Plant-Based Diets in CKD

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Clin J Am Soc Nephrol 14: 141–143, 2019. doi: https://doi.org/10.2215/CJN.08960718

Introduction

The US Department of Agriculture, the US Department of Health and Human Services, and the National Kidney Foundation recommend plant-based diets, such as the Dietary Approaches to Stop Hypertension (DASH) diet, which are high in fiber; are low in saturated fat and processed meats; contain sources of potassium, phosphorus, magnesium, and calcium; and have low levels of sodium (Figure 1). The health benefits of such diets include preventing heart disease and hypertension as well as delaying the progression of kidney disease. The Mediterranean diet is similar to the DASH diet, and it is also associated with a lower risk of mortality from cardiovascular disease. Below, we discuss the potential benefits associated with predominately plant-based diets in patients with CKD.

Potential Health Benefits of Plant-Based Diets in Patients with CKD

In contrast to meat-based diets, which are high in full-fat dairy foods as well as higher in sulfur-containing amino acids and phosphate, plant-based diets are lower in these amino acids and lower in bioavailable phosphorus, both of which have been associated with reductions in incident cardiovascular disease and CKD (1,2). Retrospective data from the National Health and Nutrition Examination Survey (NHANES) showed that participants with baseline eGFR ≥15 and <60 ml/min per 1.73 m^2 who consumed meat-based diets with elevated acid loads (calculated on the basis of 24-hour recall questionnaire data) had a higher risk of progression to ESKD than participants with lower calculated dietary acid load (1).

More recently, retrospective NHANES data showed that a higher ratio of plant to total protein was associated with a lower risk of mortality among participants with eGFR<60 ml/min per 1.73 m^2. In the prospective observational Northern Manhattan Study (N=900), plant-based diets were associated with a 12% lower risk of decline in eGFR compared with meat-based diets (3). However, stratified analyses suggested that the salutary associations with a plant-based diet were stronger among subjects without diabetes (3). In a randomized, prospective study of 71 nondiabetic patients with eGFR ≥15 and <30 ml/min per 1.73 m^2, adding fruits and vegetables lowered systolic BP compared with baseline values (4). Although patients randomized to oral sodium bicarbonate supplements achieved similar reductions in acid levels, their systolic BP did not decrease (4). Thus, consumption of fruits and vegetables may be associated with greater benefits in kidney function than supplements designed to achieve the same goals. A "vegan" diet has also been associated with delaying dialysis. In a study of nondiabetic patients >70 years of age with non-symptomatic uremia and eGFR of 5–7 ml/min per 1.73 m^2 (5) randomized to either a plant-based "vegan diet" (n=56) with dialysis delayed until overt symptoms of uremia occurred or immediate dialysis (n=56), dialysis was delayed for about a year in the "vegan" group. This was achieved without increasing the risk of death or hospitalization relative to the group on immediate dialysis (5).

Traditional Concerns of Plant-Based Diets in Patients with CKD

Phosphorus

Phosphorus from plant sources is less well absorbed than the phosphorus from animal sources. This is likely due to the presence of phytate in plants, which makes phosphorus less bioaccessible for gastrointestinal absorption compared with animal proteins (2). In two small clinical trials of subjects with eGFR of 15–60 ml/min per 1.73 m^2 (most without diabetes) who were assigned to prescribed plant-based diets, 24-hour urine phosphorus excretion decreased compared with either baseline or compared with a prescribed meat-based diet period given in a crossover design (6). In contrast, in a *post hoc* analysis of the Hemodialysis Study (N=1751), restriction in dietary phosphorus intake was associated with poorer nutritional status and higher mortality in patients on hemodialysis, suggesting that constraining phosphorus intake resulted in unintended reductions in beneficial macronutrients (7). In fact, the authors found that survival was 27% higher in those prescribed >1000 mg/d of phosphorus and 29% higher in those with no dietary phosphorus restriction compared with patients restricted to daily phosphorus intake of ≤870 mg/d (7). On the basis of the importance of phosphorus restriction in patients with CKD, pharmacotherapy has been used to reduce hyperphosphatemia. In a retrospective cohort analysis of the Dialysis Outcomes and Practice Patterns Study, noncalcium-based phosphate binders were associated with a 14% risk reduction in mortality (8). The authors hypothesized that phosphate binder treatment may have allowed dietary phosphorus restrictions to be

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DASH diet		Mediterranean diet	
Food group	Daily servings	Food group	Recommendation
Whole grains	7 to 8	Whole grains, vegetables, fruits, seeds, olive oil, beans, nuts, legumes	Base every meal on these foods
Vegetables	4 to 5		
Fruits	4 to 5		
Dairy, low-fat or nonfat	2 to 3	Fish, seafood	Eat at least twice a week
Lean meats, poultry, fish	2 or fewer	Poultry, eggs, yogurt, cheese	Eat moderate portions daily to weekly
Nuts, seeds, dry beans	4 to 5 per week		
Fats and oils	2 to 3	Meats and sweets	Eat less often than other foods
Sweets	5 per week	Wine	Drink in moderation

Figure 1. | Key features of the Dietary Approaches to Stop Hypertension (DASH) and Mediterranean diets. Excerpted from: DASH or Mediterranean: Which diet is better for you? Harvard Women's Health Watch, August, 2015.

relaxed, leading to better nutritional intake and improved survival.

Potassium

Patients with CKD are recommended to reduce their potassium intake to 2000–3000 mg/d (50–75 mEq/d), which is significantly less than the potassium recommendations of 4700 mg/d in the recent US Department of Agriculture guidelines. To restrict potassium intake, patients with CKD are advised to avoid high-potassium, plant-based foods, such as seeds, nuts, beans, and peas, as well as fruits and vegetables. The potential health benefits of plant-based/high-potassium diets may be related to their alkalinizing effects. Additionally, the potassium derived from plants may promote intracellular potassium distribution (alkaline and insulin stimulating) as well as promote fecal excretion of potassium due to the natural fibers found in plant-based diets (9). In further support of plant-based diets for patients with CKD, St-Jules *et al.* (9) noted that, although no studies have shown a difference in serum potassium levels in patients consuming predominantly plant-derived versus meat-derived potassium sources, the alkalinizing effects of high-potassium plant foods may explain reductions in metabolic acidosis and kidney disease progression observed in nondiabetic patients who were acidemic with eGFR of 15–29 ml/min per 1.73 m^2 (4). In this study of patients consuming diets containing potassium-rich foods, serum potassium was not increased despite the fact that the patients had relatively low potassium intake levels at baseline (≤4.6 mEq/L) (4). Similarly, a pilot study showed that 2 weeks of the DASH diet increased serum potassium by ≤0.6 mEq/L and did not lead to incident hyperkalemia in patients who had eGFR of 30–59 ml/min per 1.73 m^2 and normal potassium levels at baseline (10). These data are contrary to current dogma, and they suggest that even individuals with eGFR ≤60 ml/min per 1.73 m^2 may benefit from diets high in potassium and that their residual kidney function has the capacity to buffer the potassium intake. More caution may be needed with patients with eGFR <30 ml/min per 1.73 m^2, for whom restricting potassium in the diet would remain the goal pending more data.

Conclusions

There is growing evidence, mostly observational, that plant-based/DASH diets in individuals with eGFR of 30–59 ml/min per 1.73 m^2 may delay progression to ESKD and dialysis and may potentially improve survival. Larger prospective studies are needed to confirm these findings as well as to determine whether the benefits of plant-based diets in CKD extend to patients with diabetes. Availability of fresh fruits and vegetables remains a challenge, however, because racial and ethnic populations that carry a high burden of kidney disease are those least likely to be in environments where fruits and vegetables are plentiful and are not cost prohibitive. Some individuals whose remaining kidney function is not adequate to avoid elevations or wide variations in serum potassium associated with high-potassium dietary intake may be precluded from consuming diets that are plant based due to the potential adverse event of hyperkalemia. For this subset of individuals, the availability of newer once daily potassium binders may facilitate achievement of potassium homeostasis while maximizing the benefits of diets enriched in potassium. Prospective data are needed to confirm this hypothesis.

Acknowledgments

We would like to thank Jeanene Fogli for providing references and reviewing this manuscript. Writing and editorial support services were provided by Impact Communication Partners, Inc. and funded by Relypsa, Inc., a Vifor Pharma Group Company.

This work was sponsored by Relypsa, Inc., a Vifor Pharma Group Company. K.M.H.G. reports support from National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases grant K01 DK 102864.

The content of this article does not reflect the views or opinions of the American Society of Nephrology (ASN) or the *Clinical Journal of the*

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Disclosures

D.J.C. reports personal fees from Relypsa, Inc., a Vifor Pharma Group Company. K.M.H.G. reports personal fees from Relypsa, Inc., a Vifor Pharma Group Company.

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Published online ahead of print. Publication date available at www.cjasn.org.