UNIKLINIK RWTH AACHEN

Vitamingaben an Dialyse

Berliner Dialyseseminar, 06.12.2025

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Oberärztin, Klinik für Innere Medizin mit Schwerpunkt Nephrologie

Darlegung potentieller Interessenskonflikte

Der Inhalt des folgenden Vortrages ist Ergebnis des Bemühens um größtmögliche Objektivität und Unabhängigkeit.

Als Referent weise ich darauf hin, dass es **persönliche Verbindungen** zu Unternehmen gibt, deren Produkte im Kontext des folgenden Vortrages von Interesse sind. Dabei handelt es sich um die folgenden Unternehmen und Verbindungen:

Unternehmen	Verbindungen
AstraZeneca, Bayer, Medice, Stadapharm, Novartis	Vortrags- oder Beratungshonorar
DGfN e.V.	Vorsitzende Kommission Ernährung
ERA (European Renal Association)	Board Member, Renal Nutrition Working Group
Uniklinik RWTH Aachen	Arbeitgeber

Vitamine und Dialyse

- Restriktive Ernährung
  => unzureichende Vitamin-Zufuhr
- CKD-assoziierte Dysbiose / GI-Beschwerden beeinträchtigen die Aufnahme wasser- und fettlöslicher Vitamine
- Urämisches Milieu stört den (Vitamin-) Stoffwechsel
- Verschiedene Dialysemethoden entfernen anteilig (wasserlösliche) Vitamine
  (low vs high flux HD, HDF, PD: wieviel?)

Kosmadakis, G., Da Costa Correia, E., Carceles, O., Somda, F., & Aguilera, D. (2014). Vitamins in dialysis: who, when and how much? *Renal Failure*, *36*(4), 638–650. https://doi.org/10.3109/0886022X.2014.882714

Vitamine und Dialyse

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Vitamine und Dialyse – gibt‘s was Neues?

- Wasserlösliche Vitamine
  - Verlust über die Dialyse
  - Biotin
- Fettlösliche Vitamine
  - Vitamin D
  - Vitamin K
- Kein Vitamin: Omega-3-Fettsäuren

Wasserlösliche Vitamine

Vitamin	Vorkommen	Unterversorgung/Mangel?
Thiamin B1	Vollkorngetreide, Ei, Kartoffeln, Hülsenfrüchte	Alkoholiker
Riboflavin B2	Milchprodukte, Fleisch, Fisch, Eier, Innereien	
Niacin B3	Fisch, Fleisch, Brot, Erdnüsse, Pilze	Selten; Magersucht/Kurzdarm
Pantothensäure B5	Fleisch, Fisch, Eier, Weichkäse, Erdnüsse, Vollkornprodukte, Pilze	
Pyridoxin B6	Vollkorngetreide, Hasel- und Walnüsse, rote Paprika, Sardinen, Makrelen	Dialyse (Verlust)
Biotin B7	Sojabohnen, erhitzte Eier, Nüsse, Sonnen-blumenkerne, Haferflocken, Pilze Milchprodukte	
Folat B9	Spinat, Salate, Tomaten, Hülsenfrüchte, Nüsse, Orangen, Sprossen, Kartoffeln, Eier	Unterversorgung in D; Dialyse Cave: Bindung durch Sevelamer
Cobalamin B12	Tierische Lebensmittel	Alte Personen, Veganer
Vitamin C	Paprika, Petersilie, Zitrusfrüchte, Kartoffeln, Spinat und Tomaten	Dialyse (Verlust)

Empfohlene Tagesdosis und gängige Präparate

	Thiamin B1 [mg]	Riboflavin B2 [mg]	Niacin B3 [mg]	Pantothensäure B5 [mg]	Pyridoxin B6 [mg]	Biotin B7 [µg]	Folsäure B9 [mg]	Cobalamin B12 [µg]	Vitamin C [mg]
Empfohlen [DGE]	1-1,4	1-1,6	11-16	5-6	1,2-1,6	30-60	0,3	3	110
Verlust HD (ca.)	~6%	~7%	--	--	28-48%	?	~37%	--	bis 60%
HD Vitamin	1,2	1,3	16	5	10	30	1	2,4	90
Renavit	3	1,7	20	10	10	300	1	6	120
VitaRenal	1,5	1,7	20	16	10	300	1	6	60
RieVit	1,2	1,3	16	5	10	30	1	2,4	100
DialVit (Schweiz)	14	10			40		3		200

Adaptiert nach Knöller S., Vitaminversorgung bei Dialysepatienten, DiaTra, 01-2018

Verluste an HDF: nur Vitamin C wirklich zu niedrig

Wasserlösliche Vitamine vor und nach **HDF** gemessen

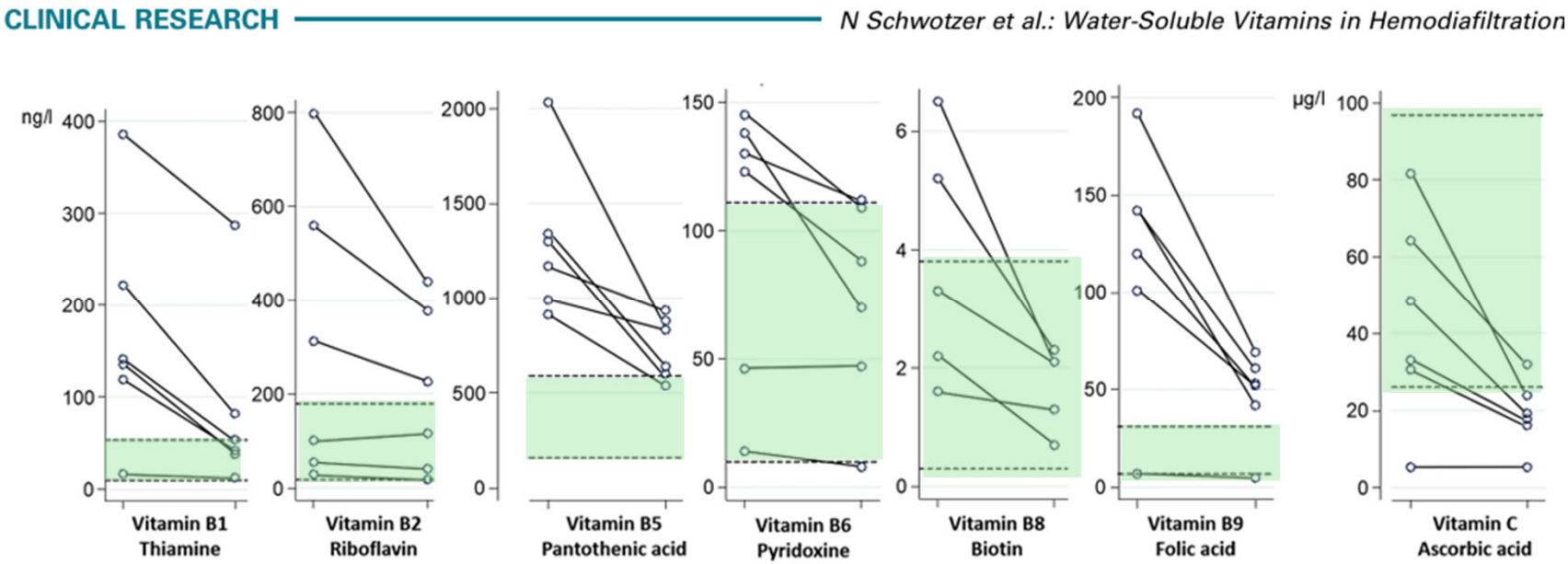

Figure 1. Vitamin loss throughout a HDF session (before and after blood levels).

Schwotzer, Nora, et al. "Water-soluble vitamin levels and supplementation in chronic online hemodiafiltration patients." *Kidney international reports* 5.12 (2020): 2160-2167.

Weniger Substitution wahrscheinlich ok – bis auf Vit C

Table 4. Vitamin values after dose adjustment (1 instead of 2 tablets postdialysis thrice weekly in all remaining participants)

Vitamin	Ref range	Mean (sd)	Deficient	Normal *n* (%)	High
Vitamin B1[a]	10–53 (nmol/l)	112.9 (±59.4)	1 (4.2)	4 (16.7)	19 (79.2)
Vitamin B2[a]	18–180 (nmol/l)	244.3 (±133.9)	–	11 (45.8)	13 (54.2)
Pantothenic acid	160–588 (nmol/l)	1399.9 (±663.1)	–	1 (4.2)	23 (95.8)
Vitamin B6[a]	6.5–69 (nmol/l) (women) 10–111 (nmol/l) (men)	116.9 (±30.7)	–	10 (41.7)	14 (58.3)
Biotin	0.3–3.8 (nmol/l)	5.0 (±3.9)	1 (4.2)	11 (45.8)	12 (50)
Folic acid[a]	7–31 (nmol/l)	94.2 (±23.9)	–	–	24 (100)
Vitamin C[a]	26–97 (µmol/l)	39.9 (±13.7)	3 (12.5)	21 (87.5)	–

[a]Substituted vitamins.

Schwotzer, Nora, et al. "Water-soluble vitamin levels and supplementation in chronic online hemodiafiltration patients." *Kidney international reports* 5.12 (2020): 2160-2167.

Weniger Substitution wahrscheinlich ok – bis auf Vit C

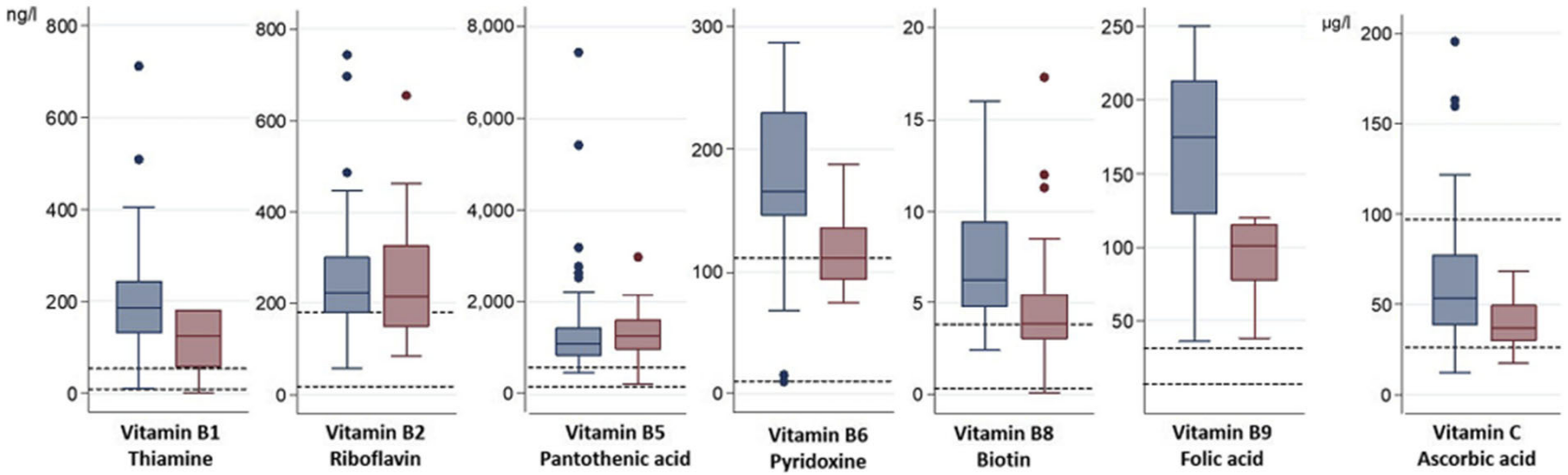

Figure 2. Predialysis vitamin levels at baseline with standard vitamin substition of 2 Dialvit tablets (blue) and follow-up vitamin levels after 3 months of lowered dose vitamin substitution of 1 Dialvit tablet (red).

Kidney International Reports (2020) **5,** 2160–2167 2165

Schwotzer, Nora, et al. "Water-soluble vitamin levels and supplementation in chronic online hemodiafiltration patients." *Kidney international reports* 5.12 (2020): 2160-2167.

Empfohlene Tagesdosis und gängige Präparate

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Verlust HD (ca.)	~6%	~7%	--	--	28-48%	?	~37%	--	bis 60%
HD Vitamin	1,2	1,3	16	5	10	30	1	2,4	90
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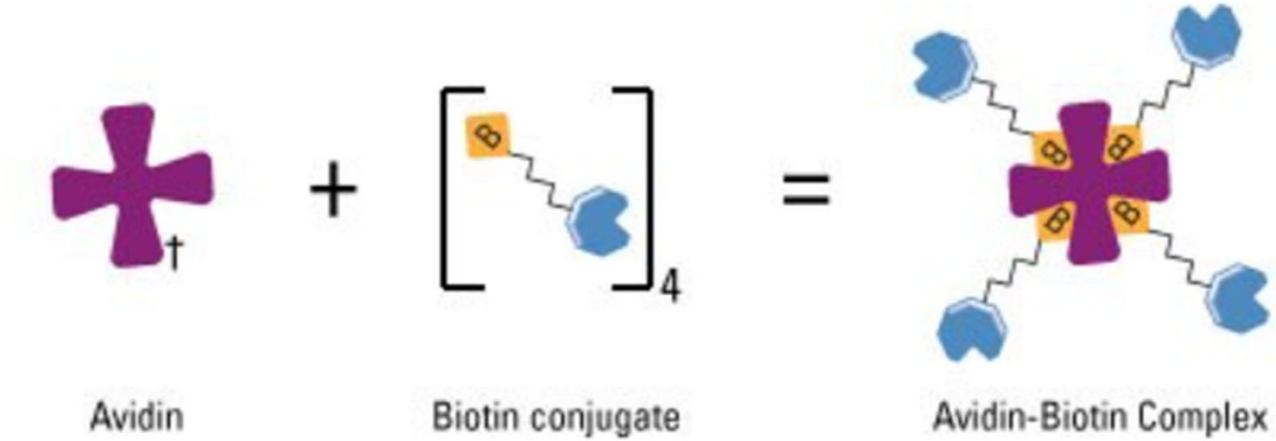
Adaptiert nach Knöller S., Vitaminversorgung bei Dialysepatienten, DiaTra, 01-2018

Biotin

The Avidin-biotin complex is the strongest known non-covalent interaction ($K_d = 10^{-15}$M) between a protein and ligand.

Streptavidin
Avidin
NeutrAvidin



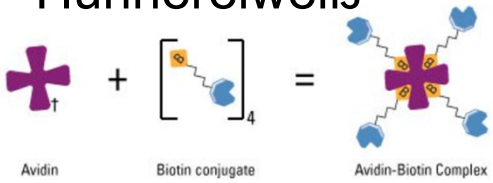
Dissoziationskonstante (Kd) 10^-15 M
= femtomolar
= praktisch irreversible Bindung unter physiologischen Bedingungen

- Enzyme linked immunosorbent assay (ELISA)
- Immunohistochemistry (IHC)
- Western, Northern and Southern blotting
- Immunoprecipitation
- Cell surface labeling
- Affinity purification

Quelle: ThermoFisher

Biotin

Avidin = in Hühnereiweiß



230g rohes Hühnereiweiß pro Tag (statt Portion Fleisch) = 28g Protein, weniger Phosphat

Using Egg Whites to Keep Protein Up and Control Phosphorus

Lynn, a DaVita® renal dietitian in Maryland, conducted a study involving people on hemodialysis who substituted liquid egg whites for meat. She hoped this would help dialysis patients keep their protein or albumin levels up while controlling phosphorus levels and reducing the amount of phosphorus binders patients would have to take.

Biotin Deficiency Caused By Long-Term Raw Egg Consumption: A Case Report

5-8 raw egg whites a day for the last 16 months

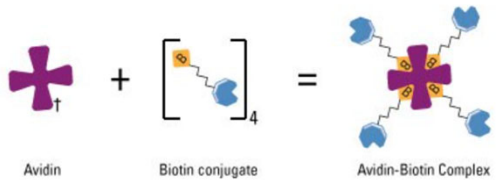
Jeffrey P. Krabbe, DC, MPH, MS, DACBN, FACN, LDN, CISSN, CSCS

The objective of this case study is to describe dietary methods to aid in the management of a biotin deficiency due to long-term raw egg white consumption..

Biotin

- Dialysepatientin mit brüchigem Haar und neuer Kosmetikerin[1]
- Überraschende laborchemische Heilung eines Hyperparathyreoidismus (iPTH-Werte von >800pg/ml auf <40pg/ml in kurzer Zeit)

?



- Biotin im Serum so hoch, dass es mit dem iPTH-ELISA interagiert hat

[1] aus der klinischen Schatzkiste von Prof. Floege

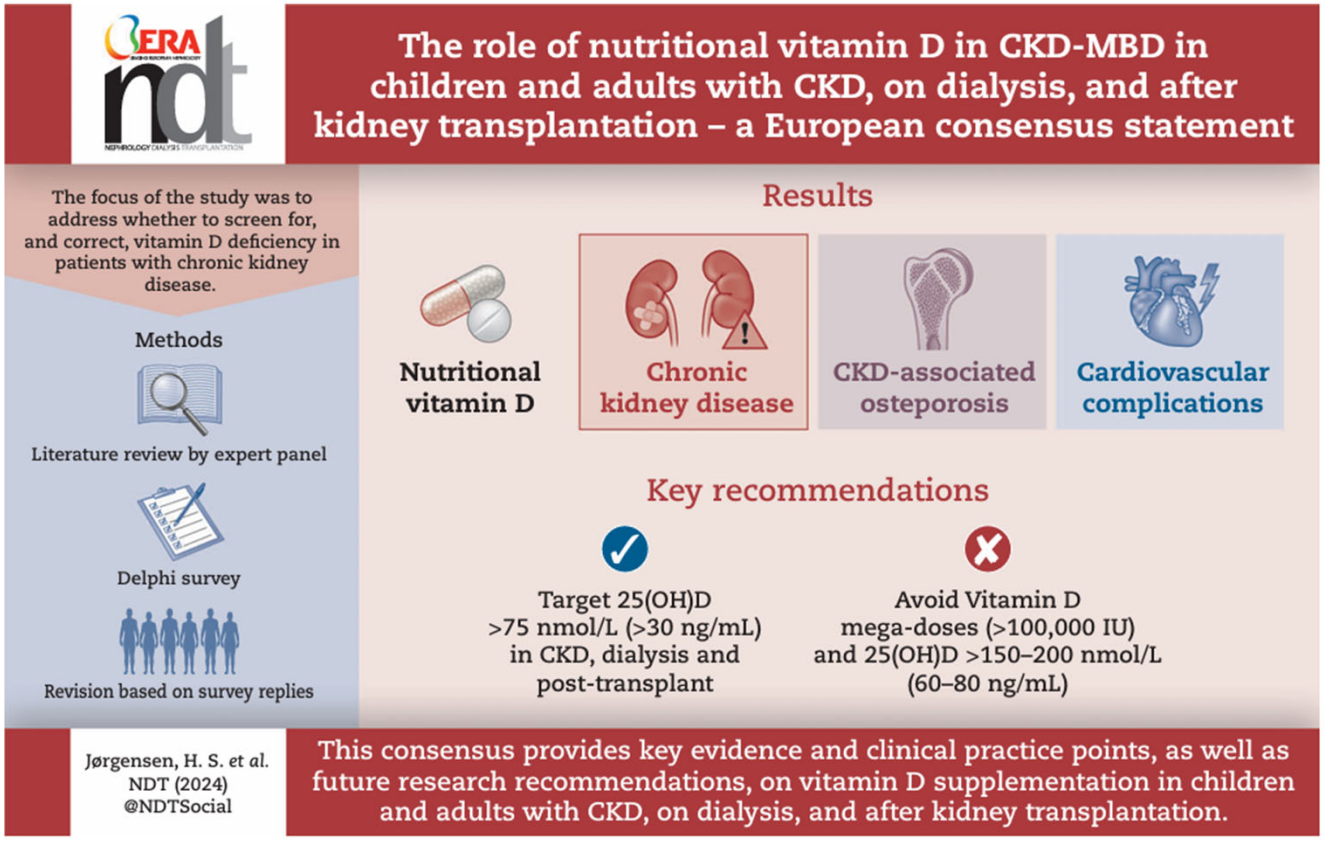
Fettlösliche Vitamine

Vitamin	Effekte	Tagesbedarf	Clearance
Retinol / Beta-Carotin (A)	Retina-Zellen;anti-oxidativ; Immunsystem; Wachstum	700-900µg	Keine (Hypervitaminose HD & PD)
Calciferol (D)	Ca-Haushalt, Knochenmineralisation	15-20µg ~800IU	
Phylloquinon (K)	Koagulation, Inhibitor von vaskulärer Verkalkung	90-120µg	?
Tocopherol (E)	Antioxidativ, hypolipidämisch	15µg	Keine Clearance

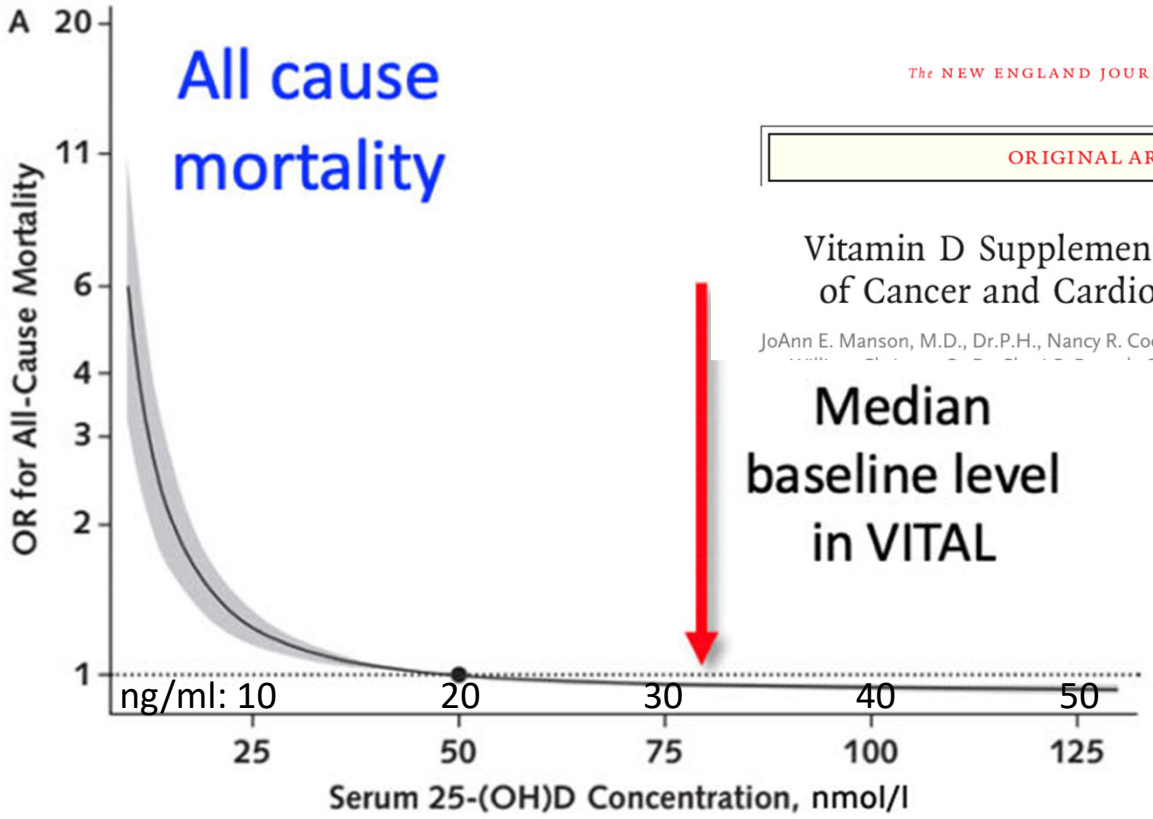
Kosmadakis, G., Da Costa Correia, E., Carceles, O., Somda, F., & Aguilera, D. (2014). Vitamins in dialysis: who, when and how much? *Renal Failure*, *36*(4), 638–650. https://doi.org/10.3109/0886022X.2014.882714

Vitamin D

- Benefit:
  - Bessere sHPT-Kontrolle (Effekt bei Dialyse unsicher)
  - Keine Evidenz für kardiovaskuläre Outcomes
- Substitutionsziel: 25-OH-D3 >30ng/ml
- Mega-Dosen (>100.000IE) und Spiegel >60ng/ml vermeiden



Vitamin-D-Mangel (UK Biobank) mit Mortalität assoziiert



The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE 2018

Vitamin D Supplements and Prevention of Cancer and Cardiovascular Disease

JoAnn E. Manson, M.D., Dr.P.H., Nancy R. Cook, Sc.D., I-Min Lee, M.B., B.S., Sc.D.,

(Negative Studie, Kein Effekt)

Sutherland JP, Zhou A, Hypponen E. Vitamin D deficiency increases mortality risk in the UK Biobank: a nonlinear mendelian randomization study. *Ann Intern Med* 2022; **175** :1552–9. https://doi.org/10.7326/M21-3324156.

CLINICAL KIDNEY JOURNAL

Vitamin K

Clinical Kidney Journal, 2021, vol. 14, no. 9, 2114–2123

doi: 10.1093/ckj/sfab017
Advance Access Publication Date: 28 January 2021
Original Article

Supplementierung = höhere Spiegel, aber kein klinischer Benefit

ORIGINAL ARTICLE

Vitamin K supplementation and arterial calcification in dialysis: results of the double-blind, randomized, placebo-controlled RenaKvit trial

Karin Levy-Schousboe[1], Marie Frimodt-Møller[2], Ditte Hansen[3,4], Christian Daugaard Peters[5], Krista Dybtved Kjærgaard[5], Jens Dam Jensen[5], Charlotte Strandhave[6], Hanne Elming[7], Carsten Toftager Larsen[7], Hanne Sandstrøm[8], Claus Lohman Brasen[9,10], Anne Schmedes[9], Jonna Skov Madsen[9,10], Niklas Rye Jørgensen[4,11], Jens Brøndum Frøkjær[12,13], Niels Erik Frandsen[1], Inge Petersen[14,15] and Peter Marckmann[16]

[1]Department of Medicine, Zealand University Hospital, Roskilde, Denmark, [2]Steno Diabetes Center,

CLINICAL KIDNEY JOURNAL

Vitamin K

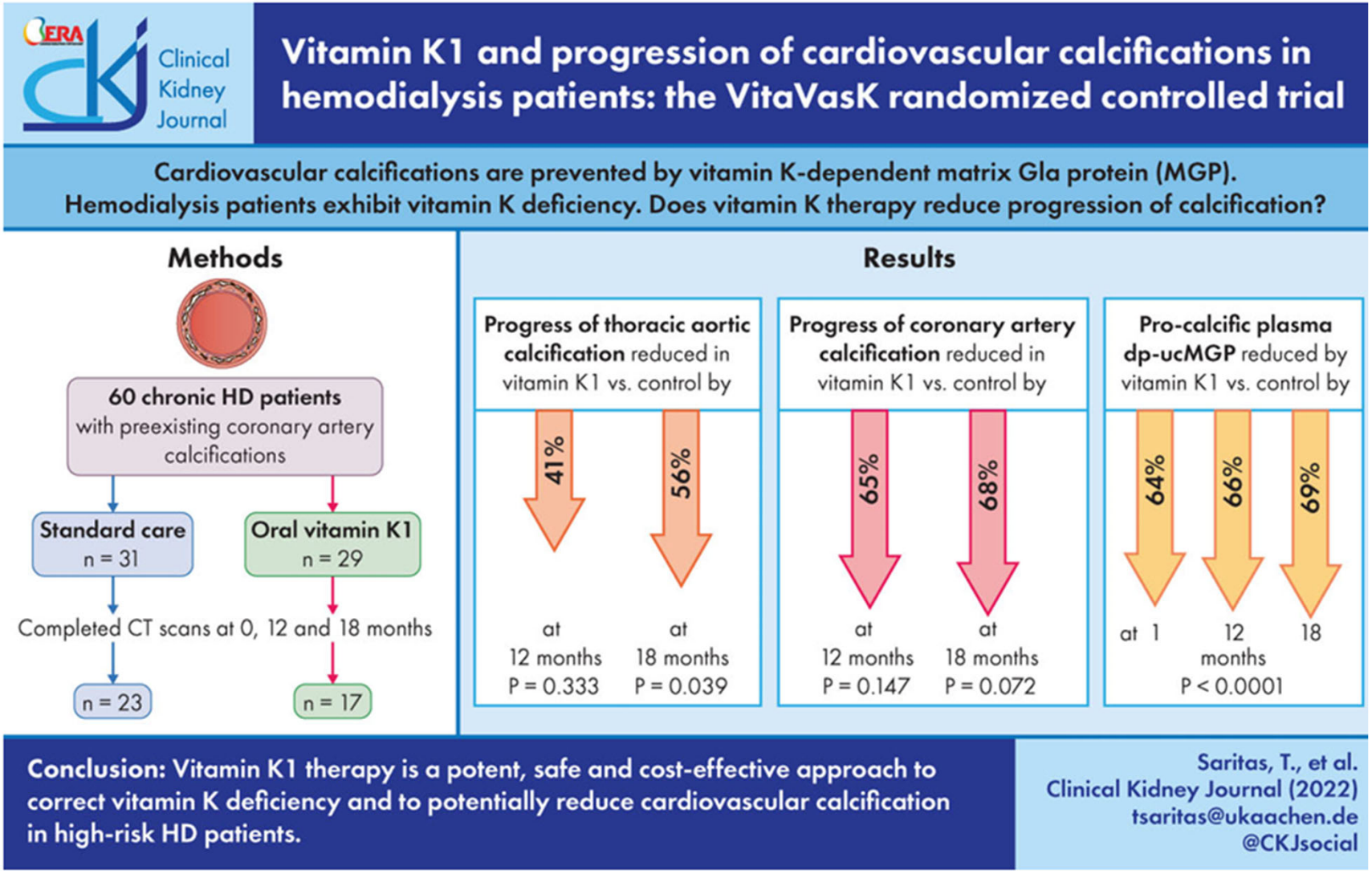
Clinical Kidney Journal, 2022, vol. 15, no. 12, 2300–2311

https://doi.org/10.1093/ckj/sfac184
Advance Access Publication Date: 24 August 2022
Original Article

ORIGINAL ARTICLE

Vitamin K1 and progression of cardiovascular calcifications in hemodialysis patients: the VitaVasK randomized controlled trial

Turgay Saritas[1,2,*], Sebastian Reinartz[3,*], Thilo Krüger[4], Markus Ketteler[5], Orfeas Liangos[6,7], Laura Labriola[8], Peter Stenvinkel[9], Christoph Kopp[10], Ralf Westenfeld[11], Pieter Evenepoel[12], Robert Siepmann[3], Stephanie Wied[13], Ralf-Dieter Hilgers[13,†], Leon Schurgers[14,†] and Jürgen Floege[1,†]; VitaVasK Investigators



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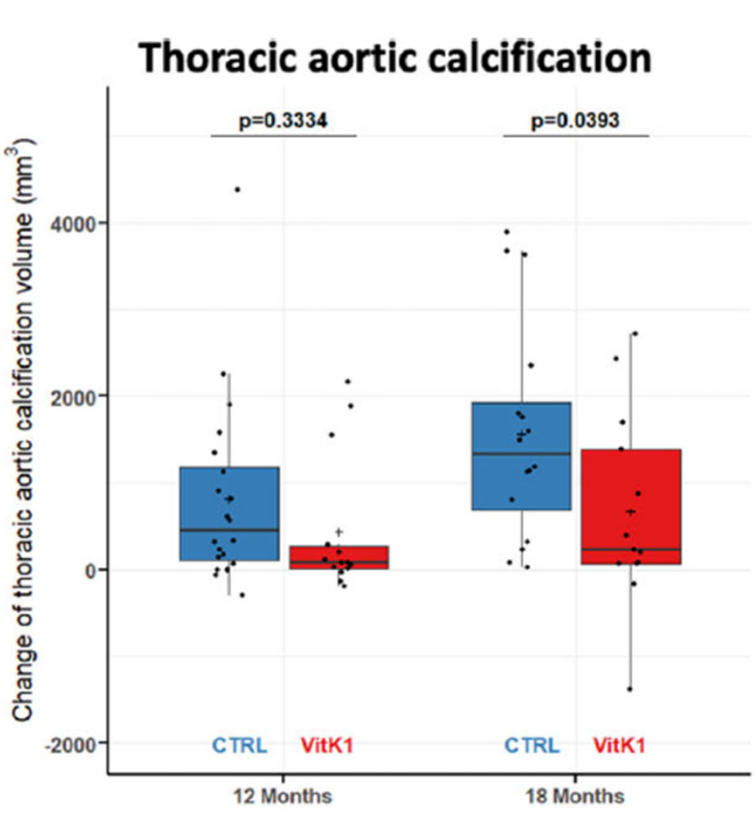
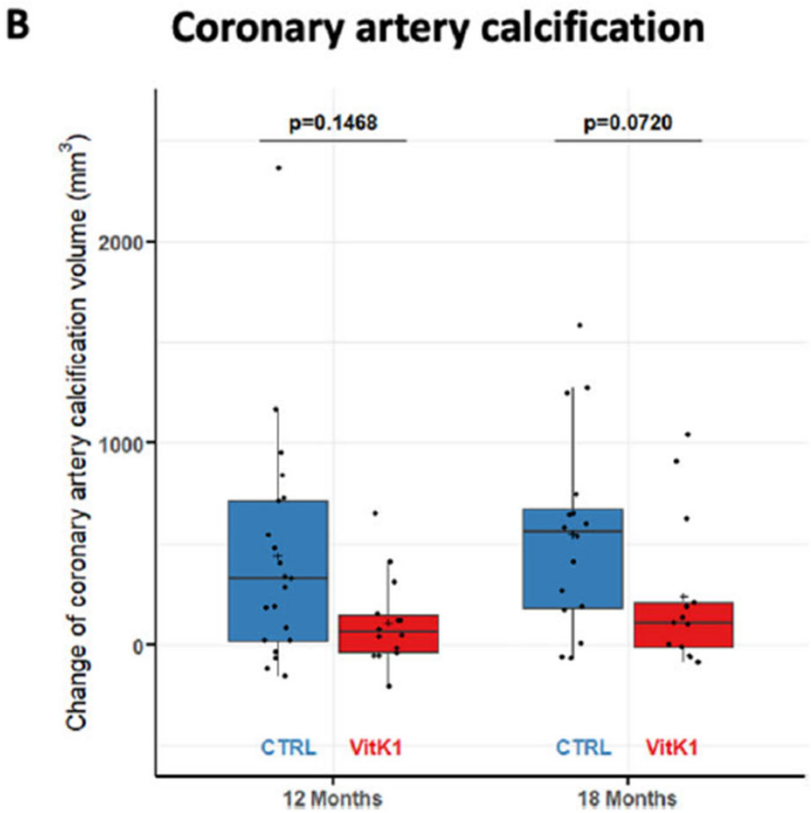
3x/Woche (nach HD) 5mg Vitamin K1

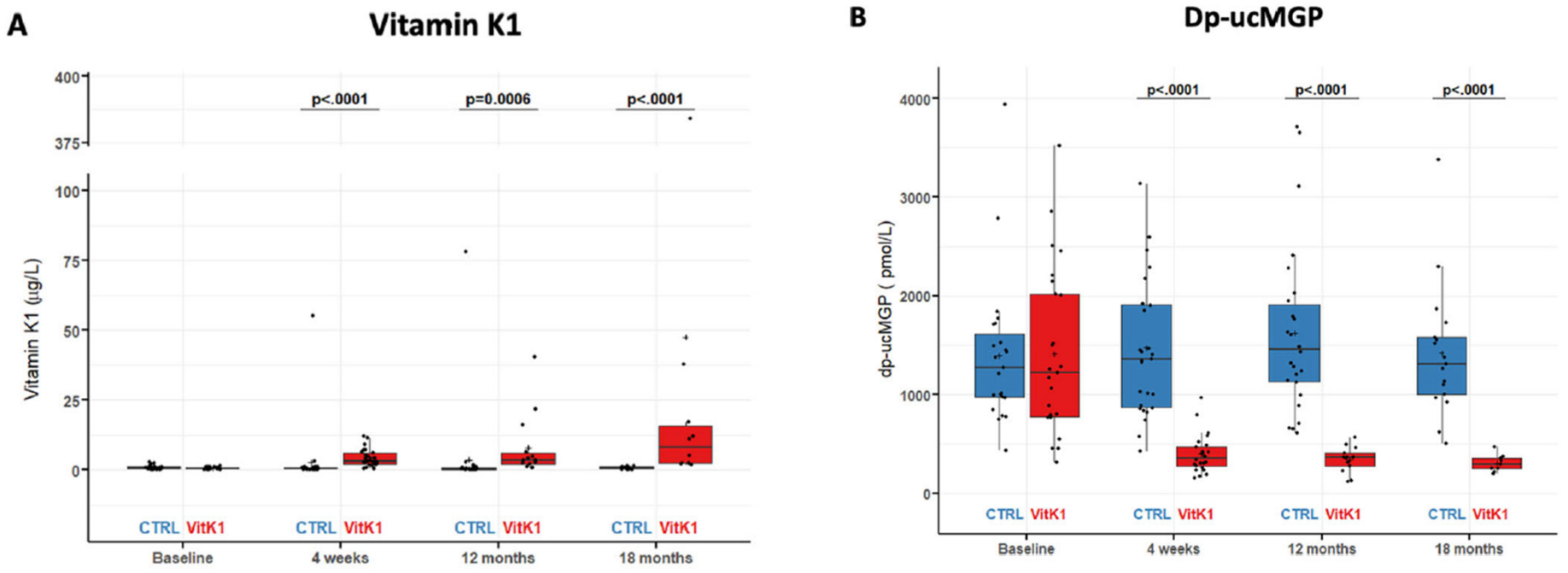
15mg Vitamin K1 pro Woche => Weniger Verkalkung





Saritas, Turgay, et al. "Vitamin K1 and progression of cardiovascular calcifications in hemodialysis patients: the VitaVasK randomized controlled trial." *Clinical kidney journal* 15.12 (2022): 2300-2311.

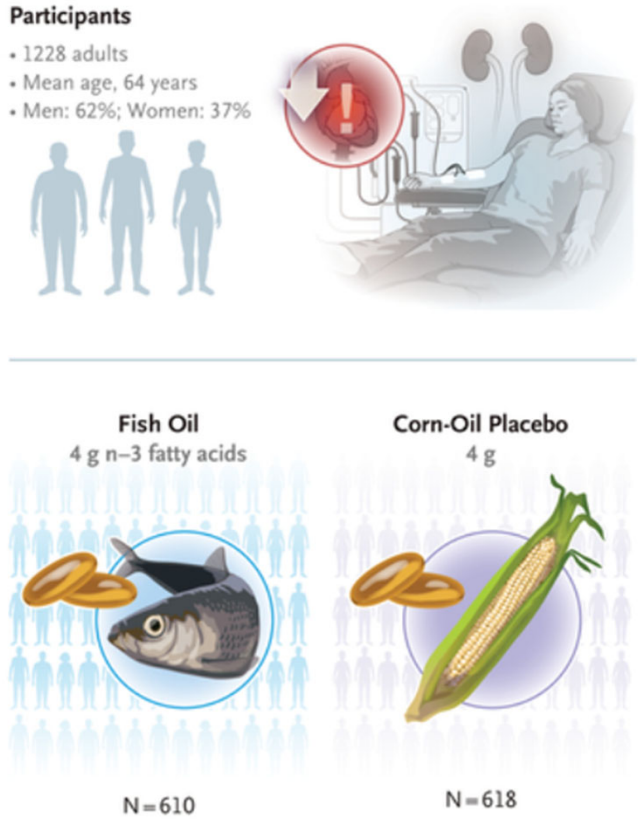
15mg Vitamin K => Suppression von Matrix-Gla-Protein

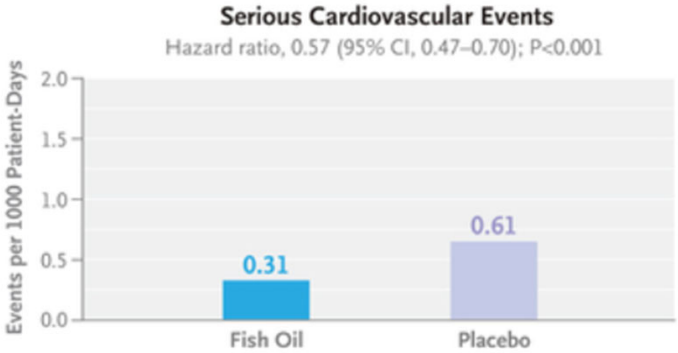


Saritas, Turgay, et al. "Vitamin K1 and progression of cardiovascular calcifications in hemodialysis patients: the VitaVasK randomized controlled trial." *Clinical kidney journal* 15.12 (2022): 2300-2311.

Fischöl / Omega-3-Fettsäuren: PISCES-Trial 2025

- 1228 HD-Patienten in Canada und Australien
- 4 g “steam deodorized, citrus-flavored n−3 polyunsaturated fatty acids” in 4x 1g-Kapseln
  = 1.6 g EPA, 0.8 g DHA
- 4g “citrus-flavored corn-oil” = Placebo
- 3,5 Jahre

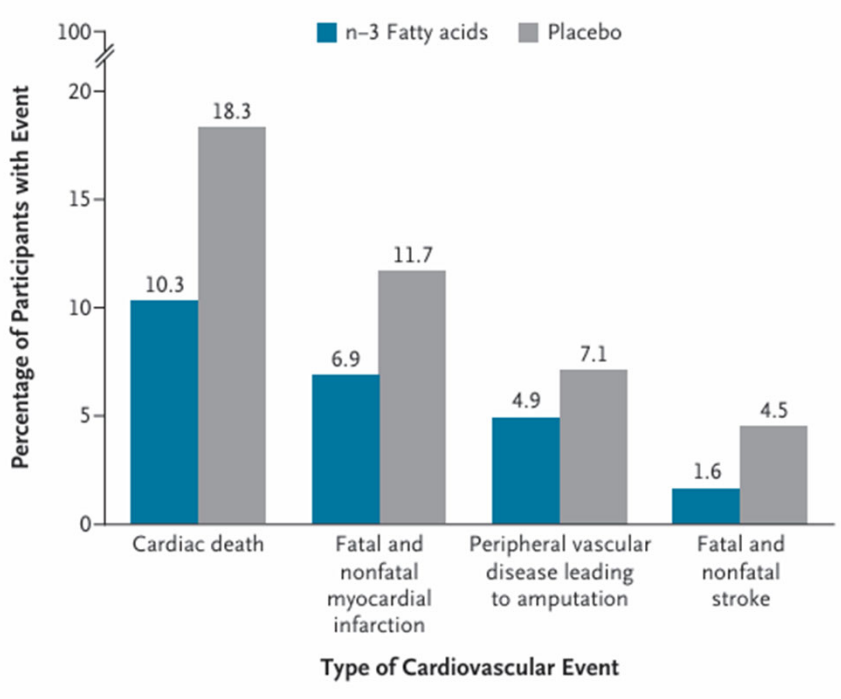


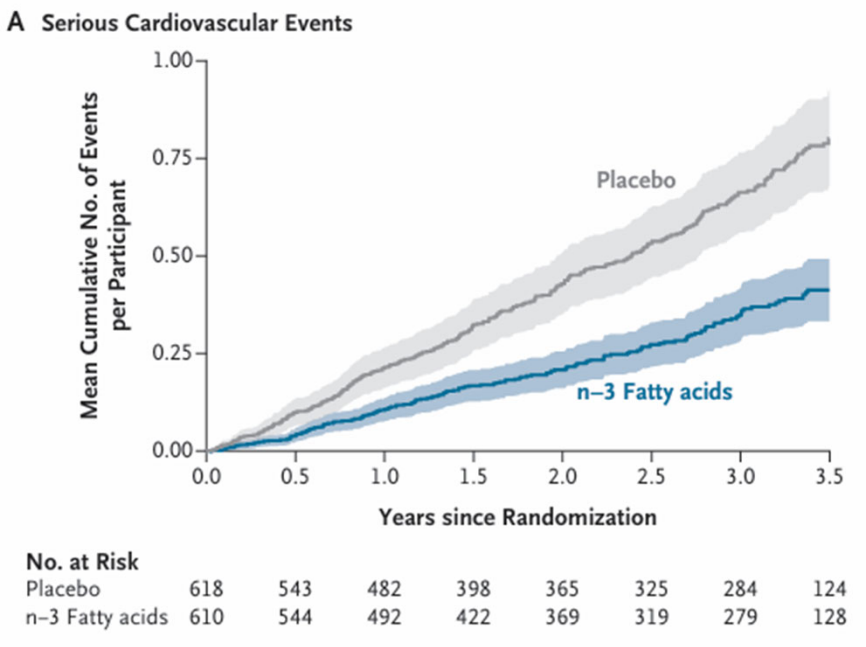


EPA = Eicosapentaensäure
DHA = Docosahexaensäure

Lok, Charmaine E., et al. "Fish-Oil Supplementation and Cardiovascular Events in Patients Receiving Hemodialysis." *New England Journal of Medicine* (2025).

Fischöl / Omega-3-Fettsäuren: PISCES-Trial 2025





Lok, Charmaine E., et al. "Fish-Oil Supplementation and Cardiovascular Events in Patients Receiving Hemodialysis." *New England Journal of Medicine* (2025).

Vitamine und Dialyse – was gibt‘s Neues?

- Ausreichend Vitamin C an bzw. nach Dialyse (100mg/d – über Ernährung eigentlich kein Problem)
- Biotin kann Ihre Labormessung beeinflussen
- Zu viel rohes Eiweiß kann Ihr Biotin beeinflussen
- Vitamin D: 25-OH-D3 >30ng/ml!
- Vitamin K:
  5mg nach jeder Dialyse für weniger Gefäßverkalkung
- Omega-3-Fettsäuren aus Fischöl: wahrscheinlich schon; Maisöl auf gar keinen Fall!

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Wasserlösliche Vitamine

Vitamin	Effects	RDA	Clearance	Supplementation
Thiamin/B_1	• Conduction of nerve impulses • Muscle function • Stimulation of appetite	M: 1.2 mg F: 1.1 mg	• HD: 6%9 • Low flux= high flux10 • PD< urine11	0.6–1.5 mg/d8
Riboflavin/B_2	• Release of energy from nutrients • Supports normal vision • Healthy skin	M: 1.3 mg F: 1.1 mg	• HD: 7%10	20 mg post-HD 3/w17
Nicotinamide/B_3	• NAD+/NADP+: oxidation-reduction reactions • Improve lipid profile • Hyperphospatemia19,20	M: 16 mg F: 14 mg	• Rapid metabolic clearance • Not cleared by dialysis	
Biotin/B_8	• Energy metabolism: tricarboxylic acid cycle • Gluconeogensis • Metabolism of fatty acids • Breakdown of amino acids	30 mcg	• Partially cleared in high flux HD	30 mcg/d
Pantothenic acid	• Synthesis of lipid, neurotransmitters, steroid hormones and haemoglobin • Part of Coenzyme A	5 mg		5 mg/
Pyridoxine/B_6	• Metabolism of amino acids and fatty acids cognitive development immune function • Steroid synthesis erythropoietic activity • Peripheral neuropathy	1.3 mg	• PD<HD • Clearance 28–48% High eff/cy HD > 50%24,25	50–300 mg i.v. post-HD 60–100 mg/d per os26–29,32
Folate	• DNA synthesis/cell division • B_{12} conversion • Interconversion of aminoacids	400 mcg Pregnancy: 600 mcg	• HD=PD11,33,34 • Clearance 37%10,17,24	5–10 mg/d for hyperhomocysteinaemia 1 mg/d in dialysis
Cobalamin/B_{12}	• DNA and RNA synthesis • Homocystein reduction	2.4 mcg	• Not cleared in HD and PD	<1000 mg/d i.v.26,28,29,48,49
Ascorbic Acid/vit C	• Antioxidant • Formation of collagen • Matrix to form teeth and bone • Wound healing • Production of Norepinephrine and Thyroxine • Iron absorption • Resistance to infections	M: 90 mg F: 75 mg	• Clearance: 30–53% • Losses: 80–280 mg per session8,55,56 Diffusion: 2/3 of loss • Convection 1/3 of loss56	60 mg/d per os

Kosmadakis, G., Da Costa Correia, E., Carceles, O., Somda, F., & Aguilera, D. (2014). Vitamins in dialysis: who, when and how much? *Renal Failure*, *36*(4), 638–650. https://doi.org/10.3109/0886022X.2014.882714