

Executive Summary of the 2020 Academy of Nutrition and Dietetics and National Kidney Foundation Clinical Practice Guideline for Nutrition in CKD



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The 2020 update to KDOQI Clinical Practice Guidelines for Nutrition in chronic kidney disease (CKD) is a result of the collaboration between the National Kidney Foundation (NKF) and the Academy of Nutrition and Dietetics (Academy). The target population for this guideline is adults with stages 1 through 5 CKD who are not receiving dialysis, end-stage kidney disease including those on dialysis, and individuals with functional kidney transplant. The updated guideline includes 83 recommendations on important nutrition topics in CKD, including nutrition screening and assessment; medical nutrition therapy; dietary protein and energy intake; micronutrients; electrolytes; nutritional supplementation; and dietary patterns. Both Academy and Grading of Recommendations Assessment, Development and Evaluation (GRADE) approaches were used to assess quality of evidence and rate the recommendation statements. Guideline recommendations were the result of a comprehensive systematic review, clinical expertise, and considerations for individualized care.

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BACKGROUND AND RATIONALE

REGISTERED DIETITIAN NUTRITIONISTS (RDNS) provide Medical Nutrition Therapy (MNT) to patients at every stage in the progression of chronic kidney disease (CKD). Chronic kidney disease is one of the leading causes of death in adults and increases the risk of many adverse health outcomes.¹ The primary aims of CKD management are to delay the onset of dialysis and maintain normal nutritional status. Hence, understanding the available methods for assessing nutritional status, determining patient-specific dietary needs, and preventing and treating nutritional deficiencies are important for optimal nutrition care for patients with CKD. Previous guidelines providing recommendations for nutrition management in CKD were published in 2000 and 2010.^{2,3} The original National Kidney Foundation (NKF) Kidney Disease Outcomes Quality Initiative (KDOQI) was published in 2000.² In 2010, The Academy of Nutrition and Dietetics (Academy) Evidence Analysis Library (EAL) published

a guideline on medical nutrition therapy (MNT) for adults with CKD (stages 1-5, including post kidney transplantation) not on dialysis.³ Since then, there has been a significant increase in the volume of evidence examining metabolic and nutritional management of patients with CKD, including those who are nondialyzed (stages 1-5), dialyzed, or with functional kidney transplant. Therefore, the current 2020 KDOQI and Academy guideline aims to provide comprehensive nutrition management recommendations for a range of individuals with CKD based on updated evidence for the practicing clinicians and allied health care workers.

GUIDELINE FOCUS

The aim of this guideline is to provide nutrition care recommendations for patients with CKD to assess, prevent, and treat protein-energy wasting, mineral and electrolyte disorders, and other metabolic disorders that are associated with kidney disease. The target population is adults with CKD stages 1-5, including those who are nondialyzed, on dialysis, and posttransplantation. The updated guideline provides recommendations

on nutrition assessment; nutrition interventions, including medical nutrition therapy by an RDN; dietary protein and energy intake; micronutrients; electrolytes; nutritional supplementation; and dietary patterns.

APPROACH

This guideline was developed collaboratively by the NKF and the Academy. Academy staff served as the evidence review team (ERT) and followed EAL methodology for conducting systematic reviews.⁴ The workgroup and ERT developed recommendation statements using both the Grading of Recommendations Assessment, Development and Evaluation (GRADE) method and EAL's guideline development methods.^{5,6} The Academy led the process of recruiting a workgroup to develop these guidelines. To ensure appropriate expertise and limit bias, a transparent process of global recruitment and selection based on a predetermined criterion was conducted by a workgroup selection committee. A total of 15 work group members comprising physicians and a registered dietitian or the international equivalent were selected to develop this guideline based on their experiences

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EAL-KDOQI: Assessment recommendations	EAL recommendation rating
CKD: Nutrition screening and assessment: Usual care statements	
<i>Routine nutrition screening</i>	
In adults with CKD 3-5D or posttransplantation, it is reasonable to consider routine nutrition screening at least biannually with the intent of identifying those at risk of protein-energy wasting (OPINION).	Consensus; Conditional
<i>Nutrition screening tools</i>	
In adults with CKD 3-5D or posttransplantation, there is limited evidence to suggest the use of one tool over others for identifying those at risk of protein-energy wasting (2D).	Weak; Conditional
<i>Routine nutrition assessment</i>	
In adults with CKD 3-5D or posttransplantation, it is reasonable that a registered dietitian nutritionist (RDN) or an international equivalent conduct a comprehensive nutrition assessment (including but not limited to appetite, history of dietary intake, body weight and body mass index, biochemical data, anthropometric measurements, and nutrition-focused physical findings) at least within the first 90 days of starting dialysis, annually, or when indicated by nutrition screening or provider referral (OPINION).	Consensus; Conditional
CKD: Nutrition assessment: Other anthropometric assessment methods	
<i>Skinfold thickness</i>	
In adults with CKD 1-5D (1B) or posttransplantation (OPINION), in the absence of edema, we suggest using skinfold thickness measurements to assess body fat.	Strong; Conditional
<i>Waist circumference</i>	
In adults with CKD 5D, we suggest that waist circumference may be used to assess abdominal obesity, but its reliability in assessing changes over time is low (2C).	Weak; Conditional
<i>Conicity index</i>	
In adults with CKD 5D on MHD, we suggest that the conicity index may be used to assess nutritional status (OPINION) and as a predictor of mortality (2C).	Weak; Conditional
<i>Creatinine kinetics</i>	
In adults with CKD 5D, we suggest that creatinine kinetics may be used to estimate muscle mass, though very high or very low dietary intake of meat or creatine supplements will influence accuracy of this measurement (2C).	Weak; Conditional
CKD: Nutrition assessment: Body mass index (BMI) as a predictor of mortality	
<i>CKD: Body mass index (BMI) as a predictor of mortality, maintenance hemodialysis (MHD)</i>	
In adults with CKD 5D on MHD, we suggest that overweight/obese status (based on BMI) can be used as a predictor of lower mortality, whereas underweight status and morbid obesity (based on BMI) can be used as a predictor of higher mortality (2B).	Fair; Conditional
<i>CKD: Body mass index (BMI) as a predictor of mortality, peritoneal dialysis (PD)</i>	
In adults with CKD 5D on PD, we suggest that underweight status (based on BMI) can be used as a predictor of higher mortality (2C).	Weak; Conditional
<i>(continued on next page)</i>	

Figure 1. CKD: Nutrition assessment recommendation statements.

EAL-KDOQI: Assessment recommendations	EAL recommendation rating
<i>CKD: Body mass index (BMI) as a predictor of mortality, nondialyzed</i>	Consensus; Conditional
In adults with CKD 1-5, it is reasonable to consider using underweight status (based on BMI) as a predictor of higher mortality, though the mortality risk associated with overweight or obesity status (based on BMI) is not clear (OPINION).	
<i>CKD: Body mass index (BMI) as a predictor of mortality, posttransplantation</i>	Consensus; Conditional
In adults with CKD posttransplantation, it is reasonable to consider using underweight and overweight/obesity status (based on BMI) as a predictor of higher mortality (OPINION).	
CKD: Nutrition assessment: Body weight and body composition usual-care statements	
<i>Body composition and body weight/body mass index</i>	
In adults with CKD 1-5D or posttransplantation, it is reasonable to consider assessing body composition in combination with body weight/BMI at the first visit and to monitor overall nutrition status periodically over time (OPINION).	Consensus; Conditional
<i>Frequency of body weight/BMI and body composition assessment</i>	
In adults with CKD 1-5D or posttransplantation who are clinically stable, it is reasonable to measure body weight and BMI and to monitor for changes in body weight/BMI and body composition as needed (OPINION): At least monthly in MHD and PD patients. At least every 3 months in patients with CKD 4-5 or posttransplantation At least every 6 months in patients with CKD 1-3	Consensus; Conditional
<i>Assessment of body weight</i>	
In adults with CKD 1-5D or posttransplantation, it is reasonable for registered dietitian nutritionist (RDN) or an international equivalent or physicians to use clinical judgment to determine the method for measuring body weight (eg, actual measured weight; history of weight changes; serial weight measurements; adjustments for suspected impact of edema, ascites, and polycystic organs) due to absence of standard reference norms (OPINION).	Consensus; Conditional
<i>Body mass index and protein-energy wasting (PEW)</i>	
In adults with CKD 1-5D or posttransplantation, BMI alone is not sufficient to establish a diagnosis of PEW unless the BMI is very low (<18 kg/m ²) (OPINION).	Consensus; Conditional
CKD: Nutrition assessment: Body composition with bioelectrical impedance (BIA) and dual-energy x-ray absorptiometry (DEXA)	
<i>Bioelectrical impedance for patients on maintenance hemodialysis (MHD)</i>	
In adults with CKD 5D on MHD, we suggest using bioimpedance and preferably multi-frequency bioelectrical impedance (MF-BIA) to assess body composition when available. Bioimpedance assessments should ideally be performed a minimum of 30 minutes or more after the end of the hemodialysis session to allow for redistribution of body fluids (2C).	Weak; Conditional
<i>Bioelectrical impedance for CKD patients not on dialysis or on peritoneal dialysis (PD)</i>	
In adults with CKD 1-5 or CKD 5D on PD, there is insufficient evidence to suggest using bioelectrical impedance to assess body composition (2D).	Weak; Conditional
<i>Dual-energy x-ray absorptiometry (DXA) for body composition assessment</i>	
In adults with CKD 1-5D or posttransplantation, it is reasonable to use DXA when feasible as it remains the gold standard for measuring body composition despite being influenced by volume status (OPINION).	Consensus; Conditional
<i>(continued on next page)</i>	

Figure 1. (continued) CKD: Nutrition assessment recommendation statements.

EAL-KDOQI: Assessment recommendations	EAL recommendation rating
CKD: Nutrition assessment: Laboratory measurements	
<i>Single biomarker measurements</i>	
In adults with CKD 1-5D or posttransplantation, biomarkers such as normalized protein catabolic rate (nPCR), serum albumin, or serum prealbumin (if available) may be considered complementary tools to assess nutritional status. However, they should not be interpreted in isolation to assess nutritional status as they are influenced by non-nutritional factors (OPINION).	Consensus; Conditional
<i>Serum albumin levels</i>	
In adults with CKD 5D on MHD, serum albumin may be used as a predictor of hospitalization and mortality, with lower levels associated with higher risk (1A).	Strong; Imperative
CKD: Nutrition assessment: Handgrip strength	
In adults with CKD 1-5D, we suggest that handgrip strength may be used as an indicator of protein-energy status and functional status when baseline data (prior measures) are available for comparison (2B).	Fair; Conditional
CKD: Nutrition assessment: Energy requirements	
<i>Assessment of resting energy expenditure</i>	
In adults with CKD 1-5D or posttransplantation, it is reasonable to use indirect calorimetry to measure resting energy expenditure when feasible and indicated, as it remains the gold standard for determining resting energy expenditure (OPINION).	Consensus; Conditional
<i>Resting energy expenditure equations</i>	
In adults with CKD 5D who are metabolically stable, we suggest that in the absence of indirect calorimetry, disease-specific predictive energy equations may be used to estimate resting energy expenditure because they include factors that may influence the metabolic rate in this population (2C).	Weak; Conditional
CKD: Nutrition assessment: Composite nutritional indices	
<i>7-Point Subjective Global Assessment (SGA)</i>	
In adults with CKD 5D, we recommend the use of the 7-point Subjective Global Assessment as a valid and reliable tool for assessing nutritional status (1B).	Strong; Imperative
<i>Malnutrition inflammation score (MIS)</i>	
In adults with CKD 5D on MHD or posttransplantation, Malnutrition Inflammation Score may be used to assess nutritional status (2C).	Weak; Conditional
CKD: Nutrition assessment: Dietary intake	
<i>Considerations when assessing dietary intake</i>	
In adults with CKD 3-5D or posttransplantation, it is reasonable to assess factors beyond dietary intake (eg, medication use, knowledge, beliefs, attitudes, behavior, access to food, depression, cognitive function) to effectively plan nutrition interventions (OPINION).	Consensus; Conditional
<i>3-Day food records to assess dietary intake</i>	
In adults with CKD 3-5D, we suggest the use of a 3-day food record, conducted during both dialysis and nondialysis treatment days (when applicable), as a preferred method to assess dietary intake (2C).	Weak; Conditional
<i>Alternative methods of assessing dietary intake in CKD 3-5</i>	
<i>(continued on next page)</i>	

Figure 1. (continued) CKD: Nutrition assessment recommendation statements.

EAL-KDOQI: Assessment recommendations	EAL recommendation rating
In adults with CKD 3-5 (OPINION) or CKD 5D (2D), 24-hour food recalls, food frequency questionnaires, and normalized protein catabolic rate (nPCR) may be considered as alternative methods of assessing dietary energy and protein intake (2D).	Consensus; Conditional
<i>Alternative methods of assessing dietary intake in CKD 5D</i>	
In adults with CKD 5D (2D), 24-hour food recalls, food frequency questionnaires, and normalized protein catabolic rate (nPCR) may be considered as alternative methods of assessing dietary energy and protein intake (2D).	Weak; Conditional

Figure 1. (continued) CKD: Nutrition assessment recommendation statements.

and skills sets. The work group members were involved in developing research questions, eligibility criteria, and search plan; evaluating and grading the evidence; and developing recommendation statements and ratings. The ERT and work group members met twice for 2-day face-to-face meetings, as well as teleconference calls once per month for the duration of the project. For details about systematic review and guideline development processes, please refer to the EAL website and Ikizler et al 2020.^{7,8}

Once the guidelines were developed, an in-depth, multiphase review process was conducted. These guidelines were reviewed internally by KDOQI leadership and the NKF Scientific Advisory Board, and externally by content experts from International

Society of Renal Nutrition and Metabolism, the Academy's expert review panel, and finally during an open public review. The work group members incorporated these review comments into the final version of the guideline.

RECOMMENDATIONS AND RATING APPROACH

Recommendation statements provide a course of action for the practitioner based on evidence and clinical expertise. Figures 1 to 5 present a list of recommendations for the focus topics covered in the guideline. The Academy rates recommendations as Strong, Fair, Weak, Consensus, or Insufficient Evidence to rate recommendations, and the GRADE method uses a level 1

(Recommend) or level 2 (Suggest) rating scale. The rating for the recommendations in both methods is based on the strength of the supporting evidence, the balance between benefits and harms anticipated, and the clinical practice implications.

LIMITATIONS AND FUTURE RESEARCH

The guideline committee focused these guidelines on principal topics of dietary management, and not all the possible nutritional intervention strategies were addressed. Thus, this guideline does not cover some nutrition topics that may be of importance to patients and caregivers. This guideline targeted adults with CKD stages 1 through 5, including those who are nondialyzed,

EAL-KDOQI CKD: Medical nutrition therapy	EAL recommendation rating
<i>MNT to improve outcomes</i>	
In adults with CKD 1-5D, we recommend that a registered dietitian nutritionist (RDN) or an international equivalent, in close collaboration with a physician or other provider (nurse practitioner or physician assistant), provide medical nutrition therapy (MNT). Goals are to optimize nutritional status, and to minimize risks imposed by comorbid conditions and alterations in metabolism on the progression of kidney disease (1C) and on adverse clinical outcomes (OPINION).	Fair; Imperative
<i>MNT content</i>	
In adults with CKD 1-5D or posttransplantation, it is reasonable to prescribe MNT that is tailored to the individuals' needs, nutritional status, and comorbid conditions (OPINION).	Consensus; Imperative
<i>MNT Monitoring and evaluation</i>	
In adults with CKD 3-5D or posttransplantation, it is reasonable for the registered dietitian nutritionist (RDN) or an international equivalent to monitor and evaluate appetite, dietary intake, body weight changes, biochemical data, anthropometric measurements, and nutrition-focused physical findings to assess the effectiveness of MNT (OPINION).	Consensus; Imperative

Figure 2. CKD: Medical nutrition therapy recommendation statements.

EAL-KDOQI: Macronutrient recommendations	EAL recommendation Rating
CKD: Macronutrients: Dietary patterns	
<i>Mediterranean diet</i>	
In adults with CKD 1-5 not on dialysis or posttransplantation, with or without dyslipidemia, we suggest that prescribing a Mediterranean diet may improve lipid profiles (2C).	Weak; Conditional
<i>Fruits and vegetables</i>	
In adults with CKD 1-4, we suggest that prescribing increased fruit and vegetable intake may decrease body weight, blood pressure, and net acid production (NEAP) (2C).	Weak; Conditional
CKD: Macronutrients: LC n-3 PUFA nutritional supplements for lipid profile	
<i>LC n-3 PUFA Nutritional supplements for lipid profile, maintenance hemodialysis</i>	
In adults with CKD 5D on MHD, we suggest that 1.3-4 g/d LC n-3 PUFA may be prescribed to reduce triglycerides and LDL cholesterol (2C) and raise HDL levels (2D).	Weak; Conditional
<i>LC n-3 PUFA Nutritional supplements for lipid profile, peritoneal dialysis</i>	
In adults with CKD 5D on PD, it is reasonable to consider prescribing 1.3-4 g/d LC n-3 PUFA to improve the lipid profile (OPINION).	Consensus; Conditional
<i>LC n-3 PUFA Nutritional supplements for lipid profile, non-dialyzed</i>	
In adults with CKD 3-5, we suggest prescribing w2 g/d LC n-3 PUFA to lower serum triglyceride levels (2C).	Weak; Conditional
CKD: Macronutrients: LC n-3 PUFA Nutritional supplements and hard outcomes	
<i>LC n-3 PUFA Nutritional supplements for mortality and cardiovascular disease, maintenance hemodialysis, and post-transplantation</i>	
In adults with CKD 5D on MHD or posttransplantation, we suggest not routinely prescribing LC n-3 PUFA, including those derived from fish or flaxseed and other oils, to lower risk of mortality (2C) or cardiovascular events (2B).	Fair; Imperative
<i>LC n-3 PUFA Nutritional supplements for mortality and cardiovascular disease, peritoneal dialysis</i>	
In adults with CKD 5D on PD, it is reasonable to not routinely prescribe LC n-3 PUFA, including those derived from fish or flaxseed and other oils, to lower risk of mortality or cardiovascular events (OPINION).	Consensus; Conditional
CKD: Macronutrients: Protein amount	
<i>Protein restriction, CKD patients not on dialysis and without diabetes</i>	
In adults with CKD 3-5 who are metabolically stable, we recommend, under close clinical supervision, protein restriction with or without keto acid analogs, to reduce risk for ESRD/death (1A) and improve quality of life (QoL) (2C):	Strong; Conditional
<ul style="list-style-type: none"> ■ A low-protein diet providing 0.55 to 0.60 g dietary protein/kg body weight/day, or ■ A very low-protein diet providing 0.28 to 0.43 g dietary protein/kg body weight/day with additional keto acid/amino acid analogs to meet protein requirements (0.55-0.60 g/kg body weight/day) 	
<i>Dietary protein intake, maintenance hemodialysis patients without diabetes</i>	
In adults with CKD 5D on MHD (1C) who are metabolically stable, we recommend prescribing a dietary protein intake of 1.0-1.2 g/kg body weight per day to maintain a stable nutritional status.	Fair; Conditional

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Figure 3. CKD: Macronutrient recommendation statements.

EAL-KDOQI: Macronutrient recommendations	EAL recommendation Rating
<i>Dietary protein intake, Peritoneal dialysis patients without diabetes</i>	
In adults with CKD 5D on PD (OPINION) who are metabolically stable, we recommend prescribing a dietary protein intake of 1.0-1.2 g/kg body weight per day to maintain a stable nutritional status.	Consensus; Conditional
CKD: Macronutrients: Protein amount, diabetes mellitus	
<i>Protein restriction, non-dialysis, diabetic</i>	
In the adult with CKD 3-5 and who has diabetes, it is reasonable to prescribe, under close clinical supervision, a dietary protein intake of 0.6-0.8 g/kg body weight per day to maintain a stable nutritional status and optimize glycemic control (OPINION).	Consensus; Conditional
<i>Dietary protein intake, maintenance hemodialysis, and peritoneal dialysis patients with diabetes</i>	
In adults with CKD 5D and who have diabetes, it is reasonable to prescribe a dietary protein intake of 1.0-1.2 g/kg body weight per day to maintain a stable nutritional status. For patients at risk of hyperglycemia or hypoglycemia, higher levels of dietary protein intake may need to be considered to maintain glycemic control (OPINION).	Consensus; Conditional
CKD: Macronutrients: Protein type	
<i>Protein type</i>	
In adults with CKD 1-5D (1B), there is insufficient evidence to recommend a particular protein type (plant vs animal) in terms of the effects on nutritional status, calcium or phosphorus levels, or the blood lipid profile.	Strong; Imperative
<i>Protein type, posttransplantation</i>	
In adults with CKD posttransplantation, there is insufficient evidence to recommend a particular protein type (plant vs animal) in terms of the effects on nutritional status, calcium or phosphorus levels, or the blood lipid profile (OPINION).	Consensus; Conditional
CKD: Macronutrients: Energy intake	
<i>Energy intake in CKD 1-5D</i>	
In adults with CKD 1-5D who are metabolically stable, we recommend prescribing an energy intake of 25-35 kcal/kg body weight per day based on age, sex, level of physical activity, body composition, weight status goals, CKD stage, and concurrent illness or presence of inflammation to maintain normal nutritional status (1C).	Fair; Imperative
<i>Energy intake for CKD posttransplantation</i>	
In adults with CKD posttransplantation who are metabolically stable, we recommend prescribing an energy intake of 25-35 kcal/kg body weight per day based on age, sex, level of physical activity, body composition, weight status goals, CKD stage, and concurrent illness or presence of inflammation to maintain normal nutritional status (OPINION).	Consensus; Conditional
CKD: Macronutrients: LC n-3 PUFA Nutritional supplements for AV graft and fistula patency and kidney allograft survival	
<i>LC n-3 PUFA Nutritional supplements for AV graft and fistula patency for maintenance hemodialysis</i>	
In adults with CKD 5D on MHD, we suggest not routinely prescribing fish oil to improve primary patency rates in patients with AV grafts (2B) or fistulas (2A).	Fair; Imperative
<i>LC n-3 PUFA Nutritional supplements for kidney allograft survival</i>	
<i>(continued on next page)</i>	

Figure 3. (continued) CKD: Macronutrient recommendation statements.

EAL-KDOQI: Macronutrient recommendations	EAL recommendation Rating
In adults with CKD posttransplantation, we suggest not routinely prescribing LC n-3 PUFA to reduce the number of rejection episodes or improve graft survival (2D).	Weak; Conditional
CKD: Macronutrients: Oral, enteral, and intradialytic parenteral nutrition supplementation	
<i>Oral protein-energy supplementation for CKD 3-5D</i>	
In adults with CKD 3-5D at risk of or with protein-energy wasting, we suggest a minimum of a 3-month trial of oral nutritional supplements to improve nutritional status if dietary counseling alone does not achieve sufficient energy and protein intake to meet nutritional requirements (2D).	Weak; Conditional
<i>Oral protein-energy supplementation for posttransplantation</i>	
In adults with CKD posttransplantation at risk of or with protein-energy wasting, it is reasonable to consider a minimum of a 3-month trial of oral nutritional supplements to improve nutritional status if dietary counseling alone does not achieve sufficient energy and protein intake to meet nutritional requirements (OPINION).	Consensus; Conditional
<i>Enteral nutrition supplementation</i>	
In adults with CKD 1-5D, with chronically inadequate intake and whose protein and energy requirements cannot be attained by dietary counseling and oral nutritional supplements, it is reasonable to consider a trial of enteral tube feeding (OPINION).	Consensus; Conditional
<i>Total parenteral nutrition (TPN) and intradialytic parenteral nutrition (IDPN) protein-energy supplementation</i>	
In adults with CKD with protein-energy wasting, we suggest a trial of TPN for CKD 1-5 patients (2C) and IDPN for CKD 5D on MHD patients (2C), to improve and maintain nutritional status if nutritional requirements cannot be met with existing oral and enteral intake.	Weak; Conditional
CKD: Macronutrients: Dialysate	
<i>Dialysate protein-energy supplementation</i>	
In adults with CKD 5D on PD with protein-energy wasting, we suggest not substituting conventional dextrose dialysate with amino acid dialysate as a general strategy to improve nutritional status, although it is reasonable to consider a trial of amino acid dialysate to improve and maintain nutritional status if nutritional requirements cannot be met with existing oral and enteral intake (OPINION).	Consensus; Conditional

Figure 3. (continued) CKD: Macronutrient recommendation statements.

those requiring dialysis, and kidney transplant recipients; however, patients with acute kidney injury were excluded because they represent a significantly different nutritional and metabolic profile. Certain nutritional management challenges, including obesity, exercise, and anabolic pharmacotherapy, were not addressed in this guideline. Considerable work remains to be accomplished in these areas of nutrition management in patients with CKD in terms of original research studies, systematic reviews, and clinical guidelines for topics not covered in this 2020 update. The future research section under the major topics covered in this guideline help to

identify and prioritize research needs in the field.⁸

IMPLEMENTATION

The main goal of developing guidelines is to improve quality of care and improve patient outcomes. Publication and dissemination of the guidelines are the first steps in raising awareness of the guidelines. However, these steps do not translate into uptake or use of the guideline. Hence, implementation activities are a critical part of maximizing the value of a clinical practice guideline.^{9,10} Some of the planned activities for these 2020 guidelines include both patient and professional educational

resources and tools. Patient resources include the National Kidney Diet (developed by the NKF Council on Renal Nutrition and the Academy's Renal Practice Group), as well as the nutrition component of the NKF Kidney Pathways.^{1,11} Professional education opportunities will include sessions at professional conferences, a webinar series, and a speaker's guide. Additionally, the Academy is currently recruiting for a nationwide study designed to evaluate how training on the new guidelines for nutrition care in end-stage renal disease impact RDN practice and patient outcomes (AUGmeNt study: Assessing Uptake and Impact of Guidelines for Clinical

EAL-KDOQI CKD: Micronutrient recommendations	EAL recommendation rating
CKD Micronutrients: General guidance	
<i>Dietary micronutrient intake</i>	
In adults with CKD 3-5D or posttransplantation, it is reasonable for the registered dietitian nutritionist (RDN) or an international equivalent to encourage eating a diet that meets the recommended dietary allowance (RDA) for adequate intake for all vitamins and minerals (OPINION).	Consensus; Conditional
<i>Micronutrient assessment and supplementation</i>	
In adults with CKD 3-5D or posttransplantation, it is reasonable for the registered dietitian nutritionist (RDN) or an international equivalent, in close collaboration with a physician or physician assistant, to assess dietary vitamin intake periodically and to consider multivitamin supplementation for individuals with inadequate vitamin intake (OPINION).	Consensus; Conditional
<i>Micronutrient supplementation, dialysis</i>	
In adults with CKD 5D who exhibit inadequate dietary intake for sustained periods of time, it is reasonable to consider supplementation with multivitamins, including all the water-soluble vitamins, and essential trace elements to prevent or treat micronutrient deficiencies (OPINION).	Consensus; Conditional
CKD: Micronutrients: Folic acid and vitamin B12 supplementation	
<i>Folic acid supplementation for hyperhomocysteinemia</i>	
In adults with CKD 3-5D or posttransplantation who have hyperhomocysteinemia associated with kidney disease, we recommend not to routinely supplement folate with or without B-complex because there is no evidence demonstrating reduction in adverse cardiovascular outcomes (1A).	Strong; Conditional
<i>Folic acid supplementation for folic acid deficiency and insufficiency, CKD 1-5 and dialysis</i>	
In adults with CKD 1-5D, we suggest prescribing folate, vitamin B12, or B-complex supplement to correct for folate or vitamin B12 deficiency/insufficiency based on clinical signs and symptoms (2B).	Fair; Conditional
<i>Folic acid supplementation for folic acid deficiency and insufficiency, CKD posttransplantation</i>	
In adults with CKD posttransplantation (OPINION), we suggest prescribing folate, vitamin B12, or B complex supplement to correct for folate or vitamin B12 deficiency/insufficiency based on clinical signs and symptoms (OPINION).	Consensus; Conditional
CKD: Micronutrients: Vitamin C supplementation	
<i>Vitamin C supplementation</i>	
In adults with CKD 1-5D or posttransplantation who are at risk of vitamin C deficiency, it is reasonable to consider supplementation to meet the recommended intake of at least 90 mg/d for men and 75 mg/d for women (OPINION).	Consensus; Conditional
CKD: Micronutrients: Vitamin D supplementation	
<i>Vitamin D supplementation for vitamin D deficiency and insufficiency, CKD 1-5D</i>	
In adults with CKD 1-5D, we suggest prescribing vitamin D supplementation in the form of cholecalciferol or ergocalciferol to correct 25(OH)D deficiency/insufficiency (2C).	Weak; Conditional
<i>Vitamin D supplementation for vitamin D deficiency and insufficiency, CKD posttransplantation</i>	
In adults with CKD posttransplantation, we suggest prescribing vitamin D supplementation in the form of cholecalciferol or ergocalciferol to correct 25(OH)D deficiency/insufficiency (OPINION).	Consensus; Conditional

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Figure 4. CKD: Micronutrient recommendation statements.

EAL-KDOQI CKD: Micronutrient recommendations	EAL recommendation rating
<i>Vitamin D supplementation with proteinuria</i>	
In adults with CKD 1-5 with nephrotic-range proteinuria, it is reasonable to consider supplementation of cholecalciferol, ergocalciferol, or other safe and effective 25(OH)D precursors (OPINION).	Consensus; Conditional
CKD: Micronutrients: Vitamin E and A supplementation	
<i>Vitamins A and E supplementation and toxicity</i>	
In adults with CKD 5D on MHD or CKD 5D on PD, it is reasonable to not routinely supplement vitamin A or E because of the potential for vitamin toxicity. However, if supplementation is warranted, care should be taken to avoid excessive doses, and patients should be monitored for toxicity (OPINION).	Consensus; Imperative
CKD: Micronutrients: Vitamin K supplementation	
<i>Anticoagulant medication and vitamin K supplementation</i>	
In adults with CKD 1-5D or posttransplantation, it is reasonable that patients receiving anticoagulant medicines known to inhibit vitamin K activity (eg, warfarin compounds) do not receive vitamin K supplements (OPINION).	Consensus; Conditional
CKD: Micronutrients: Trace mineral supplementation, selenium and zinc	
<i>Selenium and zinc supplementation</i>	
In adults with CKD 1-5D, we suggest not routinely supplementing selenium or zinc because there is little evidence that it improves nutritional, inflammatory, or micronutrient status (2C).	Weak; Imperative

Figure 4. (continued) CKD: Micronutrient recommendation statements.

Practice in Renal Nutrition). This pilot implementation study will evaluate RDN adherence, acceptability, adoption, and adaptation of the guideline recommendations specific to patients undergoing hemodialysis as well as

examine the feasibility of estimating the impact of guideline implementation on nutrition-related outcomes.

This guideline was developed by a multidisciplinary group of practitioners, with a rigorous methodology,

and provides a much-needed update on nutrition management recommendations for patients with CKD. The guidelines and related tools for implementation will be invaluable resources for renal dietitians globally

EAL-KDOQI CKD: Electrolytes & other nutrients recommendations	EAL recommendation rating
CKD: Electrolytes: Phosphorus	
<i>Dietary phosphorus amount</i>	
In adults with CKD 3-5D, we recommend adjusting dietary phosphorus intake to maintain serum phosphate levels in the normal range (1B).	Strong; Imperative
<i>Dietary phosphorus source</i>	
In adults with CKD 1-5D or posttransplantation, it is reasonable when making decisions about phosphorus restriction treatment to consider the bioavailability of phosphorus sources (eg, animal, vegetable, additives) (OPINION).	Consensus; Conditional
<i>Phosphorus intake with hypophosphatemia</i>	
For adults with CKD posttransplantation with hypophosphatemia, it is reasonable to consider prescribing high phosphorus intake (diet or supplements) to replete serum phosphate (OPINION).	Consensus; Conditional
<i>(continued on next page)</i>	

Figure 5. CKD: Electrolytes and other nutrition recommendation statements.

EAL-KDOQI CKD: Electrolytes & other nutrients recommendations	EAL recommendation rating
CKD: Electrolytes: Sodium	
<i>Sodium intake and blood pressure, CKD 3-5, non-dialyzed</i>	
In adults with CKD 3-5 not on dialysis, we recommend limiting sodium intake to less than 100 mmol/d (or <2.3 g/d) to reduce blood pressure and improve volume control (1B).	Strong; Imperative
<i>Sodium intake and blood pressure, CKD 5D, and posttransplantation</i>	
In adults with CKD 5D or posttransplantation, we recommend limiting sodium intake to less than 100 mmol/d (or <2.3 g/d) to reduce blood pressure and improve volume control (1C).	Fair; Imperative
<i>Sodium intake and proteinuria</i>	
In adults with CKD 3-5, we suggest limiting sodium intake to less than 100 mmol/d (or <2.3 g/d) to reduce proteinuria synergistically with available pharmacological interventions (2A).	Fair; Conditional
<i>Sodium intake and dry body weight</i>	
In adults with CKD 3-5D, we suggest reduced dietary sodium intake as an adjunctive lifestyle modification strategy to achieve better volume control and a more desirable body weight (2B).	Fair; Conditional
CKD: Electrolytes: Potassium	
<i>Dietary potassium amount</i>	
In adults with CKD 3-5D or posttransplantation, it is reasonable to adjust dietary potassium intake to maintain serum potassium within the normal range (OPINION).	Consensus; Conditional
<i>Dietary and supplemental potassium intake for hyperkalemia or hypokalemia, CKD 3-5D</i>	
In adults with CKD 3-5D with either hyperkalemia or hypokalemia, we suggest that dietary or supplemental potassium intake be based on a patient's individual needs and clinician judgment (2D).	Weak; Imperative
<i>Dietary and supplemental potassium intake for hyperkalemia or hypokalemia, CKD posttransplantation</i>	
In adults with CKD posttransplantation with either hyperkalemia or hypokalemia, we suggest that dietary or supplemental potassium intake be based on a patient's individual needs and clinician judgment (OPINION).	Consensus; Conditional
CKD: Electrolytes: Acid load	
<i>Dietary management of net acid production (NEAP)</i>	
In adults with CKD 1-4, we suggest reducing net acid production (NEAP) through increased dietary intake of fruits and vegetables (2C) to reduce the rate of decline of residual kidney function.	Weak; Conditional
<i>Bicarbonate supplementation</i>	
In adults with CKD 3-5D, we recommend reducing net acid production (NEAP) through increased bicarbonate or a citric acid/sodium citrate solution supplementation (1C) to reduce the rate of decline of residual kidney function.	Fair; Conditional
<i>Bicarbonate maintenance</i>	
In adults with CKD 3-5D, it is reasonable to maintain serum bicarbonate levels at 24-26 mmol/L (OPINION).	Consensus; Conditional
CKD: Electrolytes: Calcium	
<i>Total calcium intake, CKD 3-4</i>	
<i>(continued on next page)</i>	

Figure 5. (continued) CKD: Electrolytes and other nutrition recommendation statements.

EAL-KDOQI CKD: Electrolytes & other nutrients recommendations	EAL recommendation rating
In adults with CKD 3-4 not taking active vitamin D analogs, we suggest that a total elemental calcium intake of 800-1,000 mg/d (including dietary calcium, calcium supplementation, and calcium-based phosphate binders) be prescribed to maintain a neutral calcium balance (2B).	Fair; Conditional
<i>Total calcium intake, CKD 5D</i>	
In adults with CKD 5D, it is reasonable to adjust calcium intake (dietary calcium, calcium supplements, or calcium-based binders) with consideration of concurrent use of vitamin D analogs and calcimimetics to avoid hypercalcemia or calcium overload (OPINION).	Consensus; Conditional

Figure 5. (continued) CKD: Electrolytes and other nutrition recommendation statements.

who work to improve the lives of those with CKD.

References

1. National Kidney Foundation. Kidney Disease: The Basics. <https://www.kidney.org/news/newsroom/factsheets/KidneyDiseaseBasics>. Accessed August 19, 2020.
2. KDOQI Clinical Practice Guidelines for Nutrition in Chronic Kidney Disease. *Am J Kidney Dis.* 2000;35(6 Suppl 2): S11-S16.
3. Evidence-based Nutrition Practice Guideline on Chronic Kidney Disease. 2010. <https://www.andeal.org/topic.cfm?menu=5303> and copyrighted by the Academy of Nutrition and Dietetics. Accessed August 18, 2020.
4. Handu D, Moloney L, Wolfram T, Ziegler P, Acosta A, Steiber A. Academy of Nutrition and Dietetics methodology for conducting systematic reviews for the Evidence Analysis Library. *J Acad Nutr Diet.* 2016;116(2):311-318.
5. Papoutsakis C, Moloney L, Sinley RC, Acosta A, Handu D, Steiber AL. Academy of Nutrition and Dietetics methodology for developing evidence-based nutrition practice guidelines. *J Acad Nutr Diet.* 2017;117(5):794-804.
6. Guyatt GH, Oxman AD, Vist GE, et al. GRADE: An emerging consensus on rating quality of evidence and strength of recommendations. *BMJ.* 2008;336(7650): 924-926.
7. Evidence-based nutrition practice guidelines on chronic kidney disease. 2020. https://www.andeal.org/a_z_index.cfm?web_menu_id=5. Accessed August 20, 2020.
8. Ilikzler TA, Burrowes JD, Byham-Gray LD, et al; KDOQI Nutrition in CKD Guideline Work Group. KDOQI clinical practice guideline for nutrition in CKD: 2020 update. *Am J Kidney Dis.* 2020;76(3 Suppl 1): S1-S107.
9. Fischer F, Lange K, Klose K, Greiner W, Kraemer A. Barriers and strategies in guideline implementation: A scoping review. *Healthcare (Basel).* 2016;4(3):36.
10. Kredt T, Bernhardsson S, Machingaidze S, et al. Guide to clinical practice guidelines: The current state of play. *Int J Qual Health Care.* 2016;28(1):122-128.
11. National Kidney Foundation. Kidney pathways. <https://www.kidney.org/phi/form?version=health>. Accessed August 19, 2020.

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All authors were involved developing these systematic reviews and guidelines from question formulation to developing recommendation statements. DH and MR wrote the first draft of this executive summary and all authors reviewed and commented on subsequent drafts of the executive summary.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

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