Title

Does Kidney Longevity Mean Healthy Vegan Food and Less Meat or Is Any Low-Protein Diet Good Enough?

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Does Kidney Longevity Mean Healthy Vegan Food and Less Meat or Is Any Low-Protein Diet Good Enough?

AN INCREASING NUMBER of publications and presentations have recently emerged to reinvigorate the discussion about the role of low-protein diets in improving kidney longevity in persons with chronic kidney disease (CKD). It has been known for decades that intake of protein-rich foods results in dilatation of the afferent arterioles of the glomeruli, leading to elevated intraglomerular pressure and increased glomerular filtration rate. Although the increased glomerular filtration rate appears to enhance kidney function in the short term, chronic glomerular hyperfiltration as a result of frequent high protein intake may have serious consequences for long-term kidney health, especially if the number of nephrons is already reduced or if other risks factors of kidney disease exist.[1] To that end, a low-protein diet has consistently been shown to lower intraglomerular pressure, and this may extend the kidney function durability in the long term as corroborated in both animal models and human studies of participants with CKD. A recent study showed that among African Americans with diabetes, higher protein intake as a percent of total energy intake was positively associated with greater decline in estimated glomerular filtration rate in analyses that accounted for risk factors for kidney disease.[2]

Low protein intake may have additional salutary effects,[3] including a reduction in the production of nitrogenous compounds that comprise uremic toxins; hence, a reduced dietary protein intake may be an ineffective strategy in controlling uremia and delaying the start of dialysis therapy, and it can also be used as a core component of the conservative management of CKD without dialysis.[4] The following ranges of dietary protein intake have been recommended for the management of CKD: (1) 0.6 to 0.8 g/kg ideal body weight (IBW) per day in patients with non–dialysis-dependent CKD stages 3b, 4, and 5 (estimated glomerular filtration rate $<$ 45 mL/min/1.73 m^2 body surface area) or substantial albuminuria at A3 level ($>$300 mg/day); (2) 0.8-1 g/kg IBW per day in patients with CKD stages 1, 2, and 3a and without substantial albuminuria including patients with well-functioning transplants and persons with a solitary kidney or at a high risk of CKD such as those with diabetes mellitus or polycystic kidney disease.[1] It is important to note that in dialysis-dependent patients without residual kidney function, higher protein-intake targets are often recommended such as 1.2-1.4 g/kg IBW per day, and these patients should also eat during hemodialysis.[5] In this issue of the *Journal of Renal Nutrition*, Choi *et al*[6] evaluated the safety of providing supplemental meals during hemodialysis to boost the protein intake. They demonstrated no adverse effects of the meals consumed during the dialysis treatment and were able to use a varied meal plan that included a vegan approach.[6] High ranges of protein intake may also be temporarily recommended to any patient with CKD, regardless of CKD stage, with signs of protein-energy wasting (PEW) or at imminent risk of PEW, whereas low-protein diets should be the default for stable CKD patients at all times.[1] It is important to note that most adults in the Unites States of America eat 1.0 to 1.4 g/kg IBW per day.[7]

As to what type of protein intake is better for CKD management, that is, plant- versus animal-based proteins, there have been ongoing debates. A recent study confirmed that red meat and processed meat are adversely associated with CKD risk, whereas nuts, low-fat dairy products, and legumes are protective against the development of CKD.[8] There are different types of vegetarian diets: (1) vegan or strict vegetarian diets that not only exclude meat, poultry, and seafood but also eggs and dairy products and maybe even honey; (2) lacto- and/or ovo-vegetarian diets that may include dairy products and/or eggs; and (3) pescatarian or pesco-vegetarian diets that include a vegan or vegetarian diet combined with occasional intake of some or all types of seafoods. Interestingly, many religions provide certain vegetarian dietary recommendations: vegetarianism is an integral part of Hinduism and Jainism, whereas in Bengal region of India, fish is considered a sea vegetable and allowed. In some schools of Buddhism, meat is not allowed. In Judaism, the Tu B'shevat meal is composed of seven vegetarian foods including wheat, barley, grapes, figs, pomegranates, olives, and dates and usually incorporates dried fruit and nuts. Some Christian groups, such as the Seventh-Day Adventists, encourage vegetarianism as preferred lifestyles, and many Moslem Sufis maintain a vegetarian diet.

As to whether a vegetarian diet is appropriate for CKD management, traditionally, it has been suggested that at

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least half the dietary protein should be from high-biologic-value proteins with highest gastrointestinal absorbability such as dairy products and eggs to ensure adequate supply of the essential amino acids. However, other metrics including "protein digestibility–corrected amino acid score", which is the preferred method by the Food and Agricultural Organization and the World Health Organization and also gives a high score to plant-based sources such as soy protein concentrate, may be a more appropriate measure of protein quality.[9] In this issue of the *Journal of Renal Nutrition*, Joshi *et al*[9] provide a table depicting the protein digestibility–corrected amino acid score of common foods and a helpful discussion on applicability of the scoring system.

There are multiple benefits of a vegan or vegetarian diet in the management of CKD: (1) Intake of animal fat is associated with albuminuria, and other components related to meat such as choline and carnitine are converted by gut flora into trimethylamine and trimethylamine N-oxide (TMAO) that are associated with atherosclerosis and renal fibrosis.[10] (2) Vegan dieting leads to a decreased acid load, whereas ingestion of animal-based foods increases acidogenesis and ammonia production, and this favorable alkalization of vegan diet may have additional effects beyond what would be provided by mere intake of sodium bicarbonate.[11] (3) There is less absorbable phosphorus in plant-based protein given the preponderance of indigestible phytate as the main source of phosphorus and given that fresh fruits or vegetables are less likely to have added phosphorus-based preservatives that are often used for meat processing.[12,13] (4) Higher dietary fiber intake, in addition to a favorable modulation of advanced glycation end products,[14] enhances gastrointestinal motility and lowers the likelihood of constipation, which is a likely contributor to hyperkalemia. (5) A vegan diet based on fresh fruits and vegetables lessen the likelihood of exposure to potassium-based additives.[15,16] (6) There are potentially favorable impacts on the gut microbiome leading to lower generation of uremic toxins such as indoxyl sulfate, p-cresol sulfate, TMAO, and other unfavorable substances.[17] TMAO is not only elevated as a consequence of renal insufficiency but also likely contributes to the progression of CKD and the risk of mortality in patients with CKD.[18] There are other benefits from a higher intake of plant-based protein, such as lowering the likelihood of kidney stones and decreased risk of cardiovascular disease due to higher intake of natural antioxidants including carotenoids, tocopherols, and ascorbic acid.[19]

As to whether a low-protein diet with mostly to entirely plant-based protein is adequate, it is important to note that the Recommended Dietary Allowance for protein is 0.8 g/kg/day and that the estimated requirement is likely even lower, that is, 0.6 g/kg/day, based on metabolic studies, provided adequate essential amino acids are ensured.[1] Although most guidelines recommend a minimum of 10% of energy to be derived from protein and this is usually met with an Recommended Dietary Allowance of 0.8 g/kg/day of dietary protein intake, higher intakes of dietary protein such as in the ketogenic diet, where protein intake may be as high as 20% or more of the total energy source, should not be prescribed to patients with CKD or persons at high risk of CKD, unless there are exceptional circumstances that would necessitate intake of high amounts of protein for limited periods of time such as PEW correction. Nevertheless, we expect that discussion will be continued on this topic and hope that *the Journal of Renal Nutrition* provides an excellent platform for such productive scientific debates.[20]

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