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REVIEW ARTICLE

Chronic Kidney Disease : is plant-based diet effective ?

Penyakit Ginjal Kronis : apakah pola makan berbasis nabati efektif?

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ABSTRACT

Chronic kidney disease (CKD) is a global problem whose number of sufferers is increasing. Various methods have been widely used to prevent worsening of kidney function. In addition to controlling causative factors, diet planning also plays a role in improving kidney function. Confining protein utilization has long been a foundation of wholesome treatment for patients with CKD. In any case, the suggested sum of dietary protein admissions may change between consensus. A vegan who eats less that's exceptionally low in protein has appeared to diminish the chance of kidney failure in patients with progressed CKD. These findings indicate that protein sources can also influence the improvement of kidney function. Dietary medications play a good part in the management of CKD and avoiding or postponing kidney replacement therapy. The study proposes that a plant-dominant low-protein diet (PLADO) of 0.6–0.8 g/kg/day composed of >50% plant-based sources, managed by nutritionists prepared in non-dialysis CKD care, is promising and reliable with the exactness diet. Plant-based Very low-protein diets may inhibit decreased eGFR (estimated glomerular filtration rate) and the need for renal replacement therapy. This literature review aims to find evidence about the effectiveness of plant-based diets in treating cases of chronic kidney failure.

Keywords: chronic kidney disease; low-protein; plant-based diet

ABSTRAK

Penyakit ginjal kronis (PGK) merupakan masalah global yang jumlah penderitanya semakin meningkat. Berbagai metode telah banyak digunakan untuk mencegah memburuknya fungsi ginjal. Selain mengendalikan faktor penyebab, perencanaan diet juga berperan dalam meningkatkan fungsi ginjal. Membatasi jumlah asupan protein telah lama menjadi dasar pengobatan untuk pasien dengan PGK. Bagaimanapun, jumlah penerimaan protein makanan yang disarankan dapat berbeda antar konsensus. Seorang vegan yang makan sangat rendah protein telah terbukti mengurangi kemungkinan gagal ginjal pada pasien dengan PGK. Temuan ini menunjukkan bahwa sumber protein juga dapat mempengaruhi peningkatan fungsi ginjal. Mediasi diet memiliki bagian yang baik dalam manajemen PGK dan menghindari atau menunda terapi pengganti ginjal. Penelitian menunjukkan bahwa diet rendah protein dengan dominan protein nabati 0.6-0.8 g / kg / hari, yang terdiri dari >50% sumber nabati, dengan dikelola oleh ahli gizi yang disiapkan dalam perawatan PGK non-dialisis, memberikan hasil yang menjanjikan. Diet nabati sangat rendah protein, dapat menghambat penurunan eGFR (perkiraan laju filtrasi glomerulus) dan kebutuhan untuk terapi penggantian ginjal. Tinjauan pustaka ini bertujuan untuk menemukan bukti tentang efektivitas pola makan nabati dalam mengobati kasus gagal ginjal kronis.

Kata kunci: penyakit ginjal kronis; rendah protein; diet berbasis tanaman.

INTRODUCTION

Chronic kidney disease (CKD) is characterized by the presence of kidney injury or diminished glomerular filtration rate (GFR) for three or more months, independent of the cause.[1] This three-month term differentiates chronic from acute kidney disease. Kidney injury refers to pathological anomalies, either detected through kidney biopsy or imaging examination or based on markers such as urinary sediment abnormalities or increased urinary albumin excretion. Worsening kidney function refers to a decrease in the glomerular filtration rate (GFR), which is ordinarily estimated (eGFR) utilizing serum creatinine and one of a few accessible equations.[2]

The burden of kidney disease worldwide is increasing, but public awareness is still lacking, so there is a need for more effective communication by stakeholders in the Health community. Based on the Global Burden of Disease (GBD) study in 2017, there were 698 million cases of CKD (95% CI 649-752) with an evaluated worldwide predominance within the grown-up populace of 9.1 percent (8.5 to 9.8).[3] In another source, the global prevalence of CKD could reach 13.4 percent (11.7 to 15.1), with a prevalence of CKD stages 3 to 5 of 10.6 percent. (9.2 to 12.2).[4]

1.4 million deaths (1.2 to 1.6 deaths) were recorded due to kidney disease, between 1990 and 2017. There was an increase in the death rate due to CKD, by 41.5 percent globally (35.2 to 46.5) during this period. Worldwide, CKD ranked 12th as the leading cause of death in 2017, having previously ranked 17th in 1990. Globally, the death rate from chronic kidney disease based on age is 1.39 (1.28 to 1.30) times higher in men (18.9 per 100,000 population (17.9 to 19.5)) than in women (13.6 per 100,000 population (13.3 to 14.0)).[3] This literature review aims to find evidence about the effectiveness of plant-based diets in treating cases of chronic kidney failure.

METHODS

We conducted a literature review based on the relevance of this topic. In our literature search, we used all databases, namely Google Scholar, Pubmed, and ResearchGate with the following

keywords: chronic kidney disease, low-protein, and plant-based diet. In total, five articles were obtained, several systematic reviews and literature reviews related to the topic.

RESULTS

Management options for chronic kidney disease

General management of CKD patients includes treatment of reversible causative factors, prevention of worsening kidney function, management of complications, adjustment of drug doses based on estimated glomerular filtration rate (eGFR), and identification and preparation of renal replacement therapy in patients with end-stage renal disease.[5]

There is a growing understanding that for a significant fraction of patients with CKD, preservationist treatment without renal replacement therapy is an effective, patient-centered treatment choice. Patients with chronic kidney disease can choose from several overlapping intervention domains that fall within conservative treatment options. With the essential objective of anticipating the progression of chronic kidney disease and conserving kidney function to prevent dialysis for as long as feasible or, ideally, completely, kidney-preserving treatment could be a life-sustaining preservationist management approach. By effectively treating kidney and non-kidney comorbidities and their accompanying symptoms, this strategy aims to achieve the highest feasible survival, enhanced cardiovascular health, and higher quality of life.[6]

Considering that conservative treatment is characterized as chronic kidney disease care without kidney transplantation or dialysis, misinterpretations around dialysis-free management as so-called no care or misguided conflating with hospice care may have contributed to an underutilization of the total range of kidney-preserving management.[7]

The focus of efforts to slow the deterioration of kidney function may change depending on the severity of chronic kidney disease and its underlying cause, given that these measures are compatible with the secondary and tertiary prevention of chronic kidney disease. Chronic kidney disease patients as well as the general population should take precedence when it comes to lifestyle and dietary changes (table 1) as they improve cardiometabolic health and have positive long-term effects on the kidneys.[8]

By overcoming physical inactivity, obesity, smoking, high blood pressure, and high blood sugar, primary prevention treatment focuses on achieving good control of risk factors for CKD. Regardless of the level of renal function, addressing these risk factors is crucial. Although the cost-effectiveness of CKD screening for the entire population is debatable, regular evaluations of eGFR and albuminuria are advised for focused screening of those with risk factors (such as diabetes, hypertension, and obesity).

Table 1. Lifestyle modification strategies to slow the progression of chronic kidney disease and preventing adverse cardiovascular outcomes.[8]

	Effect on chronic kidney disease progression	Effect on cardiovascular disease and mortality	Comments	Recommendations
Physical activity	Slower decline in kidney function	Lower risk of adverse cardiovascular outcomes and mortality	Evidence on physical activity and progression of kidney disease and cardiovascular outcomes is largely based on observational studies; small trials of physical activity show improvements in kidney function and blood pressure in people with chronic kidney disease not receiving dialysis; small trials in patients receiving dialysis show improvements in physical function and health-related quality of life	Target of 150 min/week of moderate intensity physical activity for patients with chronic kidney disease; exercise should be individualised for patients according to comorbidities and functional status (mixed data in dialysis-dependent patients)
Smoking cessation or avoidance	Smoking is associated with a greater risk of incident chronic kidney disease	Smoking is associated with increased risk of all-cause mortality, including vascular causes and cancer, in people with chronic kidney disease	Smoking cessation should be prioritised in all individuals for numerous recognised health benefits	Smoking cessation for all patients with behavioural counselling and pharmacological therapies as required, with appropriate dose adjustment for patients with chronic kidney disease
Dietary sodium restriction	Reduced albuminuria and improved fluid status in people with and without chronic kidney disease	Reduces blood pressure and improves arterial stiffness in people with and without chronic kidney disease	People with chronic kidney disease are more likely to have salt-sensitive hypertension	Limit sodium intake to a maximum of 2·3 g/day (<100 mmol) according to the American Heart Association
Higher proportion of plant-based protein in diet	Higher proportion of plant-based protein and fibre intake might improve acidosis, mitigate inflammation, reduce phosphorus burden, slow progression of chronic kidney disease, and create less uraemic toxins	Higher red meat intake might be associated with atherosclerosis due to higher carnitine generation via gut microbiota	Reducing dietary protein intake can increase the risk of muscle mass loss and frailty; protein intake recommendations vary depending on chronic kidney disease stage, acute kidney injury, and need for dialysis	Higher intake of complex carbohydrates and fresh fruits and vegetables as opposed to processed carbohydrates
Weight reduction	Improved cardiometabolic health; potentially slower decline in kidney	Improves blood pressure	Little evidence from randomised controlled trials to guide the dietetic management of	Multidisciplinary approach to weight loss in overweight and obese individuals with chronic kidney disease

	function and improved albuminuria	people with overweight and obesity and chronic kidney disease	with involvement of a renal dietitian; mixed data in dialysis patients related to the obesity paradox

People with CKD may be advised to make various efforts to lose weight. Caloric reduction, coupled with a plant-based low-protein diet, can lead to periodic weight loss in most people with obesity and CKD.[9,10]

For individuals suffering from chronic kidney disease, in addition to protecting kidney function, it is also important to address complications and associated comorbidities and manage symptoms as they arise. Some lifestyle, nutritional, and pharmaceutical measures, including weight loss, modest protein restriction, glucose and blood pressure control, and suppression of the renin-angiotensin-aldosterone system, can be taken to slow the progression of chronic kidney disease.[11]

Glomerular filtration rate must be preserved in the short term, as a compensatory mechanism the afferent arterioles generally widen and the efferent narrow in many types of chronic kidney disease. Glomerular hyperfiltration or intraglomerular hypertension are the terms used to describe this phenomenon. Tubulo-glomerular feedback regulates a portion of this interaction.[12] Chronic glomerular hyperfiltration can make kidney disease worse by activating inflammatory mediators and placing mechanical stress on the kidney, both of which promote interstitial fibrosis. By increasing afferent arteriole tone through limiting protein intake, renal interstitial fibrosis can be reduced, intraglomerular hypertension is reduced, and CKD progression can be slowed (figure 1).[8] Angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers, which lower intraglomerular pressure by increasing efferent arteriolar vasodilatation, have a postglomerular effect on the renin-angiotensin-aldosterone pathway, is paralleled and complemented by this effect.[13]

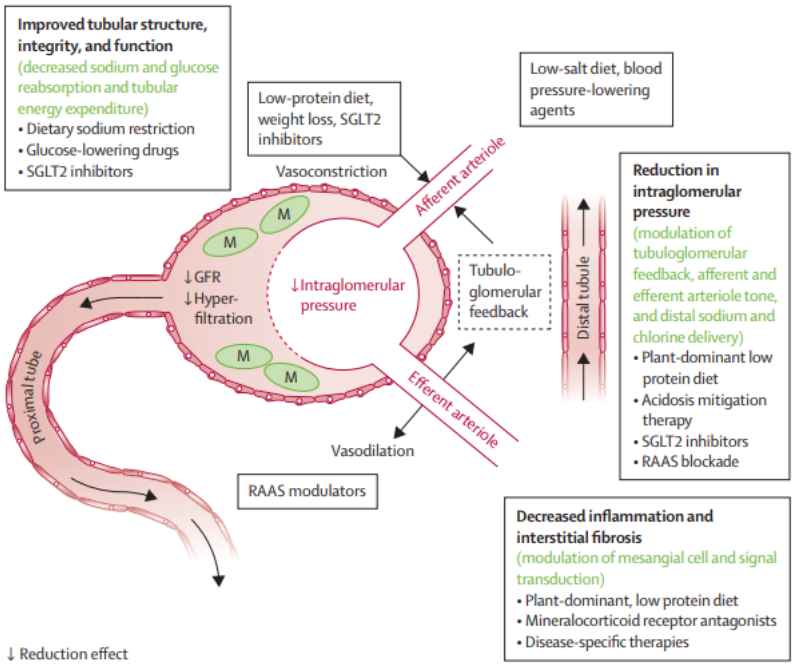

Figure 1. Effects of dietary salt and protein intake as well as pharmaceutical treatments on glomerular architecture and functioning, afferent and efferent arteriolar tone, and intraglomerular pressure[8]; restricting protein intake causes constriction of the afferent arterioles, which decreases intraglomerular pressure and further reduces long-term damage to glomerular structure and function. In parallel with and possibly in addition to the effects of SGLT2 inhibitors, interstitial fibrosis can be lessened more successfully with RAAS blockade, mineralocorticoid receptor antagonists, and other blood pressure-lowering drugs, as well as the kidney-protective benefits of

a diet high in plants and low in protein. GFR=glomerular filtration rate. M=mesangial cells. RAAS=renin–angiotensin–aldosterone system.

A low-protein diet can keep your kidneys healthy.

It has often been demonstrated that a low-protein diet (LPD), defined as dietary protein intake (DPI) of 0.6–0.8 g/kg/day, lowers intraglomerular pressure. This impact has been supported in both animal models and human trials of CKD, including multiple meta-analyses, and if it is applied regularly, it may sustain long-term renal function.[9]

The Modification of Diet in Renal Disease study compared the effects of conventional (1.3 g/kg per day) and low-protein diets (0.58 g/kg per day) on the fall of eGFR in 585 persons with nondiabetic kidney disease, provides evidence that the positive effects of dietary protein restriction are supported by randomised controlled trials.[8] As with the start of ACE medications or angiotensin receptor (AGTR1) blockade therapy, the immediate effect of dietary protein restriction lowers short-term glomerular filtration rate through afferent arteriolar constriction, was not taken into account, even though the trial's primary results were inconclusive. The Modification of Diet in Renal Disease study compared the effects of conventional (1.3 g/kg per day) and low-protein diets (0.58 g/kg per day) on the fall of eGFR in 585 persons with nondiabetic kidney disease, provides evidence that the positive effects of dietary protein restriction are supported by randomised controlled trials. As with the start of ACE medications or angiotensin receptor (AGTR1) blockade therapy, the immediate effect of dietary protein restriction lowers short-term glomerular filtration rate through afferent arteriolar constriction, was not taken into account, even though the trial's primary results were inconclusive.[8]

There may be a benefit to dietary protein restriction, according to further data from the Modification of Diet in Renal Disease research studies that did not take into account the immediate impact of the dietary change on the glomerular filtration rate. Additional research showed that limiting protein in the diet may also lower blood pressure and proteinuria. The results of this study are supported by meta-analyses that show a reduced risk of kidney failure, improvements in proteinuria, and other favorable biochemical outcomes, including higher blood bicarbonate concentrations, lower azotemia, and lower serum phosphorus concentrations.[14]

The Recommended Dietary Allowance (RDA) for dietary protein intake (DPI) is 0.8 grams per kilogram of the ideal body weight per day (g/kg/day), according to the U.S. National Academy of Medicine, 1.2 to 1.4 g/kg/day, largely from animal sources, according to analysis from the National Health and Nutrition Examination Survey (NHANES), is the average daily protein intake for Americans. Higher DPI has been advocated in practice to treat obesity and diabetes despite recent research showing a higher risk of CKD incidence and progression with higher DPI, particularly from red meat.[9,15] Keto diets, which are also rich in animal fats and protein, are becoming more and more popular as a suggested nutritional intervention for individuals with diabetes in various healthcare systems around the globe.[9] Despite the ketogenic diet's initial attraction for the treatment of type 2 diabetes, it may pose serious risks to long-term health. Randomized, controlled trials have shown that it is not as beneficial for glycemic control or weight loss as sometimes claimed.[9,10]

Positive Impact of Plant-Based Foods on Kidney Health

An open-label, 15-month randomized controlled study (RCT) by Garneata et al. compared a vegetarian sVLPD (0.30 g/kg per day supplemented with keto analogs of essential amino acids) with an LPD (0.60 g/kg per day including animal proteins) in 207 patients with an eGFR of less than 30 mL/min per 1.73 m2. The primary composite efficacious endpoint, which is the beginning of Renal Replacement Therapy (RRT) or a reduction of more than 50% in the baseline GFR, showed that a considerably smaller proportion of patients in the vegetarian sVLPD group—13% compared to 42% in the conventional low–protein diet (LPD) group ($p<0.001$). RRT initiation was required in a lower proportion in the sVLPD group (11% versus 30%; $p<0.001$). The number of patients who needed to be treated for 1 year to avoid dialysis initiation in one patient was 22.4 (95% CI, 21.5 to 25.1).[16]

After correcting for age, sex, and body weight, numerous cross-sectional studies found that vegetarians in industrialized countries had lower blood pressure (BP) than non-vegetarians.

Vegetarians also have a reduced aging-related rise in blood pressure, according to observational research.[9,17] Vegetarian Adventists had lower systolic and diastolic blood pressure than meat-eating Adventists, according to two distinct analyses of the study's black and white participants.[9] A recent meta-analysis found that when omnivores switch to a vegetarian diet, their mean systolic blood pressure decreases by 4.8 mmHg, their mean diastolic blood pressure decreases by 2.2 mmHg, and their mean arterial pressure decreases by 6.9 mmHg and 4.7 mmHg in the controlled trials and the observational studies, respectively.[9,18]

An increasing number of research has shown how plant-based diets can help prevent and treat lifestyle disorders in recent years. Parallel to this, details on the application of this dietary pattern in the management of chronic kidney disease (CKD) and its most common side effects are now available. Patients' diets that are lower in total and animal protein while higher in plant-based foods may require fewer nephroprotective medications, relieve kidney disease problems, and perhaps have a positive effect on the course of the disease and patient survival.[10]

According to a recent thorough and critical evaluation of the research, eating red meat regularly over the years may raise the chance of developing chronic kidney disease, while eating fruit and vegetable proteins may protect the kidneys.[9,19]

While plant-based diets may decrease the progression of CKD, previous studies reported by some of the authors of this paper imply that animal protein is negative for kidney function.[9]

With a DPI of 0.6-0.8 g/kg/day and a minimum of 50% vegetable sources to achieve protein intake goals, the plant-dominant low protein diet (LPD), also known as PLADO, is a type of LPD. Whole foods, rather than refined or processed foods, should be consumed (Figure 2).[9] Given that the lowest DPI needed to prevent catabolic alterations is 0.45 to 0.5 g/kg/day based on proven metabolic studies[9,19], this is compatible with the RDA of DPI of 0.8 g/kg/day, which has a high safety margin. To ensure appropriate consumption of essential amino acids, it has been suggested that 50% DPI should have "high biological value" and high gastrointestinal absorption. Other metrics, such as the "protein digestibility-corrected amino-acid score," a more precise method advised by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO), however, give high values to many plant sources and may be a gauge of which is better for protein quality.[9]

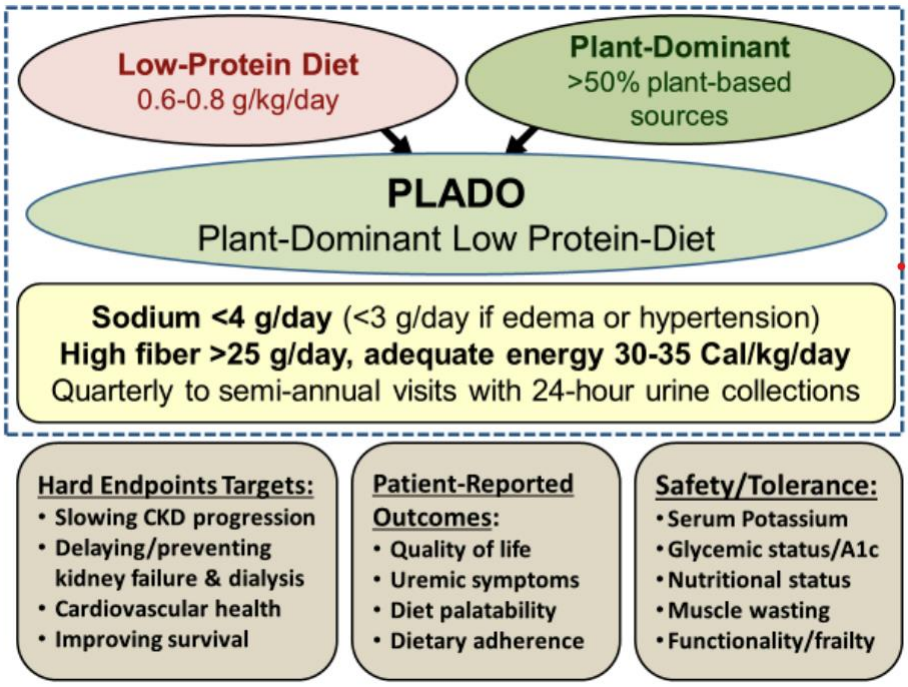

Figure 2. Overview of the plant-dominant low-protein diet (PLADO) for the nutritional management of chronic kidney disease. The PLADO is based on a total dietary intake of 0.6-0.8

g/kg/day with >50% plant-based sources, preferentially unprocessed foods, relatively low dietary sodium intake (4 g/day if no edema occurs with well-controlled hypertension), higher dietary fiber of at least 25-30 g/day, and adequate dietary energy. Based on the desired body weight, weight is assigned. After three years of following a vegan diet, serum B12 levels need to be checked.

In addition to lowering glomerular hyperfiltration, LPD with at least 50% vegetable protein sources can prevent the progression of CKD through several different mechanisms[9,20] (table 2).

Table 2. Benefits and difficulties of LPD with >50% plant-based sources of protein.

Benefits of LPD with >50% Plant Sources	Potential Challenges of LPD
• Lowering intra-glomerular pressure • Synergistic effect with RAASi and SGLT2i • Controlling uremia and delaying dialysis • Preventing cardiovascular harms of meat • Less absorbable phosphorus • Lowering acid-load with less acidogenicity • High dietary fiber enhancing GI motility • Favorable changes in microbiome • Less TMA N-oxide (TMAO), leading to less kidney fibrosis • Less inflammation and oxidative stress	• Risk of protein-energy wasting (PEW) • Inadequate essential amino acids • Undermining obesity management • High glycemic index • High potassium load and hyperkalemia • Low palatability and adherence • Inadequate fish intake if vegan

CONCLUSION

A plant-dominant low-protein diet (PLADO) can lower the risk of kidney failure in patients with advanced chronic kidney disease (CKD), albeit it is challenging to determine whether this advantage came from a vegetarian protein source or well-managed tight protein restriction.

PLADO may serve as an adjunct in management to delay the worsening of CKD. Furthermore, this diet helps to minimize CKD consequences such as metabolic acidosis, hyperphosphatemia, and uremic toxin buildup. In addition, increasing magnesium consumption can prevent blood vessel calcification and kidney injury due to phosphate. Although strict clinical monitoring is advised, the most recent research does not indicate a risk of hyperkalemia with a plant-based diet in individuals with advanced CKD. Additional research is required to determine the viability, safety, and efficacy of this diet in actual CKD patients.

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AUTHORS CONTRIBUTION

Describe the author's contribution to this work and the contributions of all authors must be described.

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The author explains all sources of costs in preparing the review literature.

CONFLICT OF INTEREST

Authors should make a conflict of interest disclosure statement or a declaration that they do not have any conflicts of interest.

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