EDITORIAL

Precision Nutrition and Personalized Diet Plan for Kidney Health and Kidney Disease Management

DIET AND NUTRITION can help improve overall and kidney health, but they can also cause kidney disease.[1] Evidence suggests that high intake of dietary protein especially from animal sources may increase the risk of chronic kidney disease (CKD)[2] in a similar way that high energy intake and presence of obesity often cause diabetes mellitus and cardiovascular disease. Once CKD is present, certain types of foods and other nutritional interventions such as a plant-dominant, low-protein diet or weight and body fat control can help slow the rate of CKD progression.[3] In opposition, high-salt, high-protein from animal sources or presence of morbid obesity with high visceral fat can accelerate the development of kidney failure.[4,5] Upon transition to maintenance dialysis therapy, high dietary protein intake may help patients survive longer, while upon successful kidney transplantation, maintaining a plant-dominant low-protein diet and avoiding obesity may confer kidney allograft longevity.[6] While patients with stable CKD and slow disease progression and persons with a solitary kidney may benefit from avoiding high protein intake, during an acute kidney injury, including an acute kidney injury on CKD episode, a higher protein intake may be beneficial for faster kidney recovery during this catabolic event, although data are not consistent.[7]

Certain food constellations may help with specific CKD etiologies. A gluten-free and dairy-free diet may be useful in children with steroid-resistant nephrotic syndrome or focal segmental glomerulosclerosis.[8] Higher fish intake or ingestion of omega-3 fatty acids are recommended for the treatment of IgA nephropathy.[9] A ketogenic diet may be promising for polycystic kidney disease.[10] Antioxidant-rich foods can be considered for the prevention of coronavirus disease 2019 and its kidney-associated pathologies.[11] There are also exotic foods such as fermented Cordyceps fungi, which grow out of the body of certain insects and arthropods and have traditionally been consumed in some Southeast Asian nations to prevent or cure diabetic kidney disease.[5,12] Hence, in the field of renal nutrition, a one-size-fits-all recipe is nonexistent given different severities, stages, and types of kidney disease.

Financial Disclosure: The authors declare that they have no relevant financial interests.

Address correspondence to Kamyar Kalantar-Zadeh, MD, MPH, PhD, University of California Irvine, Orange, CA. E-mail: kkz@uci.edu

1051-2276/$36.00
https://doi.org/10.1053/j.jrn.2020.07.005

Different persons with the same kidney disease condition and similar stage and severity of CKD may benefit from different types and ranges of dietary intake. For instance, for health management of patients with a solitary kidney, avoiding high protein intake >1 g/kg/day and high body mass index >30 kg/m^2 may be generally recommended,[13] whereas for a muscular football player with a solitary kidney, who is professionally engaged in a very high daily dietary protein intake with extraordinary body builder goals, an individualized approach with different dietary protein and body mass index targets are to be considered. Similarly, when a plant-dominant low-protein diet with >50% plant-based sources of protein is recommended for the management of CKD,[3] the remaining source of protein can vary from light meat intake as in the Dietary Approaches to Stop Hypertension diet to strictly vegan dieting based on the individualized goals, phenotypes, and genotypes. These personalized approaches are consistent with the concept of Precision Nutrition, which is a type of Precision Medicine with focus on personalized nutrition and dietary adjustments to strive a more patient-centered nutritional management of kidney health and kidney disease.[14] Global kidney health approaches need to be more effectively realigned with the implementation of the principles of precision nutrition including individualized treatment goals across different patients with different phenotypic and genotypic constellations and linking diet and nutrition to the microbiome and environment, as opposed to the traditional one-size-fits-all approach of contemporary renal nutrition.[15,16]

In this issue of the journal, Brennan et al.[17] review the role of alterations in taste among persons with CKD and examine the extent and content of prior research around this important but underappreciated nutritional symptom in CKD. Considering Precision Nutrition–based approaches, correcting taste problems is an important goal in the nutritional management of patients with CKD because taste disturbances may interfere with targeted meal plans.

In another article of this issue of the journal, St-Jules et al.[18] discuss that regular exercise may affect potassium balance favorably in people with CKD. Hence, it is possible, although not yet proven, that exercise may provide additional management options for potassium burden, so that individuals with more physical activity can enjoy even higher intake of fresh fruits and vegetables, which can be considered a personalized diet adjustment in alignment with the principles of Precision Nutrition.

Consistent with the goals of Precision Nutrition, Snelson et al.[19] examine the potential role of diet in modulating gut microbiota composition, which may have a bearing on the progression of CKD and production of uremic toxins, given that worsening uremia per se can alter microbiome. Hence, different dietary patterns such as more plant-based foods along with tailored intake of prebiotics, probiotics, and synbiotics may beneficially alter the microbiota.

Nuts are exceptionally rich in fiber and, hence, useful against constipation, but patients on dialysis are often asked to avoid nuts because of their presumably high potassium and phosphorus content. Lambert et al.[20] gave 40 g of raw almonds for 4 weeks to 10 patients on dialysis every day, followed by a 2-week washout and 4-week control periods. The study found that daily intake of almonds was safe, effective, and well tolerated and led to improved health-related quality of life and symptom burden as well as correction of constipation without causing hyperkalemia or hyperphosphatemia. In another study, using food frequency questionnaires, Ajjarapu et al.[21] studied 607 women with a history of gestational diabetes mellitus and found an association between higher or more frequent intake of nuts and lower urinary albumin-to-creatinine ratio. They concluded that moderate nut ingestion can be beneficial to kidney health among women with prior gestational diabetes, a finding in alignment with data suggesting that nut intake is associated with reduced cardiometabolic risk.[21] Fakier and Rodgers[22] examine the roles of dietary phytate ingestion and its urinary excretion as they could relate to the risk of calcium kidney stone risk and found that there was no hard evidence in support of phytate as a kidney stone inhibitor.

Hoshino et al.[23] studied data from a prospective cohort of 2,121 persons with CKD stages 3-5 not on dialysis and reported that health-related quality of life was worse in those with more severe anemia defined as hemoglobin <10 g/dL, the odds of being highly physically active were substantially greater at hemoglobin >10.5 g/d, and physical inactivity was strongly associated with greater mortality. These findings may be useful in informing future studies with focus on improving patient well-being and other relevant clinical outcomes.

Garcia-Torres et al.[24] examined the association of dietary protein and energy intake and serum phosphorus level in 358 patients on dialysis using food frequency questionnaires and found that dietary protein intake and phosphorus level were significantly lower in patients who consumed a primarily plant-based diet than those in patients consuming an animal-based diet. They concluded that consuming more plant-based protein as part of a varied diet could be nutritionally adequate while limiting intake of absorbable dietary phosphorus.

Vaz de Melo Ribeiro et al.[25] studied 83 hemodialysis-dependent persons over 4 months and implemented a nutritional intervention based on the transtheoretical model with delivery of personalized food plans, concordant with Precision Nutrition and nutritional education activities. They observed a significant change from the stage of contemplation to the stage of action after the intervention paralleled with a significant reduction in serum creatinine and urea along with improvements in controlling hyperphosphatemia, hyperkalemia, and other markers of bone and iron metabolism. They concluded that a nutritional intervention based on the transtheoretical model promoted a favorable change in the behavior of these patients with an improvement in their metabolic control as well as adequate use of phosphorus binders.

Murtas et al.[26] studied the loss of arterial blood concentration of nonessential, essential, and branched-chain amino acids comparing on-line modern high-efficiency hemodialysis and hemodiafiltration in 10 patients who were randomized to these modalities and reported a reduction of essential and nonessential amino acids, which after 12 months led to progressive deterioration of lean mass and emergence of sarcopenia. Hence, it is possible that amino acid supplementation may be needed to prevent hypercatabolism and cachexia.[26] Beberashvili et al.[27] examined the mortality-predictability of time-varying serum alkaline phosphatase in 554 patients on hemodialysis over time and found that longitudinally increasing levels of serum alkaline phosphatase was associated with improved nutritional status and lower mortality.

Finally, in this issue of the *Journal of Renal Nutrition*, there is a concise commentary by the International Society of Renal Nutrition and Metabolism (ISRNM) on the National Kidney Foundation and Academy of Nutrition and Dietetics Kidney Disease Outcomes Quality Initiative (KDOQI) Clinical Practice Guideline (CPG) for Nutrition in Chronic Kidney Disease, led by Kistler et al.[28] on behalf of the ISRNM assembled special review panel of experts, who evaluated these recommendations before public review. As one of the highlights of the CPG, the recommended dietary protein intake range for patients with diabetic kidney disease is 0.6-0.8 g/kg/day, whereas for CKD patients without diabetes, it is 0.55-0.6 g/kg/day.[28] The ISRNM endorses the KDOQI CPG with the recommendation that clinicians may consider a more streamlined target of 0.6-0.8 g/kg/day regardless of CKD etiology while striving to achieve intakes closer to 0.6 g/kg/day. In addition, we hope that the new KDOQI guidelines are implemented in accordance with the principles of Precision Nutrition including a personalized approach to intake of the dietary protein and other macronutrients and micronutrients.

Kamyar Kalantar-Zadeh, MD, MPH, PhD
University of California-Irvine
Orange, CA

Linda W. Moore, PhD, RDN, CCRP
Houston Methodist Hospital
Houston, TX

References

1. Kalantar-Zadeh K, Moore LW. Does kidney longevity mean healthy vegan food and less meat or is any low-protein diet good enough? *J Ren Nutr.* 2019;29:79-81.

2. Ko GJ, Rhee CM, Kalantar-Zadeh K, Joshi S. The effects of high-protein diets on kidney health and longevity. *J Am Soc Nephrol.* 2020;31:1667-1679.

3. Kalantar-Zadeh K, Joshi S, Schlueter R, et al. Plant-dominant low-protein diet for conservative management of chronic kidney disease. *Nutrients.* 2020;12:E1931.

4. Li PK, Garcia-Garcia G, Lui SF, et al.: World Kidney Day Steering Committee. Kidney health for everyone everywhere-from prevention to detection and equitable access to care. *Kidney Int.* 2020;97:226-232.

5. Kalantar-Zadeh K, Moore LW. Engaging nutrition and diet for primary, secondary, and tertiary prevention of kidney disease: the world kidney day 2020. *J Ren Nutr.* 2020;30:89-91.

6. Kalantar-Zadeh K, Moore LW. Improving muscle strength and preventing sarcopenia and cachexia in chronic kidney disease and transplanted patients by physical activity and exercise. *J Ren Nutr.* 2019;29:465-466.

7. Kalantar-Zadeh K, Moore LW. Why the nutritional management of acute versus chronic kidney disease should differ. *J Ren Nutr.* 2019;29:265-268.

8. Leon J, Perez-Saez MJ, Uffing A, et al. Effect of combined gluten-free, dairy-free diet in children with steroid-resistant nephrotic syndrome: an open pilot trial. *Kidney Int Rep.* 2018;3:851-860.

9. Coppo R. The gut-renal connection in IgA nephropathy. *Semin Nephrol.* 2018;38:504-512.

10. Torres JA, Kruger SL, Broderick C, et al. Ketosis ameliorates renal cyst growth in polycystic kidney disease. *Cell Metab.* 2019;30:1007-1023.e5.

11. Kalantar-Zadeh K, Moore LW. Impact of nutrition and diet on COVID-19 infection and implications for kidney health and kidney disease management. *J Ren Nutr.* 2020;30:179-181.

12. Li Y, Xu G. Clinical efficacy and safety of jinshuibao combined with ACEI/ARB in the treatment of diabetic kidney disease: a meta-analysis of randomized controlled trials. *J Ren Nutr.* 2020;30:92-100.

13. Tantisattamo E, Dafoe DC, Reddy UG, et al. Current management of patients with acquired solitary kidney. *Kidney Int Rep.* 2019;4:1205-1218.

14. Rozga M, Handu D. Nutritional genomics in precision nutrition: an evidence analysis center scoping review. *J Acad Nutr Diet.* 2019;119:507-515.e7.

15. Hughes RL, Marco ML, Hughes JP, Keim NL, Kable ME. The role of the gut microbiome in predicting response to diet and the development of precision nutrition models-Part I: overview of current methods. *Adv Nutr.* 2019;10:953-978.

16. Moore LW, Kalantar-Zadeh K. Global approaches to nutrition assessment and intervention for patients with kidney disease. *J Ren Nutr.* 2020;30:271-273.

17. Brennan F, Stevenson J, Brown M. The pathophysiology and management of taste changes in chronic kidney disease: a review. *J Ren Nutr.* 2020. https://doi.org/10.1053/j.jrn.2019.11.004.

18. St-Jules DE, Marinaro M, Goldfarb DS, Byham-Gray LD, Wilund KR. Managing hyperkalemia: another benefit of exercise in people with chronic kidney disease? *J Ren Nutr.* 2019. https://doi.org/10.1053/j.jrn.2019.10.001.

19. Snelson M, Biruete A, McFarlane C, Campbell K. A renal clinician's guide to the gut microbiota. *J Ren Nutr.* 2020. https://doi.org/10.1053/j.jrn.2019.11.002.

20. Lambert K, Bird L, Borst AC, et al. Safety and efficacy of using nuts to improve bowel health in hemodialysis patients. *J Ren Nutr.* 2020. https://doi.org/10.1053/j.jrn.2019.10.002.

21. Ajjarapu AS, Hinkle SN, Wu J, et al. Nut consumption and renal function among women with a history of gestational diabetes. *J Ren Nutr.* 2020. https://doi.org/10.1053/j.jrn.2019.10.005.

22. Fakier S, Rodgers A. Exploring the potential relationship between phytate ingestion, urinary phytate excretion, and renal stone risk in a unique human model: no hard evidence in support of phytate as a stone inhibitor. *J Ren Nutr.* 2020. https://doi.org/10.1053/j.jrn.2019.10.006.

23. Hoshino J, Muenz D, Zee J, et al. Associations of hemoglobin levels with health-related quality of life, physical activity, and clinical outcomes in persons with stage 3-5 nondialysis CKD. *J Ren Nutr.* 2020. https://doi.org/10.1053/j.jrn.2019.11.003.

24. Garcia-Torres R, Young L, Murray DP, Kheda M, Nahman NS Jr. Dietary protein source and phosphate levels in patients on hemodialysis. *J Ren Nutr.* 2020. https://doi.org/10.1053/j.jrn.2019.11.006.

25. Vaz de Melo Ribeiro P, Miranda Hermsdorff HH, Balbino KP, de Paula Santos Epifanio A, de Paula Jorge M, Bandeira Moreira AV. Effect of a nutritional intervention, based on transtheoretical model, on metabolic markers and food consumption of individuals undergoing hemodialysis. *J Ren Nutr.* 2020. https://doi.org/10.1053/j.jrn.2019.12.004.

26. Murtas S, Aquilani R, Iadarola P, et al. Differences and effects of metabolic fate of individual amino acid loss in high-efficiency hemodialysis and hemodiafiltration. *J Ren Nutr.* 2020. https://doi.org/10.1053/j.jrn.2019.12.003.

27. Beberashvili I, Samogalska O, Azar A, Stav K, Efrati S. Nutritional status and mortality predictability for time-varying serum alkaline phosphatase in hemodialysis patients: a longitudinal study. *J Ren Nutr.* 2020. https://doi.org/10.1053/j.jrn.2019.10.004.

28. Kistler BM, Moore LW, Benner D, et al. The International Society of Renal Nutrition and Metabolism Commentary on the National Kidney Foundation and Academy of Nutrition and Dietetics KDOQI clinical Practice guideline for nutrition in chronic kidney disease. *J Ren Nutr.* 2020. https://doi.org/10.1053/j.jrn.2020.05.002.