Management of Nutrition in CKD Patients

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Introduction

- Dietary factors may have an effect on the progression of kidney disease and its complications
- Significant number of factors affect nutritional and metabolic status in CKD.
- The optimal diet for individual CKD patients varies depending upon the estimated glomerular filtration rate (eGFR), type of kidney disease (ie, proteinuric or nonproteinuric), and the presence of other comorbidities such as diabetes, hypertension, or heart failure.

Nutritional recommendations for adults with chronic kidney disease stages 3 to 4

Protein	≤0.8 g/kg/day[1], increase plant source.
Salt	<2.3 g/day (<5 g/day of NaCl)[1].
Potassium	Individualize to keep the serum potassium within a normal range.
Calcium	1.5 g/day from both dietary and medication sources.*
Phosphorus	0.8 to 1 g/day or individualize to keep the value within a normal range. Increase vegetable source and avoid processed foods as much as possible.
Carbohydrate/fat[2]	30 to 35 kcal/kg/day; <30% of total calories from fat and <10% of total fat from saturated fat; DASH diet pattern highly recommended.
Fiber[3]	25 to 38 g/day.

* Some clinicians favor a lower calcium intake of 1 g/day.

References:

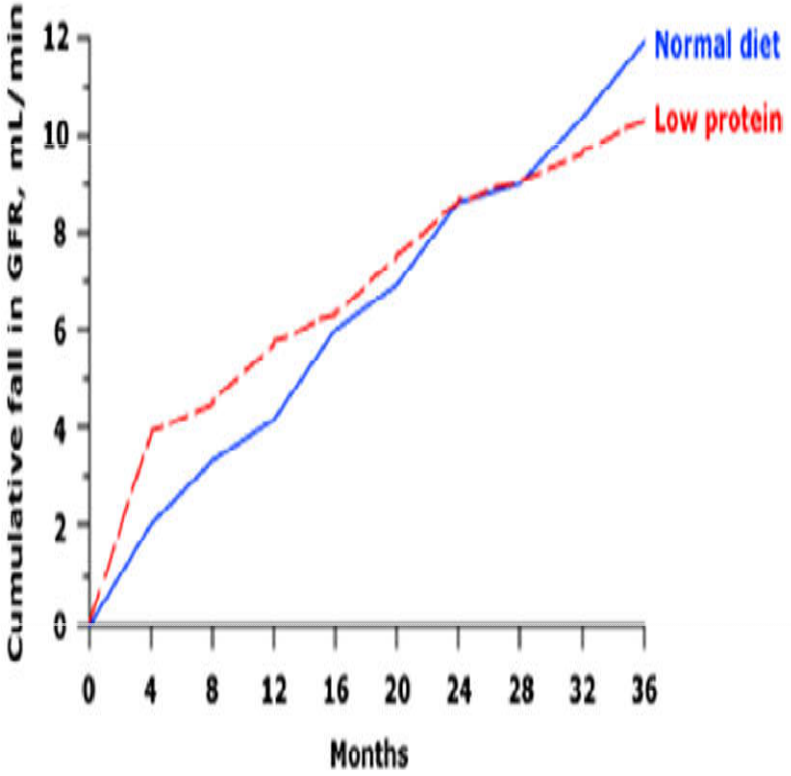
1. *KDIGO 2012 clinical practice guideline for the evaluation and management of chronic kidney disease. Kidney Int Suppl 2013; 3:5.*
2. *NKF KDOQI Guidelines 2000. Clinical practice guidelines for nutrition in chronic renal failure. https://www.kidney.org/sites/default/files/docs/kdoqi2000nutritional.pdf (Accessed on November 4, 2015).*
3. *http://health.gov/dietaryguidelines/2010/ (Accessed on November 4, 2015).*

Table of the biological value of common foods

Food item	Biological value
Egg protein	100
Whole bean	96
Whole soy bean	96
Human milk	95
Cow milk	90
Cheese	84
Rice, unpolished	83
Chicken	79
Fish	76
Beef	74
Soybean curd	72
Rice, polished	64
Corn	60
Kidney bean	49
White flour	41

Julliet P et al .Intensive Care Med 1998

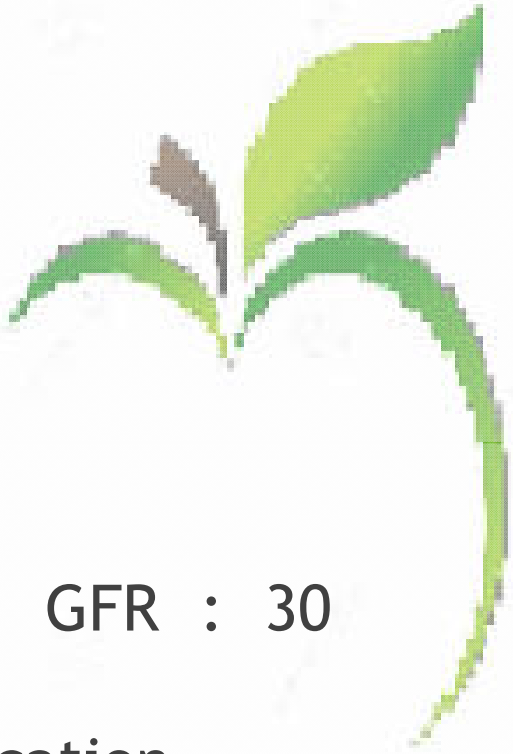
Dietary Protein



Cumulative fall in GFR over three years in patients with nondiabetic chronic renal failure (mean baseline GFR 39 mL/min) receiving a normal (solid line) and low protein (dashed line) diet. Protein restriction had little or no overall beneficial effect. There was a trend toward more rapid loss of GFR in the first four months followed by a modest slowing of progression during the last 32 months.

Klahr, S, et al, N Engl J Med 1994

KDIGO Clinical Practice Guideline 2012 in Protein Restriction



3.1.13: We suggest lowering protein intake to 0.8 g/kg/day

in adults with diabetes (2C) or without diabetes (2B) and GFR : 30 ml/min/1.73 m2 (GFR categories G4-G5), with appropriate education.

3.1.14: We suggest avoiding high protein intake (1.3 g/kg/day) in adults with CKD at risk of progression. (2C)

Dietary recommendations for salt intake in patients with CKD 3 to 4

KDIGO 2012 [1]	NKF K/DOQI 2000 (CKD class 1 through 4) [2]	US Department of Agriculture and Human Services: DGA 2010 [3]	JNC-7 2003 [4]	European Society of Hypertension 2007 [5]	US Institutes of Medicine [6]
<2 Na g/day (5 g/day of NaCl)	Na <2.4 g/day (6 g/day of NaCl)	▪ <2.3 g/day for those ages >2 years ▪ <1.5 g/day for high-risk groups (CKD, black race, HTN, diabetes, ≥51 years of age)	<2.3 Na g/day (5.75 g/day of NaCl)	<2 g/day Na (5 g/day of NaCl)	<2.3 Na g/day (5.75 g/day of NaCl)

Salt intake KDIGO Clinical Practice Guideline 2012 in

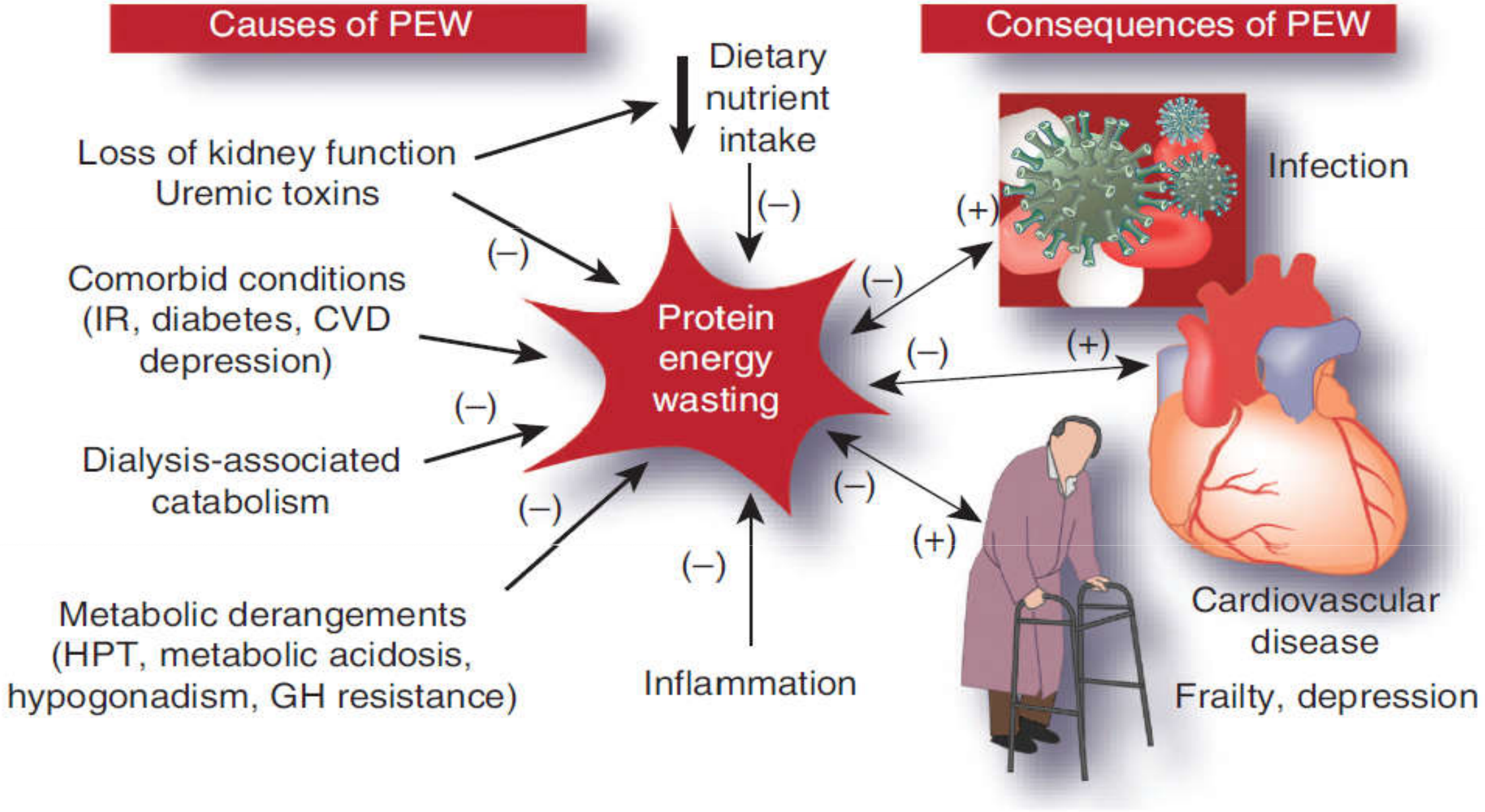
- 3.1.19: We recommend lowering salt intake to ,90 mmol (,2 g) per day of sodium (corresponding to 5 g of sodium chloride) in adults, unless contraindicated(CKD). (1C)
- 3.1.19.1: We recommend restriction of sodium intake for children with CKD who have hypertension or prehypertension, following the age-based Recommended Daily Intake. (1C)
- 3.1.19.2: We recommend supplemental free water and sodium supplements for children with CKD and polyuria to avoid chronic intravascular depletion and to promote optimal growth. (1C)

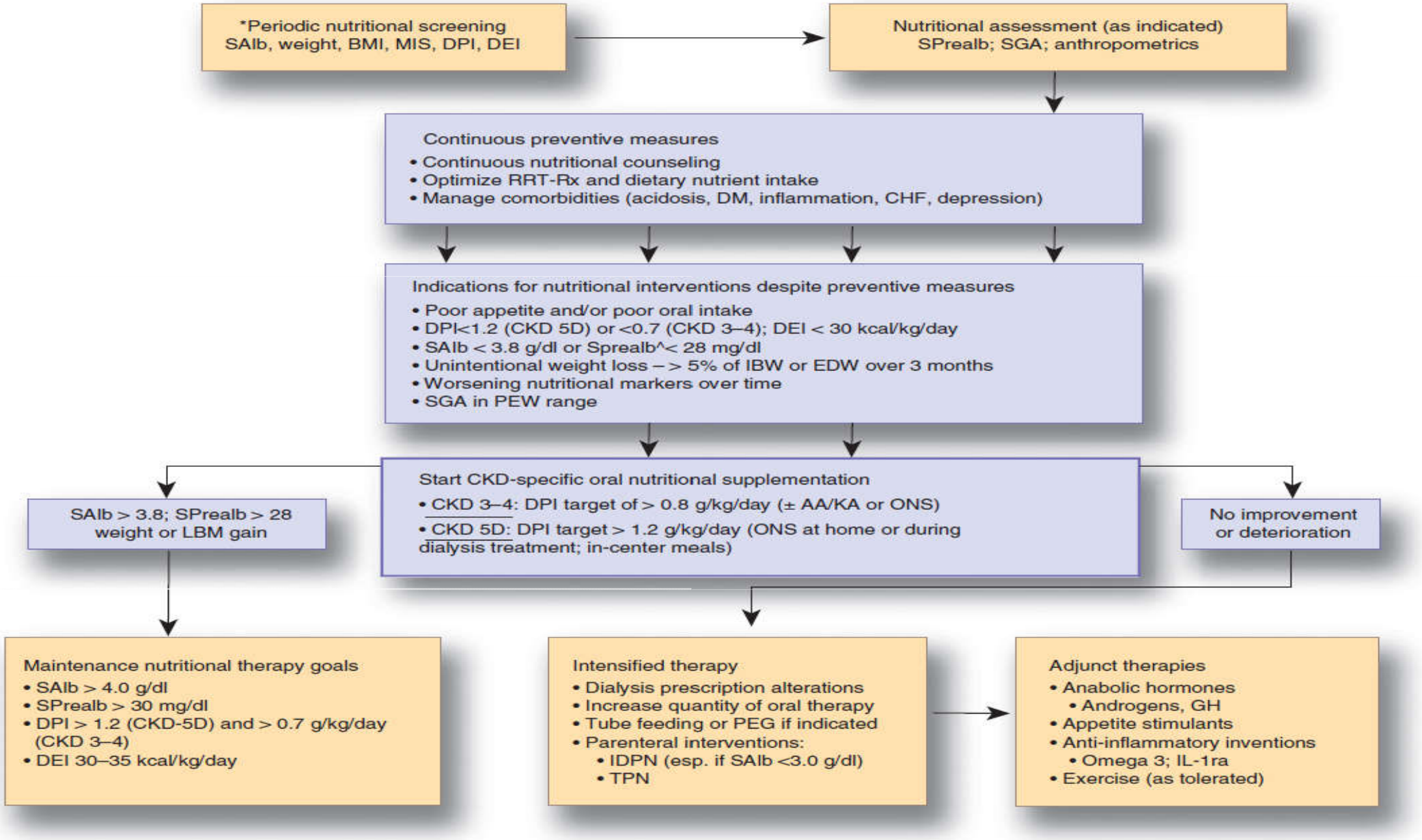
- An analysis of National Health and Nutrition Examination Survey (NHANES)-III data (including 14,543 participants and 5.8 percent with eGFR <60 mL/min/1.73 m^2), showed that, for each 10 g/day higher total fiber intake, odds of increased serum C-reactive protein was decreased by 38 percent in those with CKD and by 11 percent in those without kidney disease dietary fiber intake was inversely correlated with mortality only in those with CKD.*
- A six-week study of 13 CKD patients (mean eGFR of 30 mL/min/1.73 m^2) demonstrated that the addition of fiber (23 g/day) was associated with a reduction in serum creatinine by a mean of 0.24 mg/dL ($p<0.05$) from the baseline value (3 mL/min/1.73 m^2 increase in GFR from the baseline) .**

* Krishnamurthy et al KI 2012
**Salmean YA et al.J Ren Nutr. 2013

Table 10-4. Recommended daily supplemental vitamins for persons with chronic kidney disease and those undergoing maintenance hemodialysis or chronic peritoneal dialysis[*,†]

Vitamin	Stage 3–5 CKD‡	Maintenance Hemodialysis	Chronic Peritoneal Dialysis
Thiamine (mg/day)	1.2	1.2	1.2
Riboflavin (mg/day)	1.3	1.3	1.3
Pantothenic Acid (mg/day)	5	5	5
Niacin (mg/day)	16	16	16
Pyridoxine HCl (mg/day)[§]	5	10	10
Vitamin B_{12} (mcg/day)	2.4	2.4	2.4
Vitamin C (mg/day)	90	90	90
Folic Acid (mg/day)	1	1	1
Vitamin A	No addition	No addition	No addition
Vitamin D	See text	See text	See text
Vitamin E (mg/day)	15	15	15
Vitamin K	None	None	None


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



TA Ikizler et al,KI, 2013

Treatment of PEW in CKD

- Oral and enteral nutritional supplementation
- Growth hormone *
- Anabolic steroids
- Exercise

* Kopple NDT 2011**Ikizler et al KI 2013

Table 1. Liquid Protein Supplements

Product	Amount	Calories	Protein (g)	Calcium (mg)	Potassium (mg)	Phosphorus (mg)	Sodium (mg)
Boost	8 fl oz	240	10	330	400	310	130
Boost High Protein	8 fl oz	240	15	330	380	310	170
Boost Plus	8 fl oz	360	14	330	380	310	170
Boost Diabetic	237 mL	250	13.8	276	260	220	260
Ensure	8 fl oz	250	8.8	300	370	300	200
Ensure High Protein	8 fl oz	230	12	300	500	250	290
Ensure Plus	8 fl oz	350	13	300	500	300	240
Glucerna	8 fl oz	237	9.9	170	370	170	220
Nepro Carb Steady[a]	8 fl oz	425	19.1	250	250	165	250
Novasource Renal[a]	8 fl oz	475	17.4	308	192	154	210
Promote	8 fl oz	237	14.8	285	470	285	240
Suplena Carb Steady	8 fl oz	425	10.6	250	265	165	185
Resources Shake Plus	8 fl oz	480	15	350	250	350	200
Nutren Renal	8 fl oz	500	17.5	350	314	175	185
Re/Gen HP/HC[a]	4 fl oz	250	10	15	25	45	90

Note: Boost, Novasource Renal, Resources Shake Plus, and Nutren Renal products are manufactured by Nestle (www.nestle-nutrition.com); Ensure, Glucerna, Nepro Carbo Steady, Promote, Suplena Carb Steady, by Abbott Laboratories (www.abbott.com); Re/Gen HP/HC by Nutra/Balance Products (www.nutra-balance-products.com).

[a]Indicated for dialysis patients.

Appetite stimulants

- Megestrol Acetate , Cyproheptadine, Melatonin, Thalidomide , Ghrelin and dronabinol
- Ghrelin : Orexigenic peptide released from stomach increase appetite . It is implicated in regulating mealtime hunger and meal initiation .This drug improve appetide and causes weight gain. Subcutaneous administration also inhibit sympathetic nerve activity, inflammatory response, improve left ventricular function and exercise capacity.
- Megestrol acetate effective drug in patients with cancer . Induce appetide and serum albumin and weight . Increase risk of thromboembolism.

Ikizler et al KI 2013

Anti inflammatory interventions

- Cause of inflammation should be diagnosed and treated.
- Exercise
- Anti oxidative drug : Omega 3, Long chain fatty acids, Statins ,ACE inhibitors, Peroxisome proliferator –activated receptor γ agonist
- Anti inflammatory drug : Pentoxifyllline , Etanercept (tumor necrosis factor receptor antagonist, Il1 receptor antagonist

JAMA Internal Medicine | Original Investigation

Efficacy of Folic Acid Therapy on the Progression of Chronic Kidney Disease

The Renal Substudy of the China Stroke Primary Prevention Trial

- 15 104 Chinese adults with GFR > 3occ/min including including 1671 CKD patients were enrolled in study .(RCT)
- They received enalapril 10 mg plus folic acid 0.8 mg or enalapril alone for 4.4 years.
- Results :a 44%slower decline in renal function (0.96%vs 1.72%per year,P < .001
- Conclusion :Enalapril–folic acid therapy, compared with enalapril alone, can significantly delay the progression of CKD among patients with mild-to- moderate CKD.

Published online August 22, 2016

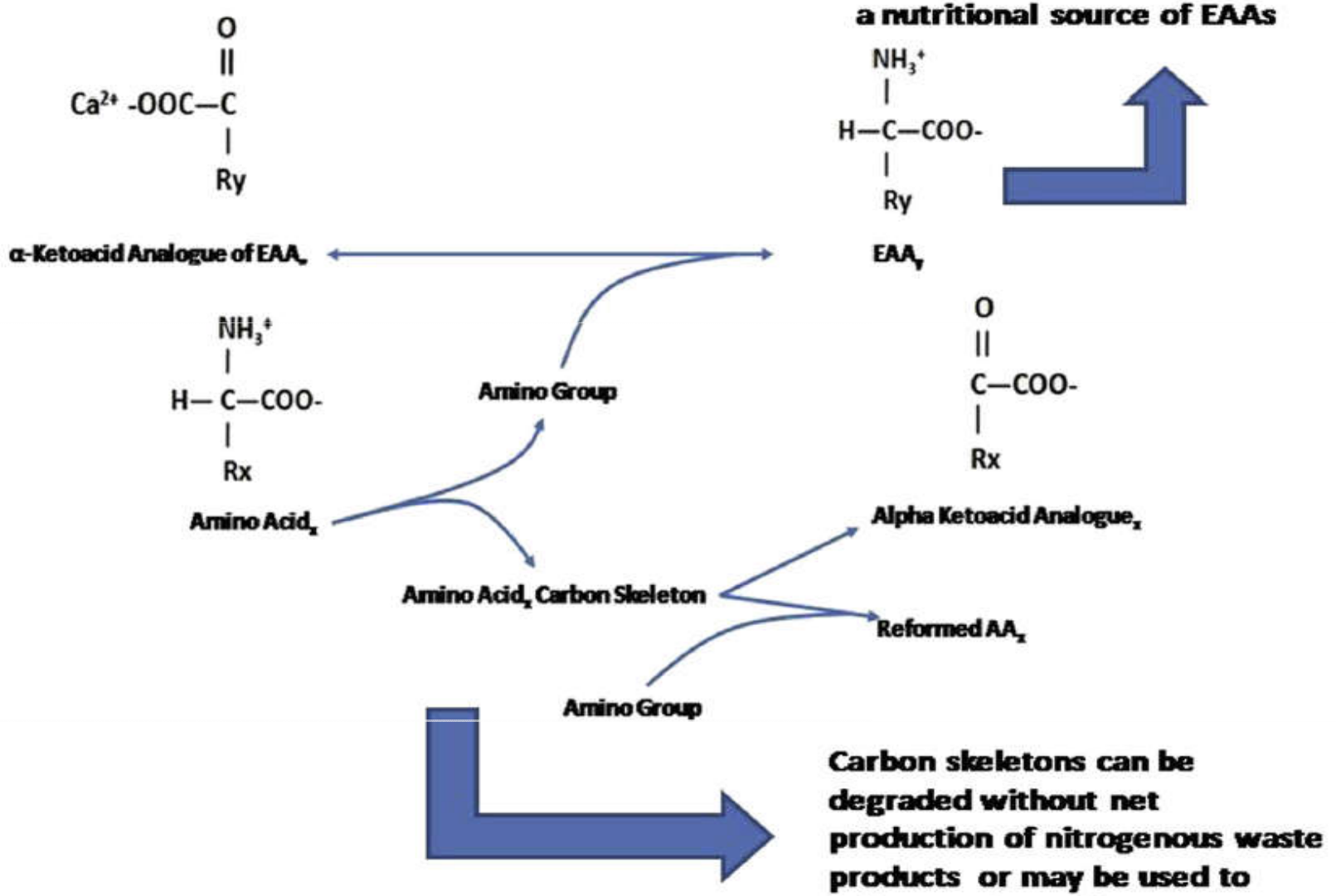
Effect of Bicarbonate Supplementation on Renal Function and Nutritional Indices in Predialysis Advanced Chronic Kidney Disease

- 40 patients with stage 4 CKD (eGFR 15 to 30mL/min per 1.73m2) who had a total CO2 less than 22mEq/L were assigned into the bicarbonate treatment (1000 mg/TDS) group or control group for 12 months.
- There were significant differences in the changes of eGFR during the study between the treatment group and the control group (-2.30±4.49 versus -6.58±6.32mL/min/1.73m2, $p<0.05$).
- Treatment of severe of acidosis has produced improvements in anthropometric measures of lean body mass in some but not all reports.

Jeong, M.D., 2014 The Korean Society of Electrolyte Metabolism

Ketoanalogue (Ketosteril)

- Ketosteril is called a ketoanalogue, which is defined as a nitrogen-free analogue of essential amino acids.
- ketoanalogues capture nitrogen and convert it into amino acids, which are the building blocks of protein.
- ketoanalogues use excess nitrogen, So they decrease production of waste products.
- This may slow the progression of chronic kidney disease and postpone dialysis.



Potential Benefits of KA/EAA supplemented LPDs

1) Enables protein-energy status to be maintained with very low protein diets
2) Reduces metabolic waste products leading to reduced uremia and ? slower GFR loss
3) The KA of leucine may decrease protein degradation and enhance protein synthesis
4) LPDs decrease phosphorus and potassium intake
5) Possible phosphate binding by the calcium salt of the KA
6) Reduced acid load from the lower protein intake and effect of the calcium salt

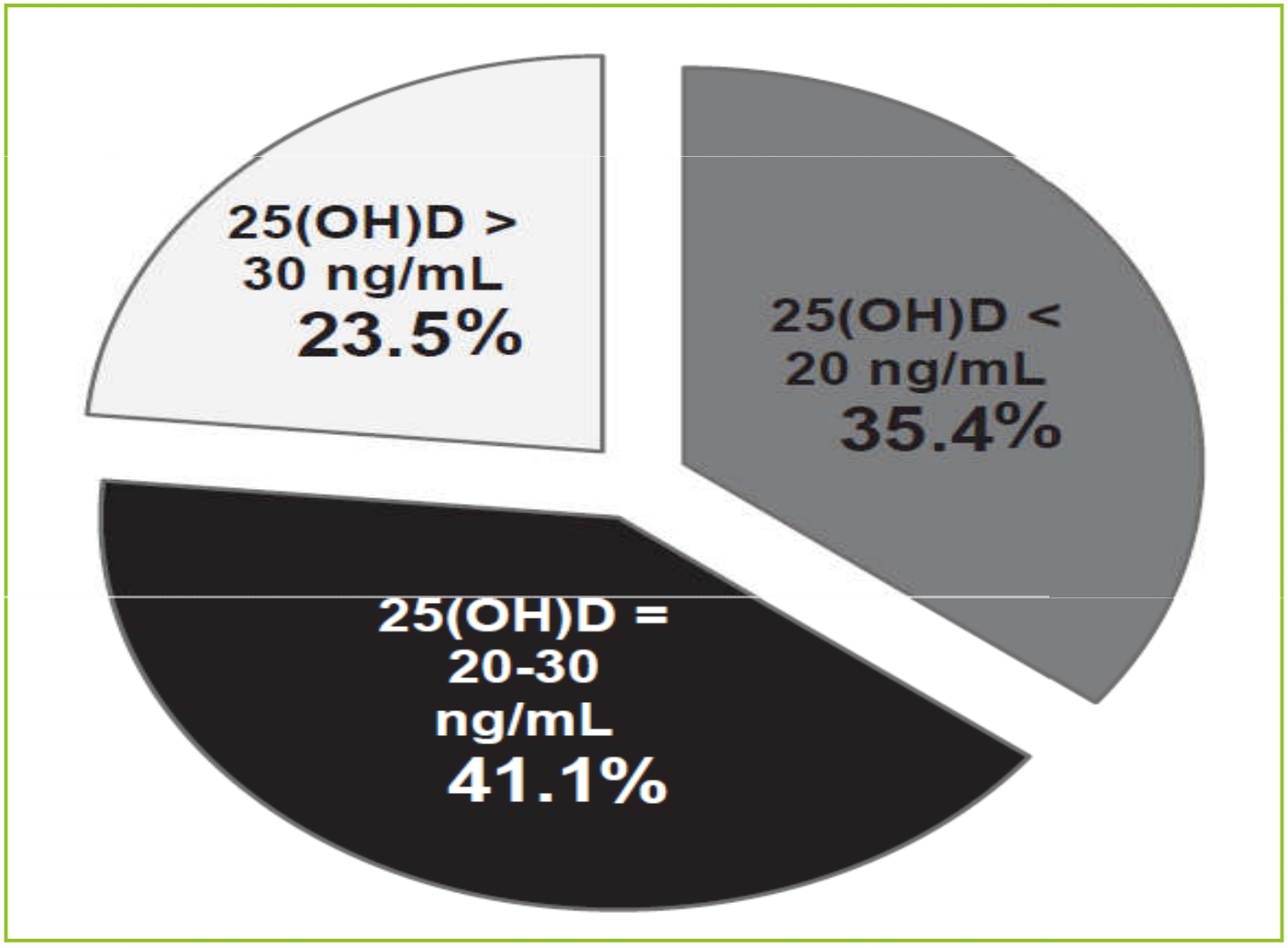
Shah et al. AJKD 2015

Ketoanalogue-Supplemented Vegetarian Very Low-Protein Diet and CKD Progression

- Prospective, RCT of safety and efficacy of ketoanalogue-supplemented vegetarian very low-protein diet (KD) compared with conventional low-protein diet (LPD).
- 207 nondiabetic adults with stable eGFR,30 ml/min per 1.73 m2, proteinuria ,1 g/g urinary creatinine.KD (0.3 g/kg vegetable proteins and 1 cps/5 kg ketoanalogues per day) or continue LPD (0.6 g/kg per day) for 15months.
- Nutritionally safe and could defer dialysis initiation in patients with eGFR,20 ml/min by ameliorating CKD-associated metabolic disturbances.
- The favorable effects of the KD seem to be mediated more by the correction of metabolic complications of advanced CKD, notably the improvement in nitrogen balance, mineral metabolism disturbances,metabolic acidosis, and inflammation, than by reduction in GFR decline.

Garneata et al JASN 2016

Serum 25-hydroxyvitamin D (25[OH]D) concentration category of US patients with stages 3-4 chronic kidney disease (CKD)



Kramer et al 2014 AJKD

Table 1. Comparison of Recommendations for 25(OH)D Testing and Supplementation for CKD

	KDOQI 2003 (Adults)	KDOQI 2005 (Children)	KDIGO 2009	ERBP 2010
Patient population for 25(OH)D measurement	CKD 3-4 if PTH above target range	CKD 2-4 if PTH above target range	CKD 3-5 and 5T	CKD 3-4
25(OH)D threshold for supplementation	30 ng/mL	30 ng/mL	None[a]	12.5 ng/mL
Methods for 25(OH)D supplementation	If 25(OH)D < 5 ng/mL, use oral ergocalciferol, 50,000 IU/wk for 12 wk, then 50,000 IU/mo for 3 mo; if 5-15 ng/mL, use 50,000 IU/wk for 4 wk then 50,000 IU/mo for 5 mo; if 16-30 ng/mL, use 50,000 IU/mo for 6 mo	Recommended ergocalciferol over cholecalciferol; dose of ergocalciferol should not exceed 2,000-4,000 IU/d or 50,000 IU/mo; use 2,000-4,000 IU/d for 12 wk	Recommended treatment strategies used for general population; no specific recommendations for use of cholecalciferol vs ergocalciferol	Recommended cholecalciferol or other 25(OH)D analogues; no specific treatment strategy specified

- IOM committee :25(OH)D<12 ng/ml defined as a state of risk of deficiency, ,insufficiency with 25(OH)D levels of 12-20 ng/mL.
- Thresholds to initiate treatment, dose, and maintenance,may differ across race/ethnicity and by CKD stages. There is no recommendation for vitamin D prescription in prevention of other disease except bone disease.
- The recommended dietary allowance was set as 600 IU daily for children and adults (male and female) aged 1-69years. For adults older than 70 years, recommended dietary allowance for 25(OH)D was 800 IU/d.
- A few clinical trials have suggested that 25(OH)D supplementation lowers PTH levels in individuals, with CKD stage 3, but may be less effective in individuals with stages 4-5 CKD.

Table 1. Herbs From NKF List Found in Reported Dietary Supplements and Associated Adverse Renal Effects

Herb	Nephrotoxic	Aggravates CKD Risk Factor	Risky in CKD
Alfalfa	Triggers lupus	—	—
Aloe	Albuminuria, acute or progressive kidney injury	—	Hypovolemia
Bayberry	—	—	Hypovolemia
Broom	—	—	—
Buckthorn	Albuminuria	—	Hypovolemia
Capsicum	—	—	Hypovolemia
Cascara	Albuminuria	—	Hypovolemia
Dandelion	—	—	Hypovolemia
Ginger	—	—	Hypoglycemia
Ginseng	—	—	Hypoglycemia
Horsetail	—	—	Hypoglycemia
Licorice	—	High BP	—
Ma huang	—	Hyperglycemia, high BP, kidney stones	Hypovolemia
Nettle	Acute or progressive kidney injury	Hyperglycemia	—
Noni	—	—	Hyperkalemia
Pokeroot	—	—	Hypovolemia
Rhubarb	—	—	Hypovolemia
Senna	Acute or progressive kidney injury	—	Hypovolemia
Wormwood	Acute or progressive kidney injury, rhabdomyolysis	—	Hypovolemia
Yohimbe	Acute or progressive kidney injury, triggers lupus	—	—

Note: Hypovolemia due to diarrhea and/or vomiting.

Grubbs V. et al 2013

Obesity-related glomerulopathy: clinical and pathologic characteristics and pathogenesis

- The incidence of obesity-related glomerulopathy (ORG) is increasing in parallel with the worldwide obesity epidemic .
- Major renal physiologic responses to obesity include increases in glomerular filtration rate, renal plasma flow, filtration fraction and tubular reabsorption of sodium
- Pathologic features of ORG include glomerulomegaly and FSGS, particularly the perihilar variant; the degree of foot process effacement in ORG is usually less than in primary FSGS
- Subnephrotic proteinuria is the most common clinical presentation of ORG; some patients have nephrotic-range proteinuria and progressive loss of renal function but full nephrotic syndrome is highly unusual

D'Agati et al ,Nature review nephrology,2016

- Among CKD patients, obesity is associated with the development and progression of cardiovascular events and mortality .
- Observational studies suggest that higher body mass index (BMI) and central adiposity are also independent risk factors for progression of CKD and incidence of end-stage renal disease (ESRD) .
- Fat should be restricted to <30 percent of daily energy intake, with saturated fat limited to <10 percent energy.

Kidney Disease and Obesity

HEALTHY LIFESTYLE FOR HEALTHY KIDNEYS

9 March 2017

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