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Diet therapy along with nutrition education can improve renal function in people with stages 3–4 chronic kidney disease who do not have diabetes: a randomised controlled trial

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Abstract

The current trial investigates the effect of renal diet therapy and nutritional education on the estimated glomerular filtration rate (eGFR), blood pressure (BP) and depression among patients with chronic kidney disease (CKD). A total of 120 CKD patients (stages 3–4) (15<eGFR < 60) were randomised into an intensive nutrition intervention group (individualised renal diet therapy plus nutrition counselling: 0·75 g protein/kg/d and 30–35 kcal/kg/d with Na restriction) and a control group (routine and standard care) for 24 weeks. The primary outcome was the change in the eGFR. Secondary outcomes included changes in anthropometric measures, biochemistry (serum creatinine (Cr), uric acid, albumin, electrolytes, Ca, vitamin D, ferritin, blood urea nitrogen (BUN), and Hb), BP, nutritional status, depression and quality of life. The eGFR increased significantly in the intervention group compared with the control group ($P < 0·001$). Moreover, serum levels of Cr and the systolic and diastolic BP decreased significantly in the intervention group relative to the control group ($P < 0·001$, $P < 0·001$ and $P = 0·020$, respectively). The nutrition intervention also hindered the increase in the BUN level and the depression score ($P = 0·045$ and $P = 0·028$, respectively). Furthermore, the reduction in protein and Na intake was greater in the intervention group ($P = 0·003$ and $P < 0·001$, respectively). Nutritional treatment along with supportive education and counselling contributed to improvements in renal function, BP control and adherence to protein intake recommendations. A significant difference in the mean eGFR between the groups was also confirmed at the end of the study using ANCOVA (β = -5·06; 95 % CI (−8·203, −2·999)).

Keywords: **Renal function: Nitrogenous toxins: Protein-restricted diet: Education: Nutrition consult: Mental disorder**

Chronic kidney disease (CKD) is a condition in which kidneys are damaged, leading to loss of filtration capacity and the aggregation of excessive fluid and waste products in the blood[1]. The prevalence of CKD was less than 1 % of the population in 1990, but it increased up to 12 % in 2013, and it has now become a global health concern[2]. CKD is classified into stages 1–5 based on estimated glomerular filtration rate (eGFR)[3]. Over time, progressive CKD can end up with irreversible end-stage renal disease (ESRD)[4,5]. ESRD patients have many co-morbidities affecting their quality of life. The main nutrition-related goals in CKD are slowing down the disease progress and attenuating uremic toxicity. Maintaining good nutritional status also lowers the risk of secondary complications, including CVD, anorexia, cachexia, bone disease, hyperlipidemia[1], oedema, anaemia and hypertension[6]. Besides, there is an association between depression and reduced kidney function and increased mortality in these patients[7,8].

Medical nutrition therapy and medications are methods for controlling CKD. Medical nutrition therapy includes restriction in the intake of protein, Na, K, P and fluids[9].Several studies have shown that restriction of protein and Na has a major role in controlling uremia and hypertension[10–12]. Yet, altering the dietary pattern and lifestyle of CKD patients is a real challenge[13]. A systematic review aiming to find benefits of multifactorial

Abbreviations: BP, blood pressure; BUN, blood urea nitrogen; CKD, chronic kidney disease; Cr, creatinine; DBP, diastolic blood pressure; eGFR, estimated glomerular filtration rate; ESRD, end-stage renal disease; SBP, systolic blood pressure.

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provided by moderate intakes of fruits and vegetables in the intervention group[62–64]. Consequently, this intervention might have played a role in BP control[65].

Dietary protein and blood pressure. Reduced protein intake in the intervention group could lower BP through a decrease in the glomerular hydrostatic filtration pressure[10].

Depression

The current study findings revealed remarkably better results regarding the attenuation of depression in the treatment group compared with the control group. The increment in the depression score might have been prevented in the treatment group through a decrease in BUN and Cr levels, an increase in eGFR, higher intake of soluble fibre and better amino acid profile in the context of high biological value protein consumption. According to the review of the literature, this has been the first study assessing the effects of dietary intervention on depression among CKD patients. Depression in CKD patients might be attributed to uremic intoxication[66], which could, in turn, exacerbate kidney failure and affect the feeling of well-being[67]. It should be noted that increased contact with healthcare providers during the educational interventions may have a beneficial role in reducing depression in the patients of intervention group.

Nutrient intake

Based on the findings of the present study, modification in the treatment group's diet (lower protein, fat, Na and P intakes with adequate energy and higher carbohydrate and soluble fibre intakes) led to better outcomes amongst the CKD patients.

Protein source. Balancing the animal and plant sources of protein intake is of paramount importance in CKD. Despite the proper high biological value protein intake, reasonable servings of fruits and vegetables were considered in the daily diet of the intervention group without adversely affecting serum phosphorus and potassium levels[68].

Phosphorus. The significant reduction in phosphorus intake in the patients who adhered to the diet might probably be the result of the limited protein, legumes and nuts intake as well as the implementation of effective educational strategies related to dietary phosphorus sources. The patients in the intervention group were instructed to replace meat with egg white, which has the lowest phosphate:protein ratio. They were also asked to limit the foods with a high phosphate:protein ratio (such as cheese and egg yolk) and to avoid rich sources of phosphorus like legumes, nuts and inorganic phosphate additives[69].

Dietary fibre. Comparison of the two groups indicated that the intake of soluble fibre was significantly increased in the patients who had adhered to their diet. This finding could be reflective of adequate consumption of low biologic value protein while maintaining a good balance of serum potassium and phosphorus. Maximum tolerable fruit and vegetable intake (4/4 mean servings) together with moderate protein restriction (Table 3) was also suggested in this regimen, which were desirable according to the study results.

Nutrition education and consultation

According to the findings of this research, better clinical improvement in renal function would be achieved if modified renal diets were supported by adequate nutrition education and consultation. An adequate diet tailored personally would be more desirable if accompanied by sufficient education about why and how to achieve that. In fact, psychological factors (knowledge, attitude and satisfaction) have been expressed as the most important determinants of adherence to treatment. In the current research, the participants were educated about a clear and distinct vision in renal diet with a distinguished definition of suitable food items through booklets (self-education) and educational classes and were periodically followed via phone contact during the study[70].

The current study had some limitations, the first of which being single measurements of serum Cr, BUN and skeletal muscle mass (SMM) during the study period (just before and after the study and not repeating the measurements for monitoring the trend). In addition, the urinary protein and urea were not measured. Considering the effect of increased contact with healthcare providers at intervention visits, which may play a supportive mental role in chronic diseases, it seems that lack of attention control group is another limitation. As the participants of this study were CKD patients without co-morbidities (diabetes, heart failure, etc.), results may not be generalised to people with CKD with complex chronic disease. Future studies are needed to evaluate the effects of renal diet therapy on inflammation and oxidative stress markers, muscle atrophy indices, and blood gas parameters for metabolic acidosis conditions. Assessing hard end points, such as progression to ESRD co-morbidities and survival, in combination with surrogate conventional biomarkers, is also suggested in long-term clinical trials.

Conclusions

According to our findings, nutritional treatment along with supportive education and counselling contributed to improvements in renal function and BP control.

In CKD, diet therapy can prevent disease progression and delay the initiation of renal replacement therapy through the modulation of the eGFR. Thus, commencing a nutritional treatment along with supportive education and consultation for better acceptance and adherence to the diet is recommended from the early stages of CKD. These comprehensive interventions can also impede the worsening of mental conditions associated with CKD-related depression.

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The authors declare that there are no conflicts of interest.

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