Malnutrition and Chronic Kidney Disease: The Role of Oral Nutritional Supplements

PRACTICE TOOL

More than 14% of US adults (37 million people) are estimated to have chronic kidney disease (CKD) with about 555,000 Americans on dialysis.[1,2] There are a number of risk factors for CKD such as diabetes, hypertension, heart disease, obesity, older age, family history of kidney disease, or personal history of acute kidney injury, many of which are also associated with nutrition problems.[3] CKD is classified into 5 stages based on glomerular filtration rate (GFR), which reflects how well the kidneys are filtering waste from the blood.[4] These stages are:

Stage 1 CKD	eGFR ≥90 and kidney damage (e.g., uACR ≥30) for 3 months or more.
Stage 2 CKD	eGFR 60 - 89 and kidney damage (e.g., uACR ≥30) for 3 months or more.
Stage 3a CKD	Mild to moderate loss of kidney function (eGFR 45–59 for 3 months or more).
Stage 3b CKD	Moderate to severe loss of kidney function (eGFR 30–44 for 3 months or more).
Stage 4 CKD	Severe loss of kidney function (eGFR 15–29 for 3 months or more).
Stage 5 CKD	Kidney failure (eGFR <15 for 3 months or more) or on dialysis.

uACR= urine albumin-to-creatinine ratio

When CKD progresses to kidney failure, individuals may require renal replacement therapy to survive. There are two types of dialysis used in kidney failure. Hemodialysis (HD) which filters blood through an artificial kidney machine before returning it to the body, and Peritoneal dialysis (PD) which uses the lining of the abdomen as a natural filter by cycling cleansing fluid in and out of the abdomen to remove waste and extra fluid.[5]

Malnutrition in CKD

Malnutrition is common in individuals with CKD, with studies reporting prevalence rates ranging from 20% to 45% in children with CKD, depending on the criteria used to define malnutrition.[6] In adults with CKD, one study found that 31% met criteria for protein-energy wasting (PEW) using the Subjective Global Assessment (SGA).[6] Therefore, it is important to identify and treat malnutrition in this population.

This practice tool supports clinicians in identifying malnutrition risk and using oral nutritional supplements (ONS) in patients with CKD. Malnutrition is common among individuals living with CKD stages 3–5 due to:[7]

- Reduced appetite
- Inflammation/Catabolic stress
- Gastrointestinal symptoms (nausea, vomiting, constipation, diarrhea, and abdominal discomfort)
- Dietary restrictions
- Metabolic acidosis

Clinical Consequences of Malnutrition in CKD

There are a number of negative clinical outcomes associated with malnutrition in CKD, particularly those undergoing dialysis, including.[7]

- Increased rates of hospitalization
- Longer recovery times
- Higher infection risk
- Higher all-cause mortality
- Muscle wasting/frailty

Maintaining and improving nutritional status in CKD can be a challenge, and it may be necessary to rely on nutritional supplements to optimize intake.[8]

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Oral Nutritional Supplements

Oral nutritional supplements (ONS) are commercially manufactured products available in liquid, powder, or solid form. They contain a combination of carbohydrates, proteins, fats, fiber, vitamins, and minerals.[9] The goals of ONS include:[10]

- Achievement of nutritional targets
- Improvement in nutritional status
- Preservation of lean body mass

Indications for Oral Nutrition Supplementation[7]

Consider ONS in patients with CKD who demonstrate:

- Not achieving adequate nutritional intake despite dietary counseling
- Unintentional weight loss exceeding 5% within 1–3 months or >10% over 6 months
- Dietary intake consistently less than 75% of recommended requirements
- Muscle mass depletion or reduced hand-grip strength
- Chronic inflammation

ONS Recommendations Across CKD Populations[7]

CKD Stage	ONS Indication	Recommended Protein Intake (Including ONS)	Key Nutrition Composition	Expected Outcomes	Monitoring Parameters	Assessment interval
CKD 3–5 (non-dialysis)	• Inadequate dietary intake (<75% energy/protein targets) • Presence of protein energy wasting	• 0.55–0.60 g/kg/day protein • Supplemented by ONS to meet targets without exceeding protein recommendations	Renal specific formulas • ~200–300 kcals • 10–15 g protein • Low Na, K, Phos content	• Improved serum albumin • Prevention of weight loss • Maintenance of muscle mass	• Serum albumin, prealbumin • Electrolytes (Phos, K) • Body weight • Muscle strength	Every 1–3 months
HD Pts	• Persistent inadequate intake despite counseling • Presence of malnutrition or PEW	• 1.0–1.2 g/kg/day protein total • Include ONS	Renal Specific ONS • ~300–400 kcal • 5–25 g protein • Low Phos, K content	• Improved BMI, lean body mass • Enhanced muscle strength • Reduced hospitalization rate	• Serum albumin • nPCR • Electrolytes (Phos, K) • Fluid status • Interdialytic weight gain • Muscle function	Every 1–3 months
PD Pts	• Same as HD • Additional losses of protein via dialysis fluid increase needs	• 1.0–1.2+ g/kg/day including ONS	Renal Specific ONS similar to HD formula above	• Better preservation of nutritional status • Muscle mass	As above + peritoneal dialysis parameters (dialysate protein losses)	Every 1–3 months

CKD: Chronic Kidney Disease; HD: Hemodialysis; PD: Peritoneal Dialysis; ONS: Oral Nutritional Supplement; nPCR: Normalized Protein Catabolic Rate; Phos: Phosphorus; K: Potassium; Na: Sodium; BMI: Body Mass Index. Table reprinted: Kang D, Youn S, Min JW, et al. Nutritional status evaluation and intervention in chronic kidney disease patients: practical approach. *Nutrients.* 2025;17(20):3264. https://doi.org/10.3390/nu17203264

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Key Nutrients and Ingredients of Emphasis for Patients with Chronic Kidney Disease[10-15]

Nutrient/Ingredient	Why It May Be Beneficial in CKD	Clinical Relevance in ONS
High-Quality Protein (Whey Protein, β-lactoglobulin, Essential Amino Acids)	CKD patients are at risk for protein-energy wasting (PEW), sarcopenia, poor physical function, hospitalization, and mortality. Adequate protein supports maintenance of lean body mass, muscle function, wound healing, and immune function. Dialysis patients have additional amino acid and protein losses during treatment.	Renal-specific ONS often provide concentrated, high-biological-value protein to help meet protein requirements without excessive volume. β-lactoglobulin is rich in branched-chain amino acids (BCAAs), particularly leucine.
Leucine/BCAAs	Leucine stimulates muscle protein synthesis through activation of mTOR pathways and may help preserve muscle mass and function in patients experiencing catabolic stress.	Especially valuable in patients with PEW, frailty, sarcopenia, or poor oral intake.
Omega-3 Fatty Acids (EPA & DHA)	CKD is characterized by chronic inflammation, increased cardiovascular risk, and dyslipidemia. Omega-3 fatty acids may reduce triglycerides, inflammatory markers (CRP, TNF-α), cardiovascular risk, and symptoms such as uremic pruritus.	Renal ONS may include EPA/DHA to support cardiovascular and inflammatory health. KDOQI* suggests 1.3–4 g/day long chain omega 3 polyunsaturated fatty acids.
Dietary Fiber (Soluble Fiber, Inulin, Prebiotics)	Fiber may reduce production and absorption of gut-derived uremic toxins, improve bowel function, support gut microbiota, lower inflammation, improve glycemic control, and reduce cardiovascular risk.	Particularly important because CKD dietary restrictions often limit natural fiber intake. Prebiotic fibers such as inulin may help reduce uremic toxin burden.
Prebiotics (e.g., Inulin, Fructooligosaccharides)	Support growth of beneficial gut bacteria, improve intestinal barrier integrity, and may reduce generation of uremic toxins such as indoxyl sulfate and p-cresyl sulfate.	Increasingly incorporated into renal-specific formulations to support the gut-kidney axis.
Low-Glycemic Carbohydrates (e.g., Isomaltulose)	Insulin resistance and diabetes are highly prevalent in CKD. Low-glycemic carbohydrates produce a more gradual glucose and insulin response and may support glycemic management.	Useful in CKD patients with diabetes or impaired glucose metabolism.
Vitamin D	Vitamin D deficiency is common in CKD and is associated with secondary hyperparathyroidism, bone disease, muscle weakness, and increased mortality risk.	Supplementation is recommended when deficiency or insufficiency is present.
B Vitamins (B_1, B_6, B_{12}, Folate)	Support energy metabolism, red blood cell production, neurologic function, and homocysteine metabolism. Water-soluble vitamins can be lost during dialysis.	Dialysis patients frequently require monitoring and replacement of B vitamins.

KDOQI = National Kidney Foundation's Kidney Disease Outcomes Quality Initiative

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Nutrient/Ingredient	Why It May Be Beneficial in CKD	Clinical Relevance in ONS
Vitamin C	Important antioxidant that supports collagen synthesis, immune function, and endothelial health. Significant amounts may be lost during hemodialysis.	Moderate supplementation may help prevent deficiency; excessive supplementation should be avoided because of oxalate accumulation risk.
Vitamin K	Supports bone metabolism and may help inhibit vascular calcification via vitamin K-dependent proteins. CKD patients often have impaired vitamin K status due to dietary restrictions.	Emerging nutrient of interest for bone and cardiovascular health in CKD.
Zinc	Supports immune function, wound healing, appetite regulation, and taste perception. Deficiency may contribute to poor intake and malnutrition.	Assessment is recommended in patients with poor intake, taste changes, or suspected deficiency.
Selenium	Functions as a key antioxidant micronutrient and may help counter oxidative stress, which is elevated in CKD and dialysis patients.	Monitoring may be appropriate, particularly in dialysis populations.
Energy-Dense Calories	Many CKD patients fail to achieve recommended calorie intake due to anorexia, dietary restrictions, inflammation, and treatment-related fatigue. Adequate caloric intake helps prevent PEW and unintended weight loss.	Renal-specific ONS are often calorically dense (e.g., 2 kcal/mL) to provide nutrition in a small volume.

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