

# What Dietitians Need to Know About Nutrition in Chronic Kidney Disease

Jerrilynn D. Burrowes, PhD, RD, CDN

**Clinical practice guidelines (CPGs) are a relatively new concept in kidney disease. Since 1997, the National Kidney Foundation has published 13 evidence-based CPGs to help improve outcomes for people in all stages of chronic kidney disease, reduce disparities in care, and reduce the complications associated with kidney disease. This article briefly reviews how the guidelines were developed, and discusses the CPGs that involve the nutritional management of adults with chronic kidney disease. *Nutr Today*. 2006;41(1):22-27**

Chronic kidney disease (CKD) affects millions of people in the United States, and millions more are at risk for developing it.<sup>1</sup> The stage of kidney disease (stages 1–5) is determined by the glomerular filtration rate (GFR), and it is used to guide the plan of care. Table 1 presents the classification and prevalence of CKD based on stage.

The exact number of people with stages 1 to 4 CKD is unknown. However, in 2003, 452,957 people were treated for stage 5 CKD (formerly referred to as end-stage renal disease). Moreover, it is projected that by the year 2010 the number of newly diagnosed people with stage 5 CKD will double.<sup>2</sup> *Healthy People 2010* aims to reduce the number of new cases of CKD and its complications, disability, death, and economic complications.<sup>3</sup>

Clinical practice guidelines (CPGs) were developed to reduce practice variation, assist with appropriate utilization of resources, integrate current research findings into practice, and improve patient outcomes by providing measurable indicators.<sup>4,5</sup> The use of CPGs to guide rational treatment of patients is a relatively new concept in kidney disease, where practice patterns have been determined primarily by opinion. However, there have been dramatic changes in the last few years. In 1997, the National Kidney Foundation instituted the Dialysis Outcomes Quality Initiative (DOQI [pronounced “dokey”]) and developed CPGs to guide the practice of

dialysis therapy for patients undergoing maintenance dialysis. Under DOQI, CPGs were developed for hemodialysis, peritoneal dialysis adequacy, vascular access, and anemia management. In 1999, the National Kidney Foundation broadened its scope to include the entire spectrum of kidney diseases, because it was necessary to improve the health status of patients before they reached stage 5. The new initiative was termed Kidney Disease Outcomes Quality Initiative (K/DOQI [pronounced k-dokey]). Since 1997, the National Kidney Foundation has published 13 evidence-based guidelines with the goal of developing CPGs that will help improve outcomes for individuals in all stages of CKD, reduce disparities in care, and reduce the complications and comorbidities associated with kidney disease. This article reviews the development of CPGs in kidney disease and current CPGs that relate specifically to nutritional management of adults with CKD.

## K/DOQI Guideline Development and Methodology

The K/DOQI CPGs have undergone scientific and methodologic rigor using a state-of-the-art evidence-based approach for development of each of the guidelines. In addition, an independent consultant was used to conduct an exhaustive literature search to uncover current medical opinion. The evidence was then submitted to an interdisciplinary Work Group for critical appraisal and grading of the evidence. The groups worked independently to facilitate an unbiased approach to guideline development, without influence of organizations or industry. Based on consensus of the Work Group, a set of guidelines was developed to address areas supported by key findings in the evidence report. By providing the evidence for each recommendation, the science base could be established and it was hoped that this would generate widespread acceptance and adoption by the medical community.

The K/DOQI guideline development review process was used to ensure that the interests and needs of the medical community and patients are fully met by

**Table 1. Classification of Stages and Prevalence of Chronic Kidney Disease**

Stage	Description	GFR (mL/min/1.73 m <sup>2</sup> )	Prevalence*	
			(1,000s)	%
1	Kidney damage with normal or elevated GFR	≥90	5,900	3.3
2	Kidney damage with mildly decreased GFR	60–89	5,300	3.0
3	Moderately decreased GFR	30–59	7,600	4.3
4	Severely decreased GFR	15–29	400	0.2
5	Kidney failure	<15 (or dialysis)	300	0.1

Adapted from: National Kidney Foundation Kidney Disease Outcomes Quality Initiative (K/DOQI). K/DOQI clinical practice guidelines for chronic kidney disease: evaluation, classification and stratification. *Am J Kidney Dis.* 2002;39(2 suppl 1):S1–S266.

\*Data for stages 1 to 4 are from the Third National Health and Nutrition Examination Survey (1998–1994); population of 177 million adults aged ≥20 years. Data for stage 5 are from the United States Renal Data System (1998) and include approximately 230,000 patients treated by dialysis and assume 70,000 additional patients not undergoing dialysis.

the guidelines. It included an internal review of the guidelines by experts, followed by a review by key allied health and nephrology organizations, patient advocacy groups and industry and finally, an open review of the guidelines by the public.

To date, CPGs of greatest interest to the dietitian have been developed for nutrition in chronic renal failure (published in 2000),<sup>6</sup> evaluation, stratification and classification of CKD (published in 2002),<sup>1</sup> bone metabolism and disease (published in 2003),<sup>7</sup> managing dyslipidemias (published in 2003),<sup>8</sup> and blood pressure management (published in 2004).<sup>9</sup>

## Clinical Practice Guidelines

### Nutrition in Chronic Renal Failure

Protein-energy malnutrition (PEM) develops early during the course of CKD and is associated with adverse outcomes. By stage 5, between 18% and 70% of adults undergoing maintenance dialysis have PEM.<sup>10,11</sup> The presence of PEM is one of the strongest predictors of morbidity and mortality. Its causes in patients with advanced CKD are multifactorial and may include inadequate protein and energy intakes secondary to anorexia, altered taste sensation, intercurrent illnesses; depression; polypharmacy; metabolic acidosis; and inflammation.<sup>6</sup> Providing adequate nutrition is a key component in the prevention and treatment of PEM in patients with CKD.

*Protein-energy malnutrition is commonly late in CKD.*

The nutrition CPGs provide recommendations regarding the assessment of protein-energy nutritional

status and the desirable dietary energy and protein intakes for adults undergoing maintenance dialysis (stage 5).<sup>6</sup> There are also several guidelines on nutritional management of patients with stages 3 to 4 CKD. Among the most prominent guidelines for adults are these: (1) for individuals with stage 5 CKD, protein-energy nutritional status should be evaluated by serial measurements of a panel of markers rather than by any single measure [eg, serum albumin; edema-free actual body weight (ie, postdialysis), percent standard body weight<sup>12</sup> or subjective global assessment<sup>13</sup>; and normalized protein nitrogen appearance or dietary interviews and diaries]. (Normalized protein nitrogen appearance is the protein equivalent of total nitrogen appearance normalized to body weight; it is also referred to as the protein catabolic rate. In clinically stable maintenance dialysis patients, normalized protein nitrogen appearance provides a valid estimate of dietary protein intake.<sup>14</sup>) (2) For individuals with stages 4 to 5 CKD, dietary energy intake of 35 kcal/kg/d is recommended for those younger than 60 years of age, and 30–35 kcal/kg/d for those 60 years of age and older. (3) Individuals receiving maintenance hemodialysis should be prescribed 1.2 g protein/kg/d; for chronic peritoneal dialysis, 1.2–1.3 g protein/kg/d; and for stage 4 CKD, 0.60 g protein/kg/d. For patients with stage 4 CKD who will not accept such a diet or who are unable to maintain an adequate energy intake with a protein diet this low (0.60 g/kg/d), a protein intake up to 0.75 g protein/kg/d may be prescribed. In addition, regardless of the stage of kidney disease, patients with decreased energy intake or PEM should undergo dietary modification, counseling and education, or specialized nutrition therapy at recommended intervals.<sup>6</sup>

### Bone Metabolism and Kidney Disease

Renal osteodystrophy is a complex bone disease that results from mineral and hormonal abnormalities as early

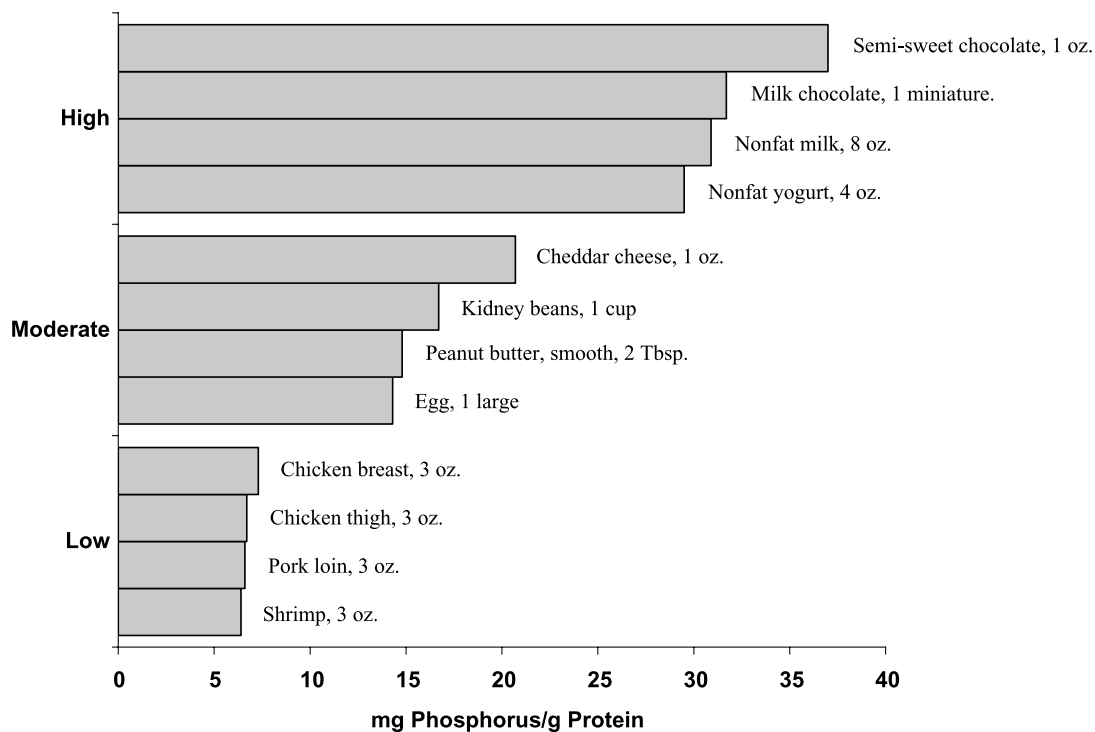


Figure 1. Phosphorus content of select protein-containing foods based on low, moderate, and high phosphorus to protein ratio. Adapted from: National Kidney Foundation. K/DOQI clinical practice guidelines for bone metabolism and disease in chronic kidney disease. *Am J Kidney Dis.* 2003;42(4 suppl 3):S1–S201.

as stage 3 CKD, and coincides with the decline in GFR. Approximately 30–50% of patients with stages 3 to 4 CKD have some degree of renal osteodystrophy,<sup>15</sup> which causes major long-term complications such as bone pain, deformities, and fractures. With early interventions (eg, dietary modifications and medications such as phosphate binders, supplementary active vitamin D sterol therapy [eg, calcitriol, paracalcitol] and calcimimetic agents), many complications can be prevented or delayed. Calcimimetic agents are pharmacologic agents that acutely suppress parathyroid hormone levels which, in turn, decreases the release of calcium and phosphorus from bone without increasing intestinal absorption of calcium and phosphorus.<sup>16</sup>

Phosphate retention occurs early in the course of CKD (probably stage 1, but certainly by stage 2) and contributes to the pathogenesis of secondary hyperparathyroidism and bone disease. Parathyroid hormone levels begin to rise when GFR falls below 60 mL/min/1.73 m<sup>2</sup> (stage 3 CKD), even when serum phosphorus levels are normal. Therefore, parathyroid hormone is a better marker than serum phosphorus for the need to begin dietary phosphorus restriction in the early course of CKD. At later stages of CKD (stages 4 and 5), serum phosphorus levels are elevated

and, therefore, a dietary phosphorus restriction is also needed.<sup>7</sup>

**Metabolic bone disease in CKD requires management of phosphorus and calcium, as well as special formulations of vitamin D.**

The nutrition-related CPG for bone metabolism and disease in CKD includes a dietary phosphorus intake of 800–1,000 mg/d (adjusted for dietary protein needs as described below) for patients with stages 3–4 CKD who have serum phosphorus levels greater than 4.6 mg/dL, and greater than 5.5 mg/dL for patients with stage 5 CKD. Serum phosphorus levels should be monitored every month after beginning the dietary phosphorus restriction.<sup>7</sup>

In patients with early stages of CKD (stages 2–3), compliance with dietary phosphorus restriction is difficult and requires intensive dietitian support. In those

with advanced CKD (stages 4–5), restriction of dietary phosphorus is more easily accomplished because of concomitant dietary protein modifications. However, in stage 5 CKD, compliance is more challenging as care must be taken to reduce phosphate intake while maintaining adequate protein intake. In individuals with body weights greater than 80 kg, it is virtually impossible to plan a palatable diet with adequate protein, while limiting dietary phosphate intake to less than 1,000 mg/d. Dietary phosphate level should be as low as possible, while ensuring an adequate protein intake.<sup>7</sup>

A reasonable phosphate level can be estimated by multiplying the recommended protein level by 10 to 12 mg phosphate per gram of protein. Foods high in protein generally are also high in phosphorus. Thus, in a 70-kg individual who requires 84 g of protein, the recommended phosphorus range is 840–1,008 mg/d. In order to limit phosphorus significantly, those protein sources with the least amount of phosphorus (eg, low or moderate amount of phosphorus per gram of protein) should be included in the meal plan (see Figure 1).<sup>7</sup>

### Managing Dyslipidemias in Chronic Kidney Disease

The incidence of cardiovascular disease (CVD) is very high in patients with CKD. In fact, individuals with the earliest indication of kidney disease are at increased risk of CVD, and may experience poor outcomes before they reach stage 5.<sup>17</sup> The 10-year cumulative risk of coronary heart disease in patients with stage 5 CKD is roughly equivalent to the risk seen in non-kidney disease patients with previous CVD.<sup>8</sup> Therefore, the National Kidney Foundation Task Force on CVD in chronic renal disease recommended that patients with CKD be considered in the highest risk category for CVD risk factor management.<sup>18</sup> With this in mind, the CPGs for managing dyslipidemia in CKD were developed to supplement the Third Report of the National Cholesterol Education Program guidelines, because they make few specific recommendations for evaluation of dyslipidemia in CKD.<sup>19</sup>

Dietary modifications for dyslipidemias in adults with CKD can be undertaken safely in well-nourished

patients.<sup>8</sup> However, patients with low serum total cholesterol (less than 150 mg/dL), which is often associated with chronic PEM and/or comorbidities, should be assessed for possible nutritional deficiencies. For these patients, improving nutrition is the primary goal, and dietary recommendations should be for high-protein, high-fat foods. However, in most cases of CKD, protein sources low in saturated fat should be encouraged. Low-fat dairy products, nuts, seeds, and beans provide protein, but must be limited because of their high potassium and phosphorus content. Also, plant sterols for fat spreads (eg, Benecol, Take Control), an increase in viscous fiber by 5–25 g/d, and fiber supplements (eg, Unifiber) are recommended.<sup>8</sup>

### Hypertension in Kidney Disease

Hypertension is both a cause and a complication of CKD, increasing the risk of loss of kidney function, kidney failure, early development of accelerated progression of CVD, and premature death.<sup>9</sup> The Hypertension Work Group advocated lifestyle modifications that lower blood pressure (ie, changes in diet, exercise, and habits that may slow the progression of CKD and lower the risk of CVD) as part of the strategies to prevent and treat hypertension. However, individuals with CKD have significant comorbid conditions in addition to high blood pressure, for which dietary modifications are recommended, including diabetes, CVD, obesity, and hyperlipidemia. Therefore, the hypertension guidelines in CKD recommend that patients with stage 1 to 4 CKD with high blood pressure be aggressively treated for their high blood pressure, with a target blood pressure of less than 130/80 mm Hg.<sup>9</sup> In addition, dietary and therapeutic lifestyle changes should be included as part of a comprehensive strategy to lower blood pressure and reduce CVD risk.

The Dietary Approaches to Stop Hypertension (DASH) and DASH-Sodium Trials were effective at reducing blood pressure in adults with high normal blood pressure ( $\geq 135/85$  and  $\leq 139/89$  mm Hg) and stage 1 hypertension (blood pressure  $\geq 140/90$  and  $\leq 159/99$  mm Hg).<sup>20</sup> Therefore, the hypertension guidelines recommended that most adults with CKD should reduce dietary sodium intake to  $<2.4$  g/d, as recommended in the DASH trial. Further reduction in sodium intake to  $<1.2$  g/d might lower blood pressure additionally, but may be more difficult to achieve.<sup>9</sup>

The macronutrient and mineral components of the DASH diet, other than sodium restriction, have not been carefully studied in CKD. Therefore, the DASH diet may be appropriate for individuals with CKD stages 1 to 2, but not for later stages. The macronutrient composition and mineral content

*Risk of coronary heart disease in stage 5 chronic kidney disease patients is as high as those without kidney disease who have had a heart attack.*

**Table 2. Macronutrient Composition and Mineral Content of the Dietary Approaches to Stop Hypertension (DASH) Diet Recommended by the JNC 7, with Modifications for Stages 3 to 4 Chronic Kidney Disease**

Nutrient	Stage of Chronic Kidney Disease Stages 1–4	
	Stages 1–2	Stages 3–4
Sodium (g/d)*	<2.4	
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)	1.4;~18	0.6–0.8;~10
Phosphorus (g/d)	1.7	0.8–1.0
Potassium (g/d)	>4	2–4

JNC 7 indicates Joint National Committee on the Prevention, Detection, Evaluation and Treatment of High Blood Pressure.

Adapted from: Kidney Disease Outcomes Quality Initiative (K/DOQI) Group. K/DOQI clinical practice guidelines on hypertension and antihypertensive agents in chronic kidney disease. *Am J Kidney Dis.* 2004;43(5 suppl 1):S1–S290.

\*Not recommended for patients with “salt-wasting.”

\*\*Adjust so total calories from protein, fat, and carbohydrate is 100%.

of the diet should be modified according to the stage of CKD (see Table 2).<sup>9</sup>

Lifestyle modifications for CVD risk reduction are recommended as part of the treatment regimen for most adults with CKD and hypertension. These include weight maintenance if body mass index is <25 kg/m<sup>2</sup>, weight loss if overweight or obese (body mass index ≥25 kg/m<sup>2</sup>), exercise and physical activity of moderate intensity (30 min/day, most days of the week), moderate alcohol intake (≤2 drinks per day for men and ≤1 drink per day for women), and smoking cessation.<sup>9</sup>

## Conclusions

Clinical practice guidelines are not standards; they are evidence-based recommendations that should be used to assist the practitioner in making decisions about patient care. Because a large number of people have CKD or are at risk for developing CKD (about 1 in 9 adults),<sup>21</sup> all healthcare providers, including dietitians who interact with patients, should know about the guidelines and use them to screen and identify patients with CKD as early as possible.

**Jerrilynn D. Burrowes, PhD, RD, CDN**, is Assistant Professor, Department of Nutrition School of Health Professions and Nursing, C.W. Post Campus of Long Island University, Brookville, NY. Correspondence: Department of Nutrition, School of Health Professions and Nursing, C.W. Post Campus of Long Island University, 720 Northern Boulevard, Brookville, NY 11548 (e-mail: jerrilynn.burrowes@liu.edu).

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### See-Saw: Mississippi and Minnesota on Opposite Ends of Healthiest-State Ranking

The overall health of Americans, which once improved by leaps and bounds, has slowed to a crawl lately because of obesity and poverty, but some states seem to be doing better than others. In the report *America's Health Rankings 2005*, the 16th annual report compiled by the United Health Federation, the American Public Health Association, and the Partnership for Prevention, Minnesota was ranked as the healthiest state in the nation, followed by Vermont, New Hampshire, Utah, and Hawaii. Mississippi got the short straw, at the bottom of the list, just behind Louisiana (49) and Tennessee (48). Health improvement rates have dropped by 80% since the 1990s, the report says.

Over the past 5 years, the health of US citizens improved only at an average rate of 0.3% each year. This is significantly down from the previous decade, when, during the 1990s, the health of Americans improved at an annual rate of 1.5% per year. The report measured several public health

risks, including smoking, infant mortality, disease, and immunizations.

The report says that some of the biggest health challenges for America are the number of children living in poverty and obesity. There are now more than 1 out of every 4 people considered clinically obese, and obesity increases risks of cardiovascular disease, diabetes, and other chronic health problems. Both obesity and children living in poverty each increased by 1% between 2004 and 2005. The obesity rate is now 23%, and the percentage of children under age 18 living in poverty is 18%.

The slight increase in premature death is likely due to shifting socioeconomic factors, including fewer people with health insurance, more children living in poverty, and lifestyle factors, such as obesity.

The United States lags in the world when it comes to healthy life expectancy, ranking 28th after other major industrialized nations, including France, Germany, and the United Kingdom.

Source: *Medpage Today*