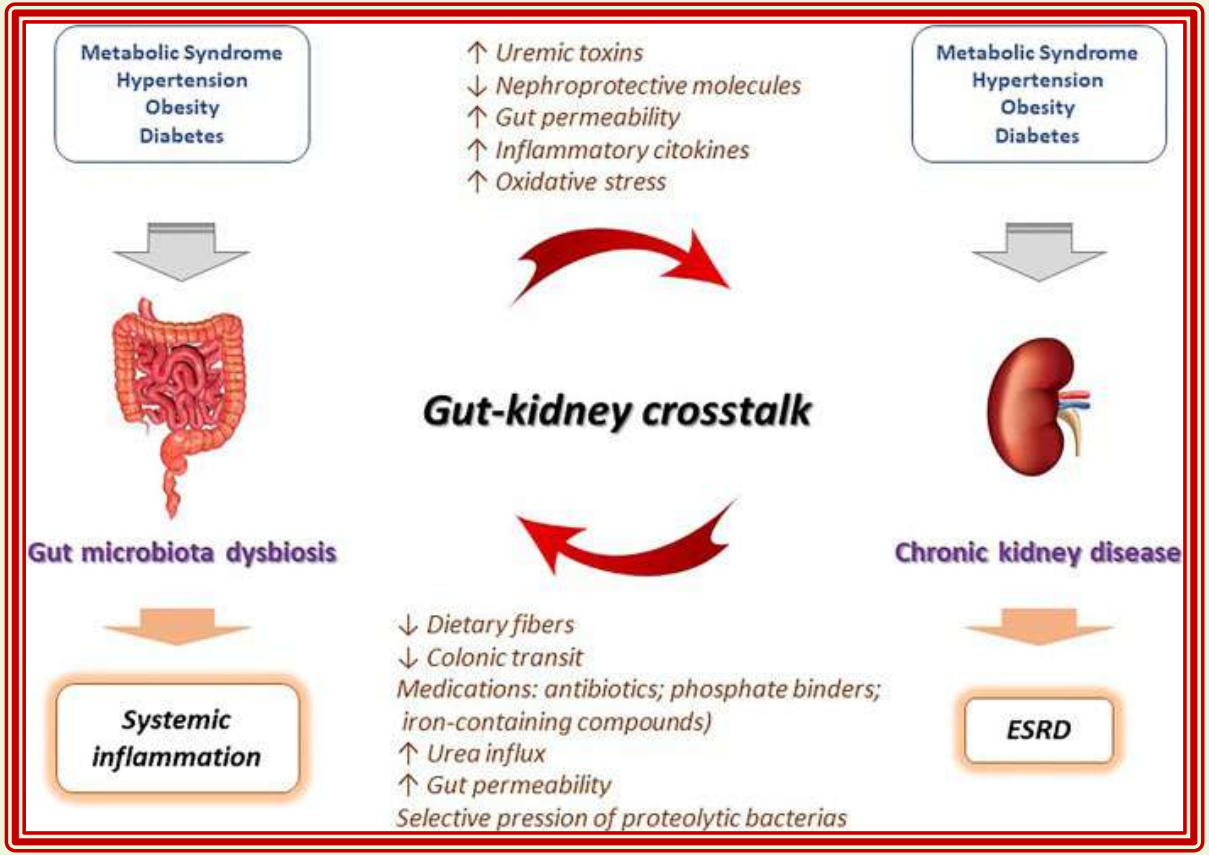


Ashkar F, Bhullar KS, Wu J. The Effect of Polyphenols on Kidney Disease: Targeting Mitochondria. Nutrients. 2022

ПРЕ-/ПРО-BIOTIKA

Feature	Prebiotics	Probiotics
Definition	Non-digestible food components that feed beneficial gut bacteria	Live beneficial bacteria that colonize the gut
Function	Supports growth of good bacteria	Adds good bacteria directly to the gut
Sources	Garlic, onions, leeks, asparagus, bananas, whole grains	Yogurt, kefir, kimchi, sauerkraut, miso
Effect on Gut	Indirectly improves gut health by nourishing bacteria	Directly improves gut microbial balance
Examples	Inulin, fructooligosaccharides (FOS), galactooligosaccharides (GOS)	Lactobacillus, Bifidobacterium, Saccharomyces boulardii

ПРОВІОТІКА


Metabolic Syndrome
Hypertension
Obesity
Diabetes
↑ Uremic toxins
↓ Nephroprotective molecules
↑ Gut permeability
↑ Inflammatory citokines
↑ Oxidative stress
Metabolic Syndrome
Hypertension
Obesity
Diabetes
Gut-kidney crosstalk
Gut microbiota dysbiosis
Chronic kidney disease
↓ Dietary fibers
↓ Colonic transit
Medications: antibiotics; phosphate binders;
iron-containing compounds)
↑ Urea influx
↑ Gut permeability
Selective pression of proteolytic bacterias
Systemic inflammation
ESRD

03

Περιβαντολλογική ευθύνη

Μείωση Περιβαλλοντικού Αποτυπώματος

Μειωμένες Εκπομπές Αερίων Θερμοκηπίου

- Η παραγωγή κόκκινου κρέατος παράγει **πολλαπλάσιες εκπομπές** CO_2 σε σύγκριση με φυτικές πρωτεΐνες.
- Η αντικατάσταση κρέατος με όσπρια, ξηρούς καρπούς και σπόρους μειώνει τον **ανθρακικό αποτύπωμα** χωρίς να θυσιάζεται η θρεπτική επάρκεια.

Μειωμένη Κατανάλωση Νερού & Χρήση Γης

- 1 κιλό βοείου κρέατος απαιτεί >15.000λίτρα νερού, ενώ τα όσπρια ~1.250λίτρα/ κιλό.

Λιγότερη Ρύπανση & Υποβάθμιση Εδάφους

- Η εντατική κτηνοτροφία προκαλεί διάβρωση εδάφους, αποψίλωση και ρύπανση υδάτων από άζωτο και φώσφορο.

Πράσινη διατροφή & ΧΝΝ

Συμπεράσματα

- Οι πράσινες διατροφικές επιλογές ωφελούν τόσο τη διαχείριση της ΧΝΝ όσο και την προστασία του περιβάλλοντος.

- Η μεσογειακή/ φυτοφαγική προσέγγιση προάγει την υγεία με χαμηλότερο περιβαλλοντικό κόστος.

ΕΥΧΑΡΙΣΤΩ

“Always do right. This will gratify some people and astonish the rest.”

—Mark Twain