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Review Article

Diet and Multiple Renal Outcomes

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Abstract

Kidney disease is highly prevalent worldwide. Dietary intervention is a potentially effective means of treatments for kidney disease. We pooled the available sporadic studies focusing on the association between dietary factors and renal outcomes and meta-analyses that reached opposite conclusions. An umbrella analysis combining various dietary factors with multiple kidney disease outcomes was conducted, in which 85 articles were reviewed for methodological quality and level of evidence, and the 36 studies with higher quality were included in results. It was found that low protein diet, low sodium diet, Mediterranean diet and moderate amounts of coffee, alcohol, fiber may be beneficial for improving renal function; Whereas the western type dietary pattern, the intake of meat and areca nut may increase the renal burden and disrupt renal function.

Keywords: Diet; Food; CKD; Kidney diseases; Renal outcomes; Umbrella review

Introduction

Kidney diseases, which are generally characterized by abnormal or decreased renal function, have considerable morbidity and mortality globally and have become a huge social burden [1,2]. Dietary intervention is an essential component of CKD management and has been shown to slow down the progression of the disease. A proper diet can help reduce the accumulation of waste products in the body and manage blood pressure and glucose levels [3]. Additionally, a balanced diet can improve the quality of life and prevent malnutrition in kidney disease patients [4]. Although there are fragmentary studies reporting the effects of a certain dietary pattern on kidney diseases, a comprehensive analysis focusing on the relationship between various dietary factors and various kidney diseases is deficient. Moreover, due to flaws in the design of the study, several meta-analyses on the same topic have come to diametrically opposite conclusions, further downgrading the evidence for dietary interventions for kidney diseases. Hence, few clinicians can formulate a dietary intervention program covering all aspects for patients with different kidney diseases.

To provide a high-quality corroborating evidence for the prevention, treatment, and outcome improvement of kidney diseases, this umbrella review retrieved meta-analyses exploring the relationship between various dietary factors and various kidney diseases, assessed the quality of methodology and levels of evidence, and gave a systematic and comprehensive clinical recommendation. Specifically, our study demonstrated the association between multiple renal outcomes and several dietary factors including low protein diet, ketoanalogue supplement, sodium restriction diet, Mediterranean diet, healthy diet, diet interventions, meat, soy protein, vegetables, fruits, fiber, coffee, sugar/artificially sweetened beverages, betel nut, tea, alcohol, and fatty acids.

Methods

Based on the previous second-level studies concerning the association between diet and kidney diseases, an umbrella analysis was conducted, which involved a comprehensive search of the databases, a critical judgment of the included studies and a summary analysis of all the available proofs. This umbrella review was conducted according to the criteria of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines. The protocol of this review was registered in PROSPERO, and our registration number is CRD42022319549.

Search Strategy and Literature Selection

Two authors (SJT and TJX) independently retrieved relevant studies from PubMed, Web of Science, Embase and the Cochrane Library (from January 1990 to July 2022). The detailed search strategies for each database are presented in Supplementary Table 1. Disagreements were resolved by either consensus or discussion with a third researcher (QW). The inclusion criteria were as follows: the study (1) was a meta-analysis of

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observational/interventional studies, (2) focused on the association between dietary factors and renal function/diseases, (3) had at least two comparison groups, and (4) the outcomes of interest were clearly defined according to guidelines. The exclusion criteria were as follows: (1) articles with no comparison groups; (2) populations less than 50; (3) data from animals or in vitro only; and (4) case reports, reviews, editorials, comments and news reports.

Data Extraction

The following characteristics of each study were extracted by two authors (SJT and TJX) independently, including the first author's name, the year of publication, outcomes, exposure/intervention, population, number of the primary studies included, sample size, comparisons, the type of study design, MA metric, effects model, estimates along with their 95% confidence intervals, and heterogeneity index (I^2). Any disagreement was resolved by consensus or discussion with a third investigator (QW). Inadequate data were identified by contacting the author by e-mail.

Study Quality Assessment

Assessing the Methodological Quality of Systematic Review (AMSTAR-2) was used for methodological assessment of the included studies. The AMSTAR-2 has a total of 16 scoring items, which consist of population, intervention, comparison, the results, protocol registration, study selection, literature search, data extraction, bias risk assessment, funding sources, meta-analysis methods, data analysis and interpretation using bias risk assessment, reporting heterogeneity, publication bias, and conflict of interest. Among them, 7 are critical items, and the others are noncritical items. The methodological quality of the study was divided into four grades: a. High: none or only one noncritical item does not conform. B. Moderate: more than 1 noncritical item does not conform. c. Low: 1 key item does not conform. d. Critically low: more than 1 critical item is not in conformity. The strength of evidence was rated by the GRADE.

Data Analysis

The characteristics of all included articles were qualitatively described. Various dietary factors can be broadly classified into three categories: "dietary patterns, foods, and nutritional supplements". The studies were divided by the type of population into those with or without kidney diseases. Within the same classification, if more than one systematic review and meta-analysis investigated the same outcome, the RCT with the highest methodological quality according to AMSTAR-2 would be presented in the results table and forest plot. If no RCTs were available, the observational studies with the highest quality were selected. If two studies were of the same methodological quality, one with a better strength of evidence was selected.

Results

Literature review

A total of 4286 studies from four databases were identified by our automated retrieval tools through the titles and abstracts. After deleting duplicates, the titles, abstracts, and full texts of the remaining 1892 articles were screened to exclude irrelevant studies according to our inclusion and exclusion criteria. The flow diagram of our literature search is presented in Figure 1. Eighty-five studies were considered eligible and then included in the data extraction and quality assessment. Among them, 16 focused on a low protein diet, 3 focused on ketoanalogue supplements with a low protein diet, 13 focused on sodium restriction, 5 focused on a Mediterranean diet, 8 focused on a healthy diet intervention, 13 focused on types of protein (meat/soy protein), 9 focused on vegetables and fruits, 7 focused on fiber (fruit, vegetable, legume, cereal, etc.), 4 on beverages (coffee, sugar-sweetened beverage, tea and alcohol), 1 on betel nuts, and 6 on nutrition supplements (fatty acid and fish oil). According to the AMSTAR-2 and GRADE assessments, among studies with the same population and outcome, one with the highest quality was preserved and included in our umbrella review. Particularly, if two studies with the same research contents drew contradictory conclusions, both would be included in the review, and the reason for the inconformity will be analyzed in our study. Detailed information of our methodological assessment for the included 36 studies can be found in Supplementary Table 2.

Effects of a Low Protein Diet on Renal Outcomes

Two meta-analyses including 27 RCTs focused on the effects of a low protein diet on renal diseases and kidney function. As shown in Table 1, among Chronic Kidney Disease (CKD) patients, compared with a normal diet, a low protein diet was associated with a lower risk of entering end-stage kidney diseases (OR=0.64, 95% CI: 0.43, 0.96) and composited renal endpoints (OR=0.59, 95% CI: 0.41, 0.85), a lower decreasing speed of eGFR (MD=-1.85, 95% CI: -0.77, -2.93), less proteinuria (MD=-0.44, 95% CI: -0.80, -0.08) and a lower serum phosphorus (MD=-0.37, 95% CI: -0.5, -0.24). However, no association was found between a low protein diet and all-cause mortality (OR=1.17 95% CI: 0.67, 2.06) or serum albumin (MD=0.23, 95% CI: -0.51, 0.97) among CKD patients [5]. For patients with both diabetes and CKD, a low protein diet indicated a significantly higher GFR (MD=22.31, 95% CI: 17.19, 27.42) but had no effect on proteinuria (MD=-2.26, 95% CI: -2.99, 1.52) [6].

There was another study focusing on the effect of ketoanalogue supplementation in a low-protein diet. Ketoanalogue supplementation was associated with a high GFR (WMD=3.14, 95% CI: 0.68, 5.61) and a lower BUN (WMD=-22.01, 95% CI: -42.42, -1.60) but had no effect on creatinine, proteinuria, or serum bicarbonate [7].

Effects of Sodium Restriction on Renal Outcomes

As shown in Table 1, four meta-analyses, consisting of 9 observational studies and 37 RCTs, explored the association between dietary sodium restriction and renal outcomes. Although no effect was found on all-cause mortality, cardiovascular events or GFR levels, sodium restriction might indicate a lower risk of adverse renal outcome events (RR=0.72, 95% CI: 0.58, 0.89) [8], lower albuminuria among CKD patients (MD=-0.05, 95% CI: -0.09, -0.01) [9], and lower proteinuria among early-stage CKD patients (MD=-0.41, 95% CI: -0.58, -0.25) [10]. Both systolic blood pressure and diastolic blood pressure were much lower among patients with all stages of CKD (post-transplant, early-stage, with diabetes and under dialysis) [10,11]. Interestingly, a significantly higher risk of symptomatic hypotension was found among patients with early-stage CKD (RR=6.26, 95% CI: 2.08, 18.81) but not among posttransplant patients (RR=10.54, 95% CI: 0.62, 18.07) [10].

Associations between Different Diet Patterns and Renal Outcomes

One study conducted among healthy people found that a Mediterranean diet may lead to a lower risk of CKD (OR=0.90, 95% CI: 0.87, 0.94) [12], hinting that Mediterranean diet may prevent CKD.

Four studies on the effects of healthy diet patterns/healthy dietary interventions (diet patterns rich in vegetables and fruits, legumes, whole grains, and fiber together with lower consumption of red meat, sodium, and refined sugars) showed that healthy dietary patterns can lower the mortality among CKD patients (RR=0.73, 95% CI: 0.63, 0.83) [13], improve the eGFR level of nondialysis CKD patients (MD=2.97, 95% CI: 2.59, 3.35) [14] and lower the risk of CKD among healthy people (OR=0.69, 95% CI: 0.57, 0.84) [15]. However, no effects were found in improving serum phosphorus or lowering the risk of ESRD. Notably, the Western-type dietary pattern, which is a type of diet with high calories and low fat, was found to be significantly associated with higher risks of CKD (OR=1.86, 95% CI: 1.21, 2.86) [15] and renal cell carcinoma (RCC, OR=1.42, 95% CI: 1.14, 1.69) [16]. The detailed data can be found in Table 2.

Effects of Food on Renal Conditions

As presented in Table 3, one study including 8 RCTs indicated that the intake of red meat might lead to a worse GFR level (RoM=0.94, 95% CI: 0.89, 1.00) and urinary albumin excretion (RoM=0.87, 95% CI: 0.77, 0.97) among diabetes patients [17]. It was also found that different kinds of meat or meat products (poultry, red meat, beef, hamburger, ham/salami/bacon/sausage) could increase the risk of RCC among healthy people. In particular, the effect was found to be the most obvious in beef (RR=1.89, 95% CI: 1.25, 2.86) [18]. However, the intake of fish was not associated with RCC (RR=0.99, 95% CI: 0.92, 1.07) [19]. Additionally, non-dairy animal protein, meat or meat products, and processed meat could lead to kidney stones while dairy protein might perverse from it.

Soy protein might significantly decrease the serum levels of creatinine (WMD=-6.23, 95% CI: -11.11, -1.35), phosphorus (SMD=-0.80, 95% CI: -1.14, -0.46), and triglyceride (WMD=-0.22, 95% CI: -0.40, -0.05) in CKD patients [20].

Vegetables (RR=0.73, 95% CI: 0.63, 0.85) and fruits (RR=0.86, 95% CI: 0.75, 0.98) could reduce the morbidity of RCC [21].

Dietary fiber could markedly decrease the concentration of creatinine, serum urea concentration, uric acid and urotoxin (indoxyl sulfate and p-cresyl sulfate) in CKD patients. Moreover, vegetable fiber and legume fiber would also reduce the risk of RCC [22-24].

Association between Different Beverages and Renal Functions

The two meta-analyses, consisting of 20 original observational studies with 4437621 people, studied the effects of coffee on the risks of CKD and RCC among healthy people as well as mortality and the mortality and the risk of ESRD among CKD patients. It was reported that compared with noncoffee drinkers, CKD patients who drank more than one cup of coffee every day had a lower mortality and a lower risk of ESRD (HR=0.82, 95% CI: 0.72, 0.94). CKD patients who drank more than 4 cups per day had the lowest mortality (RR=0.46, 95% CI: 0.30, 0.69) [25]. Among healthy people, the intake of coffee might also lead to lower risks of CKD (RR=0.86, 95% CI: 0.76, 0.97) and RCC (RR=0.88, 95% CI: 0.78, 0.99) [26].

According to a study including 13 observational studies and 45450 people, neither sugar-sweetened beverages (RR=1.30, 95% CI: 0.88, 1.94) nor artificially sweetened beverages (1.40, 95% CI: 0.65, 3.02) were found to increase the risk of CKD [27].

The intake of tea was not associated with the risk of CKD (RR=1.03, 95% CI: 0.89, 1.21) [28].

Betel nut, a popular snack and beverage in southern China, was found to increase the risk of CKD (RR=1.44, 95% CI: 1.08, 1.92), according to a study including 29125 people [29].

A total of 5 meta-analyses focusing on the effect of alcohol, including 147 original studies, were included in our review. It was found that both low (<12 g/day) (RR=0.90, 95% CI: 0.85, 0.95), moderate (12-24 g/day) (RR=0.82, 95% CI: 0.76, 0.89) and heavy (>24 g/day) (RR=0.83, 95% CI: 0.74, 0.92) alcohol intake might lower the risk of CKD, while severe alcohol intake showed no benefits (RR=1.07, 95% CI: 0.53, 2.15). Any alcohol intake could reduce the risk of RCC, with moderate intake showing the greatest effect (RR=0.79, 95% CI: 0.71, 0.88). A study focusing on alcohol categories by Song et al. explored the effects of beer (RR=0.81, 95% CI: 0.70, 0.91), wine (RR=0.75, 95% CI: 0.59, 0.91) and liquor (RR=0.76, 95% CI: 0.66, 0.87) on RCC. However, among CKD patients, the intake of alcohol showed no effects on the risks of ESRD or proteinuria improvement [30-34].

Effects of Nutritional Supplementation on Kidney Function Improvement

Omega-3 fatty acids and n-3 polyunsaturated fatty acids are the most common fatty acids found in our daily lives. Among patients with end-stage kidney diseases, the intake of n-3 polyunsaturated fatty acids (1.5-6 g/day) showed no improvement in plasma triglycerides, high density lipoprotein or low-density lipoprotein. Omega-3 fatty acids (1.5-6 g/day) were found to be effective in lowering both triglyceride (SMD=-0.35, 95% CI: -0.49, -0.20) and C-reactive protein (SMD=-0.56, 95% CI: -1.01, -0.11) among CKD patients undergoing dialysis [35]. However, omega-3 fatty acid showed no effects on serum albumin, serum total cholesterol, high-density lipoprotein, or low-density lipoprotein among CKD patients on dialysis [35,36].

Among CKD patients under hemodialysis, the intake of fish oil was associated with a decrease in triglyceride (MD=-0.23, 95% CI: -0.31, -0.14) and total cholesterol (MD=-0.12, 95% CI: -0.23, -0.01) and an increase in high-density lipoprotein (MD=0.20, 95% CI: 0.01, 0.40) but showed no effects on low-density lipoprotein [37].

Summary of Different Dietary Patterns on Different Renal Outcomes

Figure 2 summarizes the different dietary patterns on different renal outcomes. Coffee and healthy dietary patterns could reduce mortality in CKD patients. Coffee and low protein diet could delay CKD patients from entering end-stage renal disease. Dietary interventions and ketoanalogue supplementation in a low-protein diet would improve the renal function of CKD patients while red meat might disrupt kidney function in diabetes. Sodium restriction and low protein diet were beneficial for CKD patients because it reduced proteinuria levels. Moreover, for healthy individuals, alcohol, coffee, healthy dietary patterns, and Mediterranean diet could reduce the risk of CKD while betel nut and Western-type dietary pattern would increase it. Simultaneously, alcohol, coffee, legume fiber, vegetable fiber, fruits, and vegetables would preserve people from RCC, but meat and Western-type dietary pattern might increase the risk of developing RCC.

GRADE Classification and AMSTAR Score

As is shown in Table 1 to Table 5, the majority of the included studies were considered of moderate quality by GRADE. Additionally, 12 studies were classified as low quality and 2 as very low. The AMASTAR scores of them vary from 7 to 14.5. And 4 were classified as high quality, 5 as moderate quality, 15 as low quality, 12 as critically low quality, owing to the absence of key items. Detailed process of the AMASTAR quality assessment was shown in Supplementary Table 2.

Discussion

Kidney diseases have become a major public health concern worldwide, affecting millions of people. A growing body of research has investigated the role of diet in the development and management of kidney diseases. Overall, the current state of kidney diseases research suggests that dietary interventions may have some benefit in managing the condition, but there is significant debate over the optimal dietary approach for kidney disease patients. More research is needed to better understand the complex relationship between diet and kidney disease outcomes and to develop evidence-based guidelines for dietary management of kidney diseases, which was why this study was carried out.

Our study found that CKD patients might get benefit from a low-protein diet and a low-sodium diet, which was consistent with the prevailing academic view. Our study indicated that a low-protein diet might slow the progression of CKD patients by reducing proteinuria and serum phosphorus levels, while a salt-restricted diet may exert a renoprotective effect by lowering blood pressure and proteinuria. A low-protein diet can reduce the workload on the kidneys by limiting the amount of protein that needs to be processed. When protein is metabolized, it produces waste products such as urea, which must be filtered out by the kidneys. In people with CKD, the kidneys may not be able to filter out these waste products efficiently, leading to a buildup of toxins in the body. By reducing the amount of protein in the diet, the amount of waste products produced is also reduced, which can help to ease the burden on the kidneys [38]. Moreover, animal experiments have also confirmed that a low-sodium diet prevents the loss of glomerular permselectivity, suppresses macrophage-mediated immunity, and reduces the degree of renal fibrosis, stopping the progression of kidney disease [39]. A low-sodium diet is also commonly recommended for people with CKD, as it can help to manage high blood pressure, a common complication of CKD. Sodium can contribute to fluid retention, which can increase blood pressure and put additional strain on the kidneys. By reducing sodium intake, blood pressure can be better controlled, which can help to slow the progression of CKD. It has been reported that lower levels of serum sodium can reduce local inflammation and the occurrence of vascular proliferation in peritoneal, cardiac, and vascular tissues while high salt intake induces the production of intrarenal angiotensin II, increases proinflammatory cytokines and oxidative stress, and triggers sympathetic nerve activity [40,41]. Additionally, high salt intake causes excessive antidiuretic hormone production and vasoconstriction. This may trigger dysregulation of body fluid osmolality and blood pressure, leading to renal and cardiovascular damage. However, there is some controversy surrounding the use of low-protein diets and low-sodium diets. Some experts believe that severely restricting protein intake and reducing sodium intake too much can lead to malnutrition and/or electrolyte imbalances [42], which may even worsen kidney function in the long term. A more moderate approach and individualized dietary recommendations based on factors such as age, sex, and level of kidney function may be more effective where more in-depth research is needed.

Our study confirmed that healthy diet patterns that are rich in vegetables and fruits, legumes, whole grains, and fiber together with lower consumption of red meat, sodium, and refined sugars, have a positive effect on improving renal function and reducing mortality among patients with CKD. In addition, we also revealed that eating too much red meat would lead to a worse GFR level and urinary albumin excretion among diabetes patients while soy protein and dietary fiber could protect kidney function. Red meat has been shown to have a negative impact on CKD because protein and phosphorus in red meat are so high that they can be problematic for individuals with CKD. Moreover, it has been reported that red meat intake is associated with higher levels of inflammatory biomarkers, such as C-reactive protein and ferritin [43]. Red meat also triggers a high acid load, and an increased acid load in the diet can lead to metabolic acidosis, a well-recognized contributor to the progression of renal failure. A high load of acid in the diet of patients with kidney disease activates adaptive mechanisms to increase acid excretion, which promotes kidney injury. In contrast, soy protein and fiber have been shown to have a positive impact on CKD. Soy protein is a good alternative to animal protein because it is lower in phosphorus and may help to reduce the workload on the kidneys. It has also been shown to lower blood pressure and improve lipid profiles [44], which are both important factors in managing CKD. Fiber is important for maintaining bowel health and reducing the risk of cardiovascular disease. In individuals with CKD, high fiber intake has been associated with lower levels of inflammation and improved lipid profiles. Overall, reducing or eliminating red meat from the diet and a diet rich in soy protein and fiber may be beneficial for individuals with CKD.

Interestingly, our study also demonstrated that coffee intake can improve the renal function of CKD patients to a certain extent while alcohol consumption has no significant benefit for CKD. The increased excretion of urinary solutes can be induced by caffeine since it is a diuretic, which decreases uric acid, creatinine, and serum phosphorus, and reduces the risk of developing kidney stones. In addition, caffeine may increase intrarenal kinins, which in turn decrease vasopressin release and promote renal vasodilation, thereby increasing glomerular blood flow and improving GFR. These may also be the reason why coffee reduces the incidence of RCC and CKD. Although coffee consumption may have some beneficial effects on CKD, excessive coffee consumption may lead to increased blood pressure and dehydration [45], which can further damage the kidneys. Therefore, it is important for individuals with CKD to monitor their coffee intake. It should be noted that alcohol consumption did not correlate well with the severity and prognosis of CKD. But it has been acknowledged that drinking too much alcohol can increase blood pressure and damage the kidneys, leading to the development or worsening of CKD. In addition, alcohol can also interfere with the effectiveness of medications used to treat CKD, and may increase the risk of liver disease, which can further impact kidney function. Therefore, it is generally recommended that individuals with CKD limit or avoid alcohol consumption.

No significant effect of fatty acids was found on renal function or kidney diseases. Only the concentration of triglycerides and c-reactive protein was reduced by the intake of omega-3 fatty acids. This is consistent with the finding in a study that the intake of flaxseed improved systemic inflammation in hemodialysis patients [46]. We also found that fish oil could reduce total cholesterol and glycerolipids and increase high-density lipoprotein content in dialysis CKD patients, thus preventing atherosclerosis and thrombosis. Fish oil, which is rich in omega-3 fatty acids, has been shown to have anti-inflammatory effects and may improve lipid profiles in individuals with CKD [47]. It may also reduce the risk of cardiovascular disease, which is a common complication in people with CKD. However, fish oil supplementation may also increase the risk of bleeding and interact with certain medications. Overall, fish oil and omega-3 fatty acids may have potential benefits for individuals with CKD, but it is important to approach supplementation with caution.

More importantly, diet can also prevent kidney disease. For healthy individuals, alcohol, coffee, healthy dietary patterns, and Mediterranean diet could reduce the risk of CKD while betel nut and Western-type dietary pattern would increase it. Simultaneously, alcohol, coffee, legume fiber, vegetable fiber, fruits, and vegetables would preserve people from RCC, but meat and Western-type dietary pattern might increase the risk of developing RCC. The Mediterranean diet was first proposed as a vegetarian-dominated diet for environmental protection and sustainable development. However, this dietary pattern of low red meat and oil intake was gradually found to have numerous benefits, such as reducing the risk of various cancers, diabetes and cardiovascular diseases. From an acid-base point of view, meat consumption can lead to an increased acid load and thus increased demand on the renal system. Mediterranean diet by contrast, this plant-based dietary pattern requires less renal compensation to maintain homeostasis. At the same time, reducing meat while increasing egg milk vegetable intake was shown to significantly lower uric acid levels and reduce kidney burden. These physiological effects might explain the principle that these healthy dietary patterns improve kidney function. In contrast, Western-type dietary patterns with high calorie intake but low-fat intake, which indicate a high kidney burden and could lead to metabolic acidosis, increase the risks of both CKD and RCC. Contrary to what we thought, alcohol consumption can reduce the incidence of CKD and RCC. The biological mechanism of the protective effect of alcohol on the kidney is not fully understood, but some studies believe that the rise in High Density Lipoprotein (HDL) caused by alcohol intake plays a positive role in health because low HDL cholesterol increases the risk of CKD. In addition, alcohol intake can also fight against oxidase, reduce the risk of atherosclerosis, and reduce insulin sensitivity, thus improving the kidney condition. Conversely, betel nut chewing increased the risk of CKD among people without renal diseases. It has been experimentally confirmed that areca nut may trigger proteinuria. Studies have shown that chemical constituents in areca nut can inhibit vascular endothelial cell growth, which can lead to endothelial dysfunction. Areca nut also increases transforming growth factor β (TGF-β) and secretion of the profibrotic proteins fibronectin and plasminogen activator inhibitor-1 (PAI 1), thereby causing renal interstitial fibrosis in mammals [48,49]. Some studies believe that arecoline may slow renal blood flow and increase the activity of thrombin, thereby worsening renal function.

Conclusion

Different diets are closely related to the onset and progression of kidney disease. Coffee and healthy dietary patterns could reduce mortality in CKD patients. Coffee and low protein diet could delay CKD patients from entering end-stage renal disease. Dietary interventions and ketoanalogue supplementation in a low-protein diet would improve the renal function of CKD patients while red meat might disrupt kidney function in diabetes. Sodium restriction and low protein diet were beneficial for CKD patients because it reduced proteinuria levels. Moreover, for healthy individuals, alcohol, coffee, healthy dietary patterns, and Mediterranean diet could reduce the risk of CKD while betel nut and Western-type dietary pattern would increase it. Simultaneously, alcohol, coffee, legume fiber, vegetable fiber, fruits, and vegetables would preserve people from RCC, but meat and Western-type dietary pattern might increase the risk of developing RCC.

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