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The Importance of Microelements in the Development of Chronic Kidney Disease

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Annotation: Chronic kidney disease (CKD) is a common disease among the population. This is due to the frequency of risk factors for the development of CKD. Microelementosis is one of the most important risk factors for the development of nephropathy. This article examines the results of more than 30 scientific papers.

Key words: trace elements, chronic kidney disease.

Micronutrients are elements that our bodies need in small quantities, such as vitamins and minerals. Research has shown that adequate micronutrient intake can reduce the risk of CKD. In addition, reducing protein intake may reduce blood urea nitrogen production and thus delay the progression of CKD [1].

Chronic kidney disease (CKD) is a progressive kidney disease accompanied by structural and functional impairment. Pathological factors, including markers of renal failure (such as pathological xerographic changes, albuminuria and increased sodium in urine) or glomerular filtration rate (GFR) below 60 ml/min/1.73 m2, persisting for more than three months, are among the main characteristics of CKD [3,4]. The incidence and prevalence of CKD are rapidly increasing worldwide [3]. In the study, the overall prevalence of CKD was 11% among the Iranian population over the age of 20 years [4]. Cardiovascular disease, anemia, mineral and bone abnormalities, peripheral neuropathy, cognitive dysfunction, and increased infection are important complications of CKD [5]. Of the several risk factors for CKD, including diabetes, hypertension, obesity, sedentary lifestyle, alcohol consumption [1, 6], diet is a modifiable environmental risk factor that plays an important role in the incidence or development of CKD [5,7].

Because there is limited data on the association of micronutrient intake with the risk of CKD, the association between most dietary micronutrients and the risk of CKD remains unclear [3].

The purpose of this study was to examine current scientific literature and research findings on the importance of micronutrients in the development of CKD.

As kidney function declines, patients with CKD gradually develop end-stage kidney disease and must undergo dialysis or kidney transplantation to maintain their lives, placing a heavy economic burden on families and society. Therefore, it is necessary to effectively prevent and delay the progression of CKD. Essential microelements play an indispensable role in CKD [3,4,6].

Diets include a complex of diverse nutrients; people with regular diets are unlikely to consume only one nutrient. However, nutritional guidelines for patients with CKD mainly contain recommendations

focused on macronutrients (eg, energy and protein) and selected micronutrients [5, 7,14]. Other guidelines discuss the protective effects of specific dietary patterns in CKD.

In addition, most studies of the relationship between CKD and diet have analyzed only patients with CKD or those at high risk, such as hypertension, diabetes, and obesity.

Numerous studies have shown that dietary micronutrients are associated with the occurrence and progression of CKD [5, 7, 11]. A nationwide study in the United States found that higher intakes of vitamins and minerals were negatively associated with incident CKD.

For participants with CKD, dietary intake may be a critical and modifiable risk factor for disease progression. Unlike other studies, this study collected sample data from participants with different stages of CKD and proposed risk and protective factors for early and late stage CKD. This study found that higher intakes of vitamins, minerals, cholesterol, and PUFAs were negatively associated with participants with advanced CKD. Whether the results of this study can be used to effectively reduce the risk of disease progression among participants with CKD remains to be assessed in subsequent clinical trials[1,4,10].

CKD is a common disease among older people. Oxidative stress plays an important role in the progression of adverse complications in patients with CKD, and many microelements are involved in the oxidant-antioxidant balance. We examined serum copper, iron, zinc, and selenium levels in 145 patients at stages 1–4 of CKD. There were no significant differences in copper, iron, and selenium levels between the four stages of CKD. However, serum zinc levels showed a statistically significant decreasing trend in advanced stages of CKD. Zinc deficiency may increase oxidative stress and atherosclerotic complications, especially in patients with advanced CKD[7,8,13].

Oxidative stress may play an important role in the progression of complications in patients with CKD. Many microelements are involved in the oxidative-antioxidant balance. Selenium is an important element and cofactor in maintaining the activity of glutathione peroxidase, an important antioxidant enzyme that protects cells from destruction by hydrogen peroxide. Copper is an integral component of many metalloenzymes and is involved in many biological processes such as iron metabolism. Iron is one of the elements that the human body is rich in. It is an important component of a number of proteins and enzymes, such as hemoglobin, cyclooxygenase, cytochromes, ribonucleotide reductase, hydrogenase and catalase[1,5,9].

Zinc is a component of the important antioxidant enzyme superoxide dismutase. Lower concentrations of zinc may also inhibit the production of metallothionein and reduce competition with iron and copper for binding to the cell membrane, thereby increasing the production of hydroxyl radicals. Zinc deficiency increases oxidative stress, activates nuclear factor kappa B and increases the production of certain interleukins, which may contribute to atherosclerosis[5].

Knowledge of micronutrient imbalances in CKD is limited, but has recently received increased attention. Well-designed studies examining micronutrient status in this patient population are urgently needed. The current DIET-HD study raises hopes for a better understanding of the micronutrient needs of patients with CKD, as well as for the development of strategies to improve health outcomes using dietary interventions in advanced kidney disease [4, 9,12]. This is critical to ensure that micronutrient interventions are not only effective, but also targeted at those who need them most.

Essential micronutrient imbalances are a common complication of CKD and a risk factor for CKD progression, cardiovascular events, and death. This article examines the impact of essential micronutrients (iron, zinc, selenium, copper, iodine and manganese) on CKD. We review the literature and discuss the advantages and disadvantages of various essential micronutrients.

Research shows that patients with CKD have imbalances in essential micronutrients, and micronutrient-based treatments are an important area for future research. Knowledge of micronutrient homeostasis is important to improve the prognosis of patients with CKD and slow disease progression.

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