Empirical Effects of Nutritional Awareness and Calciferol Supplementation in Renal Patients

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RECAP

Vitamin D (calciferol) insufficiency has been linked to the progress of renal disease. Some variables, such as dietary status and sunshine exposure, contribute to vitamin D deficiency. The target of the research was to set the nutritional and vitamin D status of chronic kidney disease CKD patients before and after three months of dietary awareness, sun exposure, and calciferol supplementation. From January 2019 to July 2020, 60 males (45-55 years old) were randomly recruited from the National Institute of Urology and Nephrology's outpatient clinic in Cairo, Egypt. Stages 3–5 of CKD are used to categorize patients. All of the participants were divided into two groups: control and CKD. For all individuals, the assessment covered nutritional consumption, including the 24-hours recall questionnaire, anthropometric measurements, and will specific biochemical assays. According to the findings, CKD patients consumed more calories and were obese, as measured by their body mass index (BMI). The average daily protein consumption was higher than the recommended daily intake (RDI). Except for sodium being the highest, the average mineral consumption was within RDI, whereas vitamin D intake was less than 10% of RDI. CKD group's energy levels dropped from 95.4 % to 82.8 % of RDI, protein vitamin C, and fiber intake increased after three months of treatments. While sodium levels remained within the RDI, biochemical examination revealed significant improvements in vitamin D, PTH, creatinine, and urea levels. Eventually, both nutritional intervention and vitamin D supplementation improved CKD stages from stage 3 or 5 to stage 2.

Keywords: *CKD - Vitamin D deficiency – Nutritional awareness*

FOREWORD

Maurya et al., (2020), Calciferol is a lipo-soluble sec sterol, which comes in two forms: vitamin D2 (ergocalciferol) and vitamin D3 (cholecalciferol). Ergocalciferol is found in foods, but vitamin D3 is formed in the dermis by ultraviolet "UV" irradiation of 7- dihydroxy-cholecalciferol (approximately 80%) the remainder diet and supplementation **(Holick, 2007).**Without daily sunlight exposure or fortified foodstuffs, vitamin D deficiency is a risk **(Nguyen et al., 2017).**

Low vitamin D levels are in people with CKD, despite the severity of their illness. As renal function diminishes, so does the ability to synthesize active vitamin D and excrete phosphorus **(Bikle, 2014; Franca et al., 2018).** The glomerulus filters 25(OH) D, which is then actively reabsorbed into renal tubular cells via vitamin D binding protein (DBP) and albumin; in most tissues, the free (i.e., unbound) metabolite enters the cell. Through a megalin/cubilin mechanism, DBP bound metabolites can reach some cells, such as the kidney and parathyroid gland, and subsequently be transformed to 1, 25-(OH) 2D (1, 25-dihydroxy vitamin D, also known as 1, 25-dihydroxy-cholecalciferol or calcitriol) by the renal enzyme 1-hydroxylase (CYP27B1). In the kidney, parathyroid hormone (PTH) activates CYP27B1 activity, which is inhibited by fibroblast growth 23 (FGF23) and 1, 25(OH) 2D. Hypophosphatemia can also reduce CYP27B1 activity at the renal level, both directly and indirectly FGF23 **(Franca et al., 2018; Holick 2007)**.

CKD is a global problem, affecting roughly 10% of adults worldwide **(Kalantar-Zadeh et al., 2021).** The disease is a chronic, progressive disorder that can lead to significant organ damage, necessitating dialysis or an organ transplant to save life **(Sullivan et al., 2017).**

Objective:

Nutritional determinants are definitive for predicting risk and reasonable intervention; disease prevention is an important plan of action to dominate the burden of CKD. The relationship

between vitamin intake and CKD risk in individuals has remained a mystery. As a result, the goal of this study was to assess nutrition, vitamin D status, and their relationship with CKD before and after nutrition education about appropriate dietary sources of vitamin D, the optimal time to expose to sunlight, and vitamin D supplemental intake on CKD.

PARTICIPANTS

From January 2019 to July 2020, 60 male volunteers (45-55 years old) attended, who the selected from the outpatient clinic of the Nephrology Department of the National Institute of Urology and Nephrology in Cairo, Egypt. The cases were divided into two categories: Friends of patients (n=30 males) served as the control or normal group, which was matched in age and sex to the CKD. Patients with CKD were divided into two groups: those who were in stage 4 or 5 and had no diabetes, muscular diseases, pancreatitis, or malignant tumors, and those who were smokers or alcoholics. The identical group "CKD" group 2 acquired nutrition awareness for three months, the best time for exposure to sunlight and vitamin D_3 supplementation intake [(5000 IU three days/week according to **Manson et al., 2019**)] that become group 3.

METHODS

Dietary assessment:

Two quantitative non-consecutive 24-hour dietary recalls were used to assess the study subjects (one for a weekday and the other for a weekend). The National Nutrition Institute's food composition tables were used to calculate the energy and macro/micronutrients content of the 24-hour meal intake **(NNI, 2006)**. Based on the findings of the joint food and drug administration (FDA) expert opinion on human vitamins and minerals requirements, the vitamins and minerals content of food and beverages consumed were compared to the recommended nutrient intake **(FDA, 2020)**. Intake levels of 75-100 percent of the RDIs are regarded as adequate, whereas intake levels of less than 75 percent of the RDIs are deemed insufficient.

Anthropometric measures

According to the World Health Organization, anthropometrics is a measurement system **(WHO, 1995**). The patient's weight, length, or height, as well as the calculated BMI, are all measured (BMI). The BMI is a straightforward calculation based on a person's height and weight. BMI = kg/ m2, where kg denotes a person's weight in kilograms and m2 indicates their height in meters squared. Overweight is defined as a BMI of 25.0 to 29.9; obesity is defined as a BMI of 30 or more. While the normal range is 18.5 to 24.9 as the healthy range **(WHO, 1995).**

Laboratory investigations:

Collection of Specimens:

- Blood samples.

It was taken from individuals who were fasting between (9 and 11 after midnight "a.m"). 5 milliliters' of blood were collected in a serum vacationer tube and allowed to coagulate for 10 minutes before being centrifuged at 3000 rpm for 5 minutes at room temperature to separate the serum. Serum was utilized to determine the results of routine laboratory tests. For clinical chemistry tests, serum creatinine was determined according to **Soldin et al., (2007)** and urea's were estimated as stated by **Thomas et al., (1998)** using the Auto analyzer (BT1500) at the National Institute of Urology and Nephrology. According to, the Glomeruli filtration rate (GFR) is computed online using the equation as claimed by **Horio et al., (2010)**. According to **Holic et al., (2011),** vitamin D levels were estimated; PTH **(Leung et al., 2019)**; by Elisa instrument (stat fax). Sodium Na, potassium K, and magnesium Mg evaluated according to **Hamed et al., (2004) by** electrolyte Measuring Device (ST- 200).

Statistical data analysis:

Statistical Package for the Social Sciences was used to examine the data (SPSS, version 16). The data was evaluated using a one-way analysis of variance (ANOVA) followed by a post hoc test, and the results were represented as mean SE or SD. When P 0.05, the difference was considered statistically significant **(Chan, 2003).**

Ethical considerations:

Before enrolling a patient in the trial, the ethical committee of the National Nutrition Institute required that they give their informed consent. They are informed about the study's steps, the goal, the potential advantages, and the risks.

RESULTS & DISCUSSION

Figure (1, a, b, and c) indicated that the mean values of weight and BMI differed significantly among the three categories, although height differences were non-significant. The BMI of patients with CKD (G2) was the highest (32.3 kg/m2), weight and BMI of patients with CKD improved, still overweight, following intervention awareness and supplementation (G3). Obesity (BMI > 30–35) has been associated to a higher risk of complications in nephrotic transplant recipients, including graft delay, high levels of resistance, and graft loss. A significant increase in BMI of the group (2), indicating that dialysis is helpful for survival in severe stages of CKD (so-called "obesity paradox"). Sarcopenia obesity is defined as a loss of muscle mass that results in an increase in fat, and it has now been related to poor renal replacement treatment outcomes **(Kovesdy et al., 2017)**.

Data in table (1) remarked on all groups' intake of macronutrients within the limits of the RDI except for protein intake was 140,153 and 132 % respectively more than the recommended. Group (2) before the intervention period consumed more calories, but after that group (3) became improvements. The same table illustrated that there were significant differences in calories, proteins, and carbohydrates among the three groups.

Diets high in calories (due to increased fat or carbohydrates) are generally hazardous to the kidneys **(Rios, et al 2018).** Excess calories are stored as fat in the body **(HMS, 2019).** Obesity is caused by fat cell aggregation and increased fat cell adipose in tissues, both of which are dangerous for health **(Braun and Joseph 2017).** A high caloric intake that is often associated with frequent eating of fast food that is relatively high in inorganic P as an additive that is more quickly absorbed than the organic P naturally found in foodstuffs

(Sarathy et al., 2008). Because it is difficult to adjust caloric intake in a renal patient, the suggestion is based on the stage of nephrosis. The reduction in glomerular filtration rate (GFR) is typically used to define CKD into five phases **(KDIGO, 2017).** A caloric insufficiency occurs when the amount of calories eaten decreases below the calories required maintaining weight. A loss is frequently achieved by lowering input/calories taken while increasing output through increased physical activity (**Redman. et al 2009)**.

A high protein diet, defined as more than 1.2 gram of dietary protein per kilogram weight per day, is usually regarded to cause major changes in renal function and other organs **(Kalantar et al 2016)**. Higher protein intake, in contrast to fat and carbohydrate eaten, affects renal hemodynamics by increasing renal blood flow and increasing intraglomerular pressure, resulting in a higher glomerular filtration rate (GFR) and more effective excretion of protein-derived nitrogenous waste products, and an enhance in kidney volume and weight (**Fouque., et al 2007).** The so-called "glomerular hyper-filtration" produced by a high-protein diet has been widely documented in animal models as well as several human clinical research (**Liz, et al 2010; Tirosh, et al 2013).** Experimental investigations have shown that glomerular injury caused by an increase in intraglomerular pressure and flow can lead to glomerular sclerosis and progressive glomerular damage **(Fouque, et al 2007; Bellizzi, et al 2013).** As a result, while GFR may rise in the short term, kidney damage and trouble with renal function may come to long-term exposure to increased dietary protein intake **(Knight et al., 2003).** The impact of protein consumption on the risk of end-stage nephropathy may depend on the type of protein sources, according to **Lew et al., (2016).** Other protein sources, such as poultry, fish, eggs, and dairy products, were not shown to be strongly related with a daily dosage increase in the risk of ESRD. The stomach acid load induced by sulfur-containing acids and products from meat and dairy may harm renal function. Another

community-based cohort study found a link between excessive protein consumption and cardiovascular disease, but not with renal function decline **(HalbeSma et al., 2009).**

Fiber consumption is poor in CKD (group 2) patients because of dietary limits on its resources. In CKD patients, a high fiber diet has been reported to reduce uremic toxins and, as a result, improve the gut flora. **(Camerotto et al., 2019),** promotes the growth of benefit bacteria **(Wang et al., 2019).** Diet is one of the numerous obstacles, which comes with living with chronic nephritis (CKD). While following the opposite diet recommendations for CKD, people with CKD may discovery challenging to take adequate fiber-rich foods. Individuals with CKD should limit diets heavy in phosphorus and potassium as their renal function diminishes. A higher-fiber diet is recommended for people with CKD. It is possible to eat an adequate amount of fiber while adhering to the dietary restrictions imposed by CKD in its later stages. Consuming the proper quantity of fiber may have a number of advantages for persons with CKD. A higher fiber intake has been linked to a better possibility of survival **(Joshi et al., 2021).** Sufficient fiber, particularly insoluble fiber, may help promote laxation and reduce constipation in people with CKD. **(Salmean et al., 2013).**

Statistical **data in table 2** indicated that a highly significant deference was observed in the mean iron and zinc intake between groups (G2&G3). In relation to percentage, RDI iron intake represented acceptably were 85% and 87% compared to the control group 62.2%. Regarding zinc intake, showed that there was an increasing intake from 83.6 to 100.9% RDI versus the control group of 77.2%. Mean calcium in this study was recorded within 50% of RDI while magnesium and potassium were lower than 50%. Unfortunately, the mean sodium intake in group 2 or control cases was the highest minerals assimilation while G3 had a decrease. To avoid anemia, CKD patients should consume enough amounts of iron (**Zhu et al., 2020).** There have been fewer prospective cohort studies in the public, which

looked at the link between dietary consumption and the risk of Hemodialysis. Only a previous Chinese cross-sectional study that found Fe levels to be positively linked to the risk of CKD supports the current report's Fe findings **(Nurko et al., 2006).** The presence of ferrous in the urine has been linked to the onset and progression of renal illness, while too much Fe can cause inflammation and organ damage **(Martines et al., 2013; Nakanishi et al., 2016).** Deficiency is caused by insufficient iron absorption or excessive loss. In the intestines, absorption is strictly regulated, based on the individual's iron level, the kind of iron, and other nutritional parameters. Iron is well preserved once it has been ingested **(Beard, 2001).** Patients with CKD, particularly those on dialysis, exhibit considerable alterations in Fe balance and tissue division **because** of lower Fe intake, higher metal losses, with poorer mobilizing of Fe from reserves **(Wish et al., 2018).** If left untreated, iron homeostatic failure is a key contributor to anemia in people with CKD. Zinc is a crucial nutrient that regulates the expression of various genes microglial and antioxidant resistance, as well as antiviral and antibacterial immunity **(Kristensen et al., 2019)**. Mean zinc is a key vital mineral with catalytic, metabolic, and categorised. Zinc is involved in a number of enzyme-dependent processes, including deoxy-ribonucleic acid **(**DNA**)** replication, cell proliferation, energy consumption, and growth **(Macdonald 2000; Haase and Rink 2014).** Zinc is also necessary for the structure and stability of proteins **(Laitaoja et al., 2013)**. **It is** also required to keep the shape and composition of cell membranes **(Maret, 2017).** According to new studies, zinc is also involved in the control of antioxidant activity, leptin, and insulin **s**ignaling **(Yang et al., 2013; Wijesekara et al., 2009).** As a result, zinc deficiency has been linked to a variety of ailments **(Freitas et al., 2017; Singh et al., 1998).** Low serum zinc levels have been linked to higher mortality in people with cardiovascular disease (CVD) **(Shi et al., 2018; Capdor et al., 2013)**. Zinc supplementation in the diet has been shown to

benefit those suffering from chronic metabolic disorders **(Palmer and Clegg, 2016).** Zinc consumption is correlated to decreased blood pressure and better glucose control in Chinese diabetic and CVD patients **(Wang et al., 2018).** Zinc deficiency has attracted the interest of the nephrology community in recent years, as various studies have suggested that it can cause erythropoietin-resistant anemia and raise the risk of renal dysfunction in insulin resistance, IgA nephropathy, and exploratory acute renal failure **(Teslariu et al., 2016; Altimimi et al., 2014).** Reduced serum zinc levels have also been associated to oxidative stress and a high load of atherosclerosis, two factors that have a role in the progression and severity of renal illness **(Choi et al., 2018).** Increased dietary K+, on the other hand, provides a therapeutic challenge in people with late-stage CKD who are at risk for hyperactive kalemia **(Palmer and Clegg 2016; Kovesdy et al., 2017)**. Dietary K+ restriction (3 g/d) is recommended for people at risk of hyperkalemia, but it should be done individually because it can prevent patients from reaping the benefits of a heart-he**althy diet (Rastogi et al., 2016; Cupisti et al., 2018 and Kinsella and colleagues, 2010).** According to the study done by **Hoorn et al., (2011),** hyponatremia is linked to lower joint mineral density and a higher risk of fracture.

The results in table 3 showed that there were significant differences in vitamin D and vitamin C levels within all groups. The vitamin C intake of group 3 was 100.1 percent of the RDI, whereas the control subject's intake was just 32.1 percent. In all cases, the mean vitamin D level was less than 10% of the RDI. Previous studies on vitamin C intake and renal disease had provided conflicting results (**Ferraro et al., 2016; Farhadnejad et al., 2016).** In comparison to the recommended range (90 mg/daily), the highest vitamin C intake was implicated in the development of CKD stage three or above. Another cohort study that connected higher vitamin C intakes than the recommended level (90 mg) to a greater likelihood of kidney stones indirectly matched the current

findings **(Ferraro, et al 2016)**. Despite the inconsistency of epidemiological evidence, the association between increasing vitamin C intake and a reduction of the estimated glomerular filtration rate appears biologically reasonable. Because metabolic by-products of vitamin C might accumulate and impede renal function, CKD patients should consume no more than 100 mg of vitamin C per day **(Lamarche et al., 2011).** In the growing plate, vitamin D occurs in a functional intercellular feedback loop between 1, 25(OH) 2D and parathyroid-related protein (PTHrP), with vitamin D intakes in all research groups being lower than the % RDI. PTHrP increases vitamin D receptor synthesis in chondrocytes, promoting chondrocyte sensitivity to 1, 25(OH) 2D, whereas 1, 25(OH) 2D reduces PTHrP production. **(Bach et al., 2014).**

Table (4) revealed that the mean magnesium and potassium levels within cases were on the base scale. There is no statistical significance between any of the magnesium levels in the sample. With a percent change of 21.3 percent, G2 had a greater potassium level than the control set. While sodium was at a lower level than the standard limits and the control category, with a -8.9% change. Hyponatremia is widespread in CKD patients (**Hecking et al., 2012),** and bone formation concerns are common in this group, particularly in dialysis patients **(k/DOQI., 2003).** Osteoporosis is characterized by the loss of bone strength and mineral density, and persistent moderate hyponatremia has recently been identified as a risk factor.

The statistical **result in table (5)** showed that the mean vitamin D level, PTH, creatinine, urea, and GFR of the group (2) were significant differences compared to the control group, with percent changes of -70%, 61%, 400%, 307%, -70.6% respectively. While results for the group of kidney patients after intervention with nutritional awareness and taking vitamin D therapy for 3 months, calciferol, PTH, creatinine, urea, and GFR levels were significant differences compared to the same group of kidney patients before intrusion

with a percent change of 247, -34, -45,-39-54%. GFR of the group (3) was improved from stage 4 to stage 2. It is the first study to look at renal disease information in stages 3 to 5 CKD patients. Other studies using awareness, such as the 62.14 percent provided by **(Wembenyui 2017);** 62% **(Nguyen 2018);** 64.8 %, and 66.0% **(Wright et al., 2011),** support these current findings. To provide a baseline from which to improve their knowledge and ensure improved self-care habits, researchers must investigate disease awareness among CKD patients who do not require dialysis **(Schrauben et al., 2020).** This situation is amplified by CKD patients' poor response to higher cholecalciferol medication and less sufficient renal hydroxylation of calciferol (Cianciolo and colleagues, 2021). A higher baseline GFR, such as renal hyperactive filtration, has been correlated to a rapid GFR reduction in various studies **(Lin 2021)**. Because of insufficient renal excretion, urea accumulates in the blood of patients with renal failure, diffuses into the intestinal lumen, and is connected to an increase in the public of urease-positive bacteria **(Vaziri et al., 2014).**

CONCLUSION

This is a research project aimed at learning more about CKD information among patients in stages 3–5. Their relationship to vitamin D level in these patients and the sources of vitamin D (good nutrition/supplementation and sun exposure). According to the findings of this study, nutritional education had a slight effect, as demonstrated by a lack of micronutrient consumption due to the economic condition. As regular exposure to the sun or taking nutritional supplements is a good effect, as seen by the findings of the participants' chemical analyses, CKD was improved from stage 5 to stage two in the study. As a result, its conclusions have generalizable practical implications. These findings may help nurses fill knowledge gaps among CKD patients, perhaps increasing the overall quality of life and self-management behavior.

REFERENCES:

Al-Timimi DJ; Sulieman DM and Hussen KR (2014):

Zinc status in type 2 diabetic patients: relation to the progression of diabetic nephropathy. *J Clin Diagn Res; 8*: CC04–CC08.

Bach FC; Rutten K ; Hendriks K ; Riemers FM ; Cornelissen ; de Bruin A; Arkesteijn GJ; Wubbolts R; Horton WA and Penning LC (2014):

The Paracrine Feedback Loop between Vitamin D_3 (1, 25(OH) $_{2D3}$) and PTHrP in Prehypertrophic Chondrocytes 229(12).

Beard JL (2001):

Iron Biology in Immune Function, Muscle Metabolism and Neuronal Functioning. *Journal of Nutrition*, 131, 568-579.

Bellizzi V (2013):

Low-protein diet or nutritional therapy in chronic kidney disease? Blood Purif.; 36:41–46. *[PubMed: 23735624]*

Bikle DD (2014):

Vitamin D metabolism, mechanism of action, and clinical applications. *Chem. Biol*. 21, 319–329.

Braun and Joseph M (2017):

"Early-life exposure to EDCs: role in childhood obesity and neuro-development." *Nature Reviews Endo-crinology* 13.3: 161-173.

Camerotto C; Cupisti A; D'Alessandro C; Muzio F and Gallieni M (2019):

Dietary fiber and gut microbiota in renal diets. *Nutrients*, 11(9), 2149.

Capdor J; Foster M; Petocz P and Samman S (2013):

Zinc and glycemic control: a meta-analysis of randomized placebo controlled supplementation trials in humans. *J Trace Elem Med Biol*; 27(2):137e42.

Chan YH (2003):

Biostatistics 102: quantitative data–parametric and non-

parametric tests. Blood Press, 140(24.08), 79.

Choi S; Liu X and Pan Z(2018): Zinc deficiency and cellular oxidative stress: prognostic implications in cardiovascular diseases. Acta Pharmacol Sin 2018; 39: 1120–1132

Cupisti A; Kovesdy CP; D'Alessandro C and Kalantar-Zadeh K (2018) Dietary approach to recurrent or chronic hyperkaliemia in patients with decreased kidney function. *Nutrients*; 10(3):261.

Farhadnejad H.; Asghari G; Mirmiran P; Yuzbashian E and Azizi F (2016): Micronutrient Intakes and Incidence of Chronic Kidney Disease in Adults: Tehran Lipid and Glucose Study. *Nutrients*, 8, 217.

Ferraro PM; Curhan GC; Gambaro G and Taylor EN (2016): Total Dietary and Supplemental Vitamin C Intake and Risk of Incident Kidney Stones. *Am. J. Kidney Dis*. 2016, 67, 400–407.

Food and drug Administration FDA (2020): Daily value on the new nutrition and supplement facts labels

Franca Gois PH; Wolley M; Ranganathan D and Seguro AC (2018): Vitamin D Deficiency in Chronic Kidney Disease: Recent Evidence and Controversies. Int. *J. Environ. Res. Public Health*, 15, 1773.

Freitas EP; Cunha AT; Aquino SL; Pedrosa LF; Lima SC and Lima JG (2017): Zinc status biomarkers and cardio metabolic risk factors in metabolic syndrome: a case control study. *Nutrients*; 9(2).

Fouque D and Aparicio M (2007):

Eleven reasons to control the protein intake of patients with chronic kidney disease. *Nat Clin Pract Nephrol;* 3:383–392.

Haase H and Rink L (2014):
Multiple impacts of zinc on immune function. *Metallomics;* 6 (7): 1175 e80.

Halbesma N; Bakker SJ and Jansen DF (2009):
High protein intake associates with cardio-vascular events but not with loss of renal function. *J Am Soc Nephrol*.; 20:1797–1804.

Hamed, S. A., Abdellah, M. M., & El-Melegy, N. (2004):
Blood levels of trace elements, electrolytes, and oxidative stress/antioxidant systems in epileptic patients. *Journal of pharmacological sciences*, 96(4), 465-473.

Harvard Medical School (HMS) (2019):
Harvard Health, trusted advice for a healthier life. Harvard Health publisher.

Hecking M; Karaboyas A and Saran R (2012):
Pre-dialysis serum sodium level, dialysate sodium, and mortality in maintenance hemodialysis patients: The Dialysis Outcomes and Practice Patterns Study (DOPPS) . *Am J Kidney Dis*; 59: 238– 248.

Holick MF (2007):
Vitamin D deficiency. N. Engl. *J. Med*, 357, 266–281.

Holick MF (2011):
Evaluation, treatment, and prevention of vitamin D deficiency: an endocrine society clinical practice guideline. *J. Clin Endocrinal Metabol*; 96:1911-1930

Hoorn EJ; Rivadeneira F and van Meurs JB (2011):
Mild hyponatremia as a risk factor for fractures: The Rotterdam Study. *J Bone*

Miner Res. ; 26: 1822– 1828.

Horio ME; Yasuda IY; Watanabe T and Matsuo S (2010):
Modification of the CKD epidemiology collaboration (CKDEPI) equation for Japanese: accuracy and use for population estimates, *American Journal of Kidney Diseases*, vol. 56, no. 1, pp. 32–38.

Joshi, Shivam, Michelle McMacken, and Kamyar Kalantar-Zadeh (2021):
Plant-based diets for kidney disease: a guide for clinicians." *American Journal of Kidney Diseases* 77.2 : 287-296.

Kalantar-Zadeh K; Jafar TH; Nitsch D; Neuen BL and Perkovic V (2021):
Chronic Kidney Disease. *Lancet*, 398,786–802.

Kalantar-Zadeh K; Moore LW and Tortorici AR (2016):
North American experience with Low protein diet for Non-dialysis-dependent chronic kidney disease. *BMC Nephron*.; 17:90.

Kidney Disease: Improving Global Outcomes (KDIGO) CKD-MBD Update Work Group. KDIGO (2017):
Clinical Practice Guideline Update for the Diagnosis, Evaluation, Prevention, and Treatment of Chronic Kidney Disease-Mineral and Bone Disorder (CKD-MBD). *Kidney Int. Suppl*., 7, 1–59.

Kinsella S, Moran S, Sullivan MO, Molloy MGM, Eustace JA (2010):
Hyponatremia independent of osteoporosis is associated with fracture occurrence. *Clin J Am Soc Nephrol.* ; 5: 275– 280.

Knight EL; Stampfer MJ and Hankinson SE (2003):
The impact of protein intake on renal function decline in women with

normal renal function or mild renal insufficiency. *Ann Intern Med*.; 138:460–467.

Kovesdy CP; Furth SL and Zoccali C (2017):

For the World Kidney Day Steering Committee Obesity and kidney disease: hidden consequences of the epidemic. Kidney Int.; 91:260–262

Kristensen JH; Basit S and Wohlfahrt J (2019):

Pre-eclampsia and risk of later kidney disease: nationwide cohort study. *BMJ*; 365: l1516

Laitaoja M; Valjakka J, and Janis J (2013):

Zinc coordination spheres in protein structures. *Inorg Chem*; 52(19):10983e91.

Lamarche J; Nair R; Peguero A and Courville C (2011):

Vitamin C-Induced Oxalate Nephropathy. Int. *J. Nephrol*., 146927.

Leung EK; Lee CC; Angelos P; Kaplan EL; Grogan RH; Sarracino DA and Yeo KTJ (2019):

Analytical differences in intraoperative parathyroid hormone assays. The Journal of Applied Laboratory Medicine, 3(5), 788-798.

Lew QLJ; Jafar TH; Koh HWL; Jin A; Chow KY; Yuan JM and Koh WP (2017):

Red meat intake and risk of ESRD. Journal of the American Society of Nephrology, 28(1), 304-312.

Lin YC; Lai TS; Lin SL; Chen YM; Chu TS and Tu YK (2021):

The impact of baseline glomerular filtration rate on subsequent changes of glomerular filtration rate in patients with chronic kidney disease. Scientific reports, 11(1), 1-9.

Li Z; Treyzon L and Chen S (2010):

Protein-enriched meal replacements do not

adversely affect liver, kidney or bone density: an outpatient randomized controlled trial. *Nutr J*.; 9:72. [PubMed: 21194471

MacDonald RS (2000):
The role of zinc in growth and cell proliferation. *J Nutr*; 130(5S Suppl.): 1500se8s.

Manson JE, Cook NR, Lee IM, Christen W, Bassuk SS, Mora S, Gibson H, Gordon D, Copeland T, D'Agostino D, Friedenberg G, Ridge C, Bubes V, Giovannucci EL, Willett WC, Buring JE; VITAL Research Group (2019):
Vitamin D Supplements and Prevention of Cancer and Cardiovascular Disease. *N Engl J Med*. Jan 3;380(1):33-44.

Maret W (2017):
Zinc in cellular regulation: the nature and significance of "zinc signals". *Int J Mol Sci*; 18(11).

Martines AMF; Masereeuw R; Tjalsma H; Hoenderop JG; Wetzels JFM and Swinkels DW (2013):
Iron metabolism in the pathogenesis of iron-induced kidney injury. *Nat. Rev. Nephrol.* ;9:385–398

Maurya VK; Bashir K and Aggarwal M (2020):
Vitamin D micro-encapsulation and fortification: Trends and technologies. *J. Steroid. Biochem. Mol. Biol.*, 196, 105489.

Nakanishi T; Kuragano T; Nanami M and Hasuike Y (2016):
Iron Localization and Infectious Disease in Chronic Kidney Disease Patients. *Am. J. Nephrol.* ; 43:237–244.

National Kidney Foundation. K/DOQI (2003):
Clinical practice guidelines for bone metabolism and disease in chronic kidney disease. *Am J Kidney Dis.* ; 42(4 suppl. 3): S1 – S201.

National Nutrition Institute NNI (2006):

Food Composition Tables, Cairo, A.R.E., 2006.

Nguyen-Yamamoto L; Karaplis AC; St-Arnaud R and Goltzman D (2017):

Fibroblast Growth Factor 23 Regulation by Systemic and Local Osteoblast-Synthesized 1, 25-Dihydroxyvitamin D. *J. Am. Soc. Nephrol*., 28, 586–597.

Nguyen TN (2018):

Self-management program for people with chronic kidney disease in Vietnam: A pragmatic randomized controlled trial. PhD Thesis, Queensland University of Technology, Brisbane, QLD.

Nurko S and Weigelt JA (2006):

Anemia in chronic kidney disease: Causes, diagnosis, treatment. *Clevel. Clin. J. Med.; 73:289*–297.

Palmer BF and Clegg DJ (2016):

Achieving the benefits of a high potassium, Paleolithic diet, without the toxicity. *Mayo Clin* Proc.; 91(4):496-508.

Rastogi A; Arman F and Alipourfetrati S (2016):

New agents in treatment of hyperkalemia: an opportunity to optimize use of RAAS inhibitors for blood pressure control and organ protection in patients with chronic kidney disease. *Curr Hypertens Rep.*; 18(7):55.

Redman LM; Heilbronn LK; Martin CK; de Jonge L; Williamson DA; Delany JP and Ravussin E (2009):

Metabolic and Behavioral Compensations in Response to Caloric Restriction: Implications for the Maintenance of Weight Loss. PloS one, 4(2), e4377.

Rios R; Pineda C; Lopez I; Muñoz-Castañeda J; Rodriguez M; Aguilera-Tejero E and Raya AI (2018):

Phosphorus restriction does not prevent the increase in

fibroblast growth factor 23 elicited by high fat diet. *PLoS One*, 13(6), e0198481.

Sarathy S; Sullivan C; Leon JB and Sehgal AR (2008):
Fast food, phosphorus-containing additives, and the renal diet. *J. Ren. Nutr*, 18, 466–470

Salmean YA; Zello GA and Dahl WJ (2013):
Foods with added fiber improve stool frequency in individuals with chronic kidney disease with no impact on appetite or overall quality of life. *BMC* Res. Notes, 6, 510.

Shi Z; Chu A; Zhen S; Taylor AW; Dai Y and Riley M (2018):
Association between dietary zinc intake and mortality among Chinese adults: findings from 10-year follow-up in the Jiangsu Nutrition Study. *Eur J Nutr*; 57(8):2839e46

Singh RB; Niaz MA; Rastogi SS; Bajaj S; Gaoli Z and Shoumin Z (1998):
Current zinc intake and risk of diabetes and coronary artery disease and factors associated with insulin resistance in rural and urban populations of North India. *J Am Coll Nutr*; 17(6):564e70.

Schrauben SJ; Cavanaugh KL; Fagerlin A; Ikizler TA Ricardo AC and Eneanya ND (2020):
The relationship of disease-specific knowledge and health literacy with the uptake of self-care behaviors in CKD. *Kidney International Reports*, 5(1), 48–57.

Soldin SJ; Brugnara C and Wong EC (2007):
Pediatric Reference Intervals.6th ed.AACC Press,: p. 77-78 .

Sullivan ED; Hughes J and Ferenbach DA (2017):
Renal Aging: Causes and Consequences. *J. Am. Soc.*

Nephrol. 2017, 28, 407–420.

Teslariu O; Pasca AS and Mititelu-Tartau L (2016):
The protective effects of zinc in experimental gentamicin induced acute renal failure in rats. *J Physiol Pharmacol*; 67: 751–757

Thomas, L. (Ed.). (1998):
Clinical laboratory diagnostics: use and assessment of clinical laboratory results. TH-books Verlagsgesellschaft. p.374-7.

Tirosh A; Golan R and Harman-Boehm I (2013):
Renal function following three distinct weight loss dietary strategies during 2 years of a randomized controlled trial. *Diabetes Care*. 36:2225–2232.

Vaziri ND (2014):
Gut microbial translocation in the pathogenesis of systemic inflammation in patients with end-stage renal disease. *Dig Dis Sci;* 59(9):2020–2.

Wang Y; Jia XF; Zhang B; Wang ZH; Zhang JG and Huang FF(2018):
Dietary zinc intake and its association with metabolic syndrome indicators among Chinese adults: an analysis of the China Nutritional Transition Cohort Survey 2015. Nutrients; 10 (5).

Wembenyui CF (2017):
Examining knowledge and self-management of chronic kidney disease in a primary health care setting: Validation of two instruments. Master's Thesis, Queensland University of Technology, Brisbane, QLD

WHO (1995):
Physical status: the use of and interpretation of anthropometry, report of a WHO expert committee.

Wijesekara N; Chimienti F and Wheeler MB (2009):

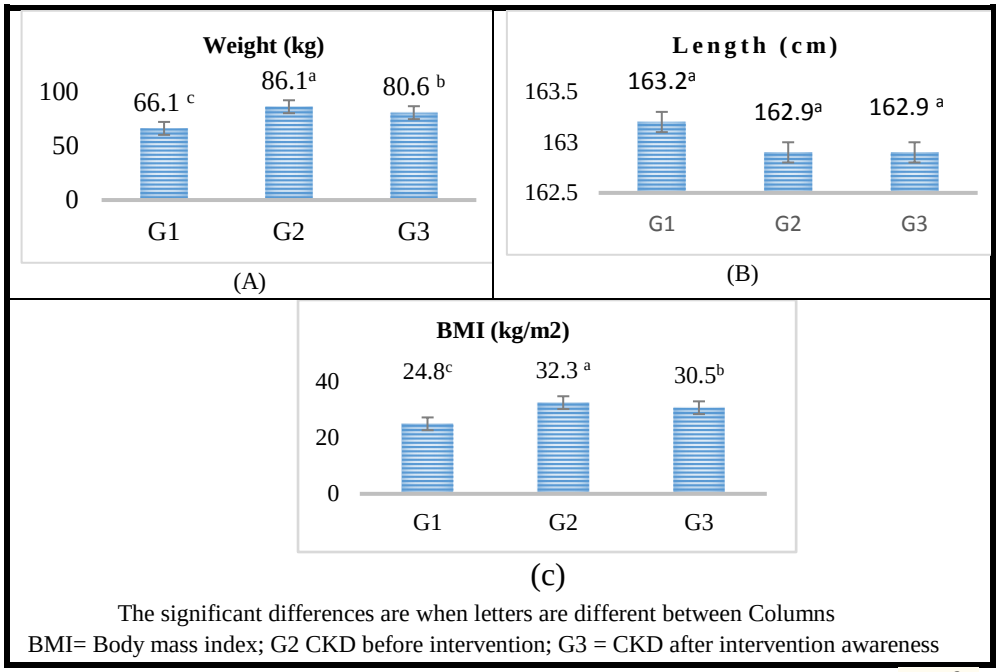
Zinc, a regulator of islet function and glucose homeostasis. *Diabetes Obeis Metab*; 11(Suppl. 4):202e14.

Wish JB; Aronoff GR; Bacon BR; Brugnara C; Eckardt KU; Ganz T and Wood JC (2018):
Positive iron balance in chronic kidney disease: how much is too much and how to tell?. *American journal of nephrology*, *47*(2), 72-83.

Wright JA; Wallston KA; Elasy TA; Ikizler TA and Cavanaugh KL (2011):
Development and results of a kidney disease knowledge survey given to patients with CKD. *American Journal of Kidney Diseases,* 57(3), 387–395.

Yang M, Liu R, Li S, Luo Y, Zhang Y, Zhang L (2013):
Zinc-alpha2-glycoprotein is associated with insulin resistance in humans and is regulated by hyper-glycemia, hyperinsulin-emia, or liraglutide administration: cross-sectional and intervene-tional studies in normal subjects, insulin-resistant subjects, and subjects with newly diagnosed diabetes. Diabetes Care; 36 (5): 1074 e82.

Zhu Y; Liu X; Li N; Cui L; Zhang X; Liu X; Yu K; Chen Y; Wan Z and Yu Z(2020):
Association between Iron Status and Risk of Chronic Kidney Disease in Chinese Adults. *Front. Med.; 6:303.*



The significant differences are when letters are different between Columns
BMI= Body mass index; G2 CKD before intervention; G3 = CKD after intervention awareness

Figure, 1: Anthropometric measurements of studied samples [weight (kg), Height (cm), BMI (kg/m^2)]

Table (1) Macronutrients intake in the daily diet (mean ± SE) and percent from RDI for studied samples (n=30/ each)

Groups / Nutrients	G1 *(control subject)*	G2 (*before intervention)* CKD	G3 (*After intervention)* CKD	p-value
Calorie (kcal)	1257± 101	1908±149	1656±109	0.000
RDI	**2000 kcal**			
% from RDI	62.8 %	95.4%	82.8%	
Fat (g/d)	59.4±5.5	58.0±7.5	53.2±5.3	0.07
RDI	**78g**			
% from RDI	76.2%	68.2%	74.3%	
Protein (g/d)	70.0± 5.1	76.5±7. 0	66.0± 5.0	0.02
RDI	**50g**			
% from RDI	140%	153%	132%	
Carbohydrate (g/d)	163.5± 14.5	270.1±19.2	228.2 ±16.5	0.000
RDI	**275 g**			
% from RDI	59.4%	98.2%	83%	
Fiber (g/d)	8.9 ±1.5	8.5±0.9	9.3±1.2	0.78
RDI	**28g**			
% from RDI	31.7%	30.3%	33.2%	

Significant is when P < 0.05 SE= standard Error RDI according to FDA 2020;

Table (2) Micronutrients intake in the daily diet (average ± SE) and percentage from RDI for studied samples (n= 30each)

	Micronutrients intake			
Groups / Nutrients	**G1** (control subject)	**G2** (before intervention)	**G3** (After intervention)	**p-value**
Iron (mg /d)	11.2± 0.8	15.4±1.8	15.8±1.3	0.006
RDI	18			
% from RDI	62.2%	85.5%	87.7%	
ZINC (mg/d)	8.5±0.6	9.2±0.7	11.1±0.9	0.001
RDI	11 mg			
% from RDI	77.2%	83.6%	100.9%	
Calcium (mg/d)	630.5±58.2	647.1±78	701.2±69.4	0.03
RDI	1300 mg			
% from RDI	48.5%	49.7%	53.9%	
Phosphorus **(mg/d)**	765.7.3±53.2	1071.5±92.9	844.8±72.6	0.001
RDI	1250 mg			
% from RDI	61.2%	85.7%	67.5%	
Magnesium (mg/d)	116.9 ±11.2	115±11.5	138.2±13.5	0.126
RDI	420 mg			
% from RDI	27.8%	27.3%	32.9%	
Potassium (mg/d)	1797.3±129.8	2163.5±226.8	2086.1±154.7	0.185
RDI	4700 mg			
% from RDI	38.2%	46%	44.4%	
Sodium (mg/d)	2863.7±280.5	2996.3±342	2109.4±356.5	0.064
RDI	2300 mg			
% from RDI	124.5%	130.2%	91.7%	

Significant is when P < 0.05 SE= standard Error RDI according to FDA 2020

Table (3) Vitamin C and vitamin D intake in the daily diet (mean ± SE) and percent from RDI for studied sample (n= 30/ each)

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Micronutrients intake				
Parameters/ Groups	G1 (control subject)	G2 (*before intervention)*	G3 (*After intervention)*	*p- value*
Vitamin C (mg/ d)	28.9 ±8.0	66.2±30.8	90.1±32.9	0.002
RDI	90 mg			
% from RDI	32.1%	73.5%	100.1%	
Vitamin D (IU / d)	53.4±7.0	31.9±4.6	38.7±5.7	0.007
RDI	800 IU			
% from RDI	6.7%	3.9%	4.8%	

Significant is when $P < 0.05$ SE= standard Error RDI according to FDA 2020

Table (4) Na, K, Mg in Serum (mean ± SE) for studied sample (n=30/each).

Groups /Parameters	Cut of point of normal	G1 **(Control subject)**	G2 **(before intervention)**	G3 **(After intervention)**	*P*- value
Na (mill moll/ L)	135 - 150	139.2±0.85	126.8±6.9	135.8±1.0	0.098162
Na % change vs. G1		0.0	-8.9	-2.4	
K (mill moll/ L)	3.5-5.0	4.2±0.12	5.0±0.25	4.0±0.13	0.000
k% change vs. G1		0.0	21.3	-4.7	
Mg (mg/dl)	1.6-2.3	1.84±0.05	1.75±0.2	2.0 ±0.1	0.272
Mg% change vs. G1		0.0	-4.89	8.7	

Significant is when P < 0.05 SE= standard Error

Table (5) Vitamin D and PTH, Urea, Creatinine, and GFR in Serum (mean ± SE) for studied sample (n=30/each)

Parameters/ Groups	Cut of point of normal	G1 **(control subject)**	G2 **(before intervention)**	G3 **(After intervention)**	p- value
VD ng/ml	20-30	45.5±4.46 [a]	13.87±0.85 [b]	47.94±3.98 [a]	0.000
VD % Change vs G1		0	-70	-5.5	
VD % Change vs. G2		228	0	247	
PTH (pg/ml)	10-65	293.9±29.3 [a]	472±24.1 [b]	308.1±16.7 [a]	0.000
PTH % Change calculate vs. G1		0	61	4.8	
PTH % Change Calculate vs. G2		-37.7	0	-34.7	
Creat (mg/dl)	0.7 - 1.3	0.9±0.02 [a]	4.6±0.8 [b]	2.1±0.3 [a]	0.000
Creat % Change Calculate vs. G1		0	400	133.3	
Creat % Change calculate vs. G2		-80.4	0	-45.1	
Urea (mg/dl)	14-23	26.7±1.3 [a]	108.7±12.6 [b]	65.4±6.7 [c]	0.000
Urea% Change Calculate vs. G1		0	307	145	
Urea % Change Calculate vs. G2		-75.4	0	-39.8	
GFR (%)	Stage 1-5	100.7±2.8	29.6±5.1	64.7±7.2	0.000
GFR% Change Calculate vs. G1		0	-70.6	-35.7	
GFR% Change Calculate vs. G2		55.6	0	-54.2	

Significant is when P < 0.05 SE= standard Error

Stage one GFR is 90, Stage two GFR is 60-89, Stage three GFR is 30-60, Stage four GFR is 15-29, and Stage fife GFR is 15-29.

تجربة تأثيرالتوعية التغذوية ومكملات الكاليسيفيرول على مرضى الكلى

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الملخص العربي:

ارتبط نقص فيتامين د (كالسيفيرول) بتدهور أمراض الكلى. تساهم بعض المتغيرات، مثل الحالة الغذائية والتعرض لأشعة الشمس، في نقص فيتامين د. كان هدف البحث تحديد حالة التغذية وفيتامين (د) لمرضى الكلى المزمن قبل وبعد ثلاثة أشهر من الوعي الغذائي والتعرض للشمس وتناول مكملات كالسيفيرول. في الفترة من يناير ٢٠١٩ إلى يوليو ٢٠٢٠، تم تعيين ٦٠ ذكرًا (٥٥-٤٥ عامًا) بشكل عشوائي من العيادة الخارجية للمعهد القومي لأمراض الكلى والمسالك البولية في القاهرة ، مصر. استخدمت المراحل ٣-٥ من مرض الكلى المزمن لتصنيف المرضى. تم تقسيم جميع المشاركين إلى مجموعتين: الضابطة ومرضى الكلى المزمن CKD. بالنسبة لجميع الأفراد ، غطى التقييم الاستهلاك الغذائي ، بما في ذلك استبيان الاسترجاع لمدة ٢٤ ساعة، والقياسات البشرية ، والمقاييس البيوكيميائية المحددة. وفقًا للنتائج، استهلك مرضى CKD سعرات حرارية أكثر وكانوا يعانون من السمنة، وفقًا لمؤشر كتلة الجسم (BMI). كان متوسط استهلاك البروتين اليومي أعلى من المدخول اليومي الموصى بهRDI . باستثناء الصوديوم كان الأعلى ، كان متوسط استهلاك المعادن ضمن RDI ، بينما كان تناول فيتامين D أقل من ١٠٪ من RDI. انخفضت مستويات الطاقة لمجموعة CKD من ٩٥,٤٪ إلى ٨٢,٨٪ من RDI، وزاد تناول البروتين فيتامين C والألياف بعد ثلاثة أشهر من العلاج. بينما ظلت مستويات الصوديوم ضمن RDI ، كشف الفحص البيوكيميائي عن تحسن كبير في مستويات فيتامين D و PTH والكرياتينين واليوريا. في النهاية ، أدى كل من التدخل الغذائي ومكملات فيتامين (د) إلى تحسين مراحل مرض الكلى المزمن من المرحلة ٣ أو ٥ إلى المرحلة ٢.

الكلمات المفتاحية : مرضى الكلى المزمن – التدخل الغذائى بفيتامين D