Protein Intake and Renal Function of CKD Patients

Nicole Preder

Relevance

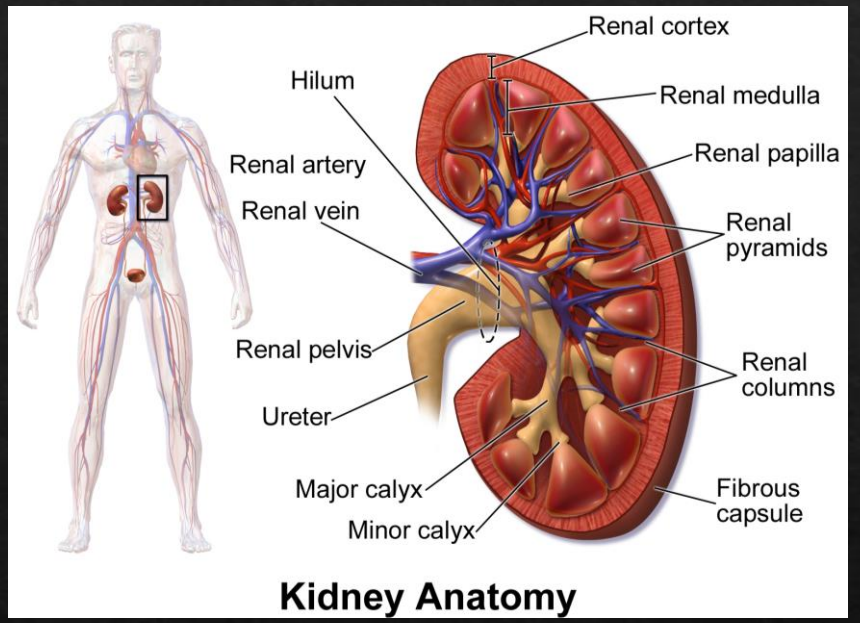
- 9th leading cause of death
  - 50,633 deaths in 2016
- 5-15% of Americans have CKD
- Primary causes:
  - HTN
  - DM
- Suboptimal nutritional intake is common in the population of CKD and ESRD and poses a direct risk for protein malnutrition

Schmidt , A. (2019, February). *MNT II.*

Function of the Kidney

- Main functions:
  - Remove waste products from the body
  - Release hormones that regulate blood pressure
  - Produce an active form of vitamin D
  - Control the production of red blood cells

- Healthy kidneys **don't allow** a significant amount of protein to pass through
- Damaged kidneys **let** proteins (albumin) leak from blood into urine



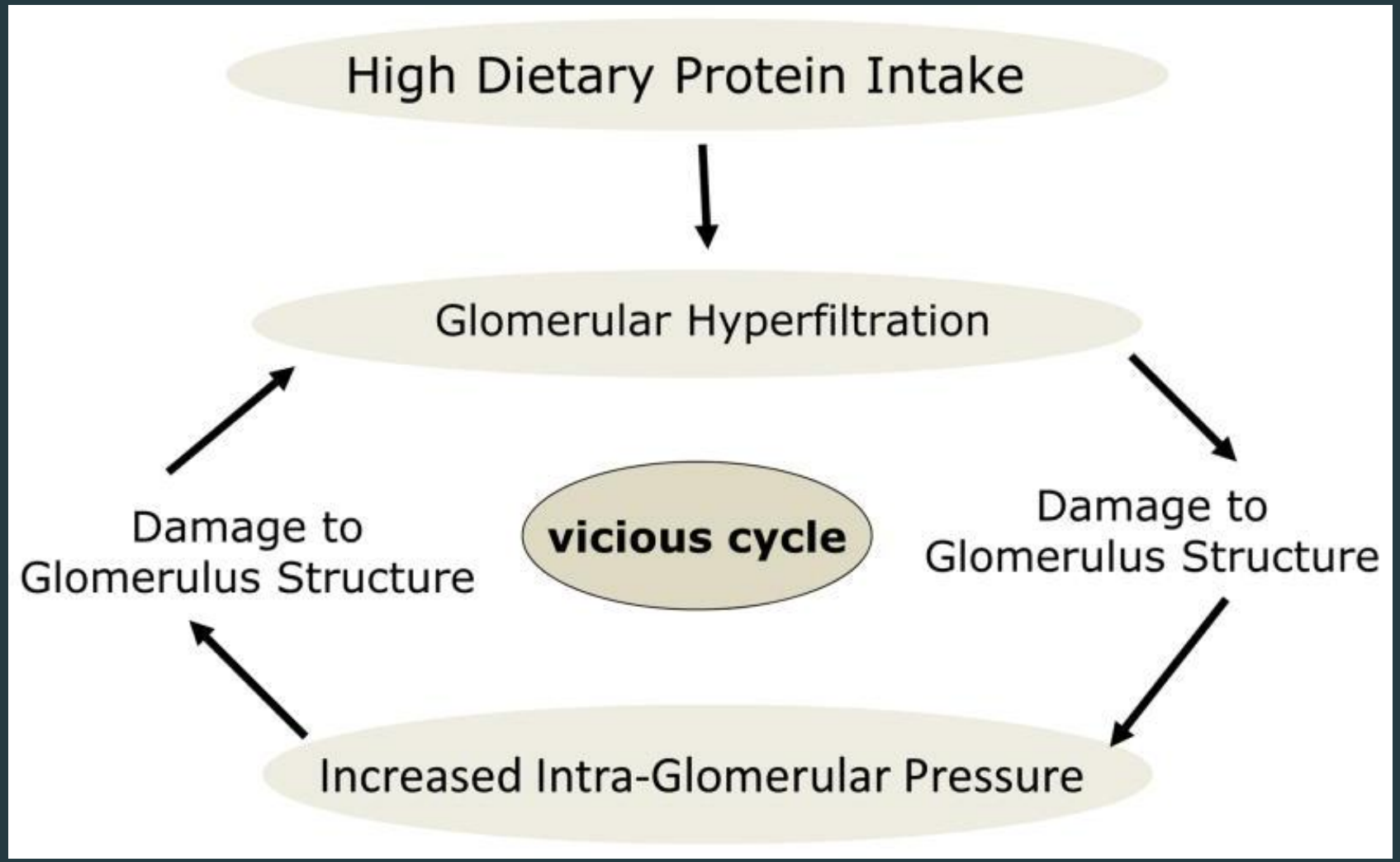
Poulton , C. (2017). Glomerular Disease.

Importance of Protein Intake r/t CKD

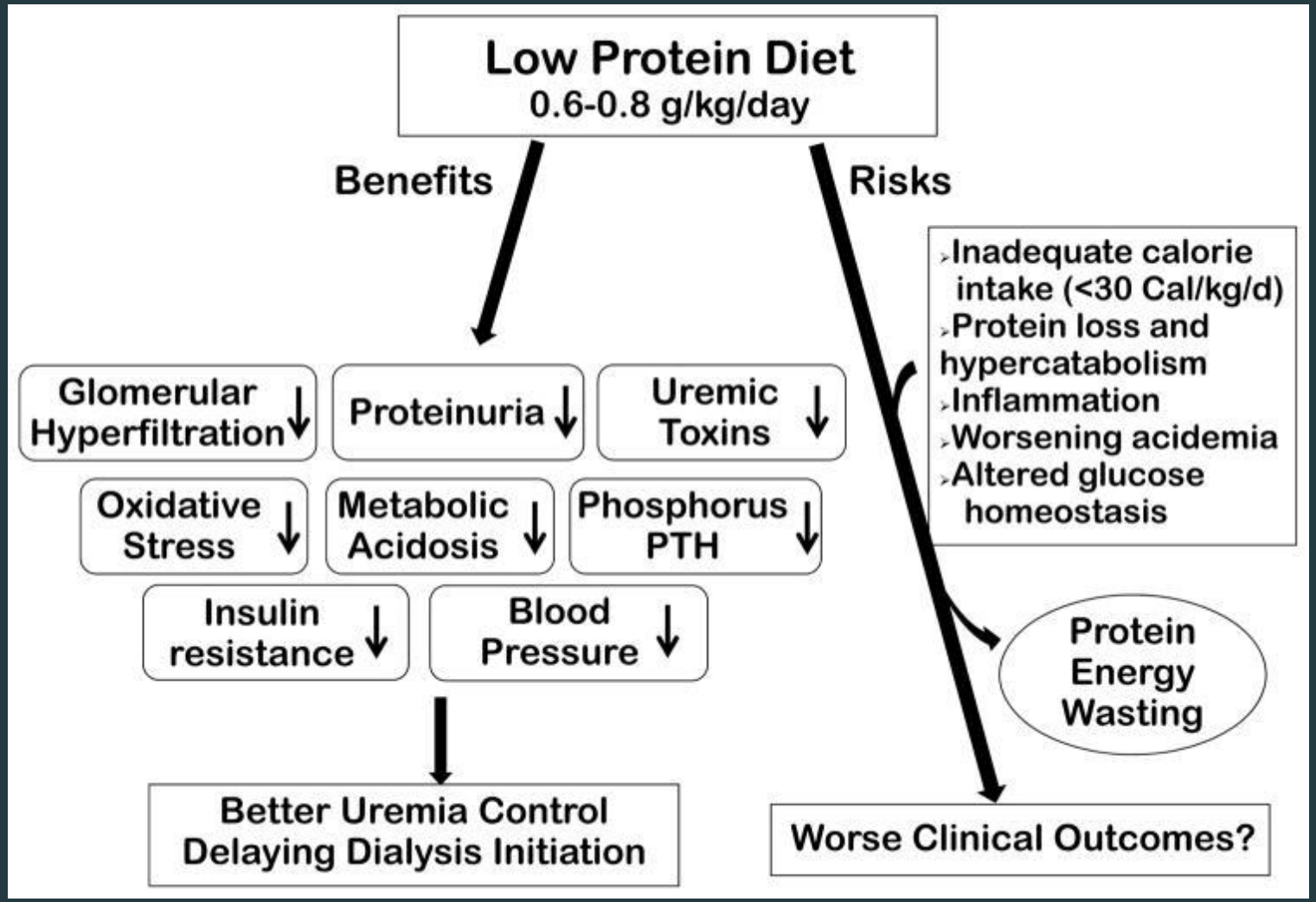
- Adequate, not excessive!
- High protein intake may lead to increased:
  - Intraglomerular pressure
  - Glomerular hyperfiltration
- Low-protein diet management can reduce costs, enhance physiological adaptation, and preserve residual renal function upon transition to dialysis
- Adequate protein and energy intake to avoid protein-energy wasting

DaVita Dialysis, 2019.

Ko, G. J., et. all., (2017). Dietary protein intake and chronic kidney disease.



Ko, G. J., et. all., (2017). Dietary protein intake and chronic kidney disease.



Ko, G. J., et. all., (2017). Dietary protein intake and chronic kidney disease.

Nutrient	Impaired Renal Function	Hemodialysis	Peritoneal Dialysis	Transplant (4-6 weeks after)	Transplant (6 weeks after)
Energy	30-35 kcal/kg IBW	35 kcal/kg IBW	30-35 kcal/kg IBW	30-35 kcal/kg IBW	Achieve or maintain IBW
Protein	0.6-1.0 g/kg IBW	1.2 g/kg IBW	1.2-1.5 g/kg BW	1.3-2 g/kg IBW	1 g/kg BW
Fluid	Ad libitum	1000-1500 mL/day	Minimum of 2000 mL/day	Ad libitum	Ad libitum
Sodium	Variable; 2000-3000 mg daily	2000-3000 mg/day	2000-4000 mg/day	2000-3000 mg/day	2000-3000 mg/day
Potassium	Variable	2000-3000mg/day	3000-4000 mg/day	Variable	Variable
Phosphorus	0.8-1.2 g/day	0.8-1.2 g/day	0.8-1.2 g/day	Calcium 1200 mg/day	Calcium 1200 mg/day

Case Study for CKD in Pregnancy

Campos-Collado, A. X., et. all, (2016). Medical Nutrition Therapy for Chronic Kidney Disease in Pregnancy: A Case Report. *Journal of the Academy of Nutrition and Dietetics.*

Assessment

- 22 y/o Hispanic pregnant woman, stage 5 CKD
- 14 weeks gestation
- Hemodialysis 14 hours/week
- Usual dietary intake: Hispanic Foods
  - 112% of recommended energy intake
  - 1.9 g/kg protein
  - Excessive Na+, adequate Fe
  - Carbonated beverages 4x/week
  - Water 500 mL/day
- Prenatal Vitamin

Table 3. Weight gain during pregnancy and classification according to the Institute of Medicine guidelines[1,2]

Gestational week	Weight gain (kg)	Weekly weight gain[a]	Interpretation
14.3	1.2	—	—
18.3	0	0 kg	Insufficient
22.2	1.8	0.46 kg	Excessive
24.5	1.3	0.56 kg	Excessive
27.5	3.2	1.06 kg	Excessive
29.5	1.4	0.7 kg	Excessive
31.5	0.5	0.25 kg	Adequate

[a]Recommended weekly weight gain in overweight women: 0.23-0.33 kg.[1,2] Pregestational weight=79 kg.

Assessment cont.

- Pregestational BMI= 27.08
- Electrolyte and mineral status WNL
- Energy Recommendation:
  - 30-35 kcal/day x pregestational IBW
  - = 2,236-2,550 kcal/day
- Protein Recommendation:
  - 1.2-1.5 g/day x pregestational IBW
  - = 85.2-104.2 g/day

Table 1. Energy, macronutrient, vitamin, and mineral intake throughout pregnancy for a woman with chronic kidney disease receiving medical nutrition therapy[a]

	First trimester[b]	Second trimester[c]	Third trimester[d]	Reference intake[10,18]
Gestational age (wk)	13.3	24.2	30.5	
Energy (kcal/d)	2,869	2,281	1,873	Individualized
Protein (g/d)	122.5	83.9	91.1	75.3-94.2 (1st trimester) 85.3-104.2 (2nd and 3rd trimesters)[e]

Diagnosis

Excessive protein intake r/t lack of knowledge regarding nutrition and CKD and undesirable foods choices AEB proteinuria (1,036 mg/24- hour urine) and consumption of 1.9 g/kg pregestational IBW.

Undesirable food choices related to eating away from home and a complicated schedule because of HD sessions as evidenced by high intake of high-energy-density and high-Na foods.

Nutrition Prescription (Intervention)

- 2,000 kcal/day and 99 g protein/day
  - 55% CHO, 19% protein and 26% lipids
- Eliminate high-phosphorus foods, except dairy products that were recommended
- Moderate Na+ intake
  - 2,000 mg/day
- Moderate K+ restriction
  - >250 mg/serving size
- Consume 5 meals/day
- Continue Prenatal Vitamin

Nutrition Education and Counseling (Intervention)

- Discussed impact of dietary choices
- Food sources rich in Na^+, K^+, and P
- Example of a 1-day menu with the recommended food groups and serving sizes
- Reading food labels
  - Calculating grams of protein
  - Na^+, P, K^+ content

Monitoring and Evaluation

RD will follow-up with patient in 2 to 3 weeks.

RD will reevaluate weight, dietary intake, lab values and adherence to prescription.

Patient's Outcome

- Reduced intake of sugar-sweetened beverages, high-fat Mexican food, high-Na+, K+, P foods
- Increased vegetable intake
- 4-5 meals/day
- Maintained fluid intake to 1,000 mL/day
- Energy intake decreased
- Proteinuria was decreased from 1,036 mg/day to 640 mg/day

Baby's Outcomes

- Born at 34.2 weeks gestation d/t ruptured membranes
- Hospitalized:
  - Respiratory distress syndrome
  - Sepsis
  - Neuroinfection
  - Severe pulmonary bronchodysplasia
- Growth rate during hospitalization was sub-adequate

Case Study Conclusion

Renal RD has a unique role within the health care team responsible for treating CKD in pregnancy

Main challenge of this case study, energy intake recommendation

More research for pregnant women with CKD is urgent


Research Analysis

"The Associations of Plant Protein Intake With All-Cause Mortality in CKD"

Chen. X., et al., American Journal of Kidney Diseases, 2016.

- When: 2016
- What: Observational Study
- Who: U.S. Noninstitutionalized citizens, greater than or equal to 20 y/o
  - 14,866 people
  - w/eGFR <150 mL/min/1.73 m^2
  - Non-missing data for plant protein and total protein intake
- How: NHANES III and anthropometric measurements done at mobile examination center

Methods

- Nutrition Coordinating Center (NCC)
  - Total protein vs. animal protein vs. plant protein
  - Calculated from Nitrogen in food
  - Plant protein ratio
- Analyzed impact of plant protein diet on eGFR
- Study population: 14,866 people, w/eGFR <150 mL/min/1.73 m^2

Results

- The prevalence of eGFR < 60 mL/min/1.73 m^2 was 4.9%
- Mean age= 44.8 ± 15.8 years
- 48% men
- 10% African American
- Mean value for plant protein intake= 24.6 ± 13.2 g/d
- Plant protein ratio= 33.0% ± 14.0%

Results cont.

	Q1: <22.4% (n = 3,781)	Q2: 22.4%-30.6% (n = 3,611)	Q3: 30.7%-40.9% (n = 3,632)	Q4: >40.9% (n = 3,842)	*P*
eGFR, mL/min/1.73 m^2	101 ± 20	100 ± 20	98 ± 20	97 ± 20	<0.001
eGFR < 60 mL/min/1.73 m^2	3.8	4.6	5.3	5.9	0.002

Chen. X., et al., American Journal of Kidney Diseases, 2016.

Conclusion

1

^ intake of plant proteins from gluten decreases LDL cholesterol, uric acid and TG

2

^ intake of soy protein decreases total cholesterol, LDL cholesterol and TG

3

^ intake of plant-proteins in junction with some animal-proteins ensures more variety of amino acids

4

In a Western diet, more than half of dietary phosphorus comes from animal protein

Evaluating the Research

Strengths

- Recent, three years old
- Strict inclusion criteria
- Large sample population
- Nearly 50/50 man to woman ratio
- “Gold Standard” anthropometric collection

Weaknesses

- No method of dietary intake assessment is perfect
- Minimal diversity
- eGFR was calculated based on a single measurement of serum creatinine
  - Doesn’t measure accurately over time

"Which low-protein diet for which CKD patient? An observational, personalized approach."
Piccoli, G., et all., The American Journal of Clinical Nutrition., 2014.

- When: December 1, 2007-January 31, 2013
  - Accepted January 2014
- What: Observational Study
- Who: 417 Stage 4, 5 and progressive stage 3 CKD patients of Outpatient Nephrology Unit, San Luigi Hospital
  - University of Torino, Italy
- How: Patients were offered a variety of low-protein diets to determine which diet worked best for them, to prolong the start of their dialysis treatments

Methods

- Two low-protein diets (LPD), 0.6g protein/day
  - Vegan supplemented diet (LPD-KA)
  - Aproteic commercial food (LPD-ACF)
  - Control
- 30-35 kcal/kg/day
- Biochemical/anthropometrics were assessed every month for stable patients
  - If the GFR dropped too low, dialysis began
- RDs met with patients with complex cases
- Two unrestricted meals/week

Baseline clinical data of patients on LPD-KA and LPD-ACF and those on the diet.

	LPD-KA	LPD-ACF	No diet (GFR < 30 mL/min at first update)	P-value (among groups)
n	185	122	110	
M/F[†]	123/62	78/44	66/44	0.532
Age (y; mean [std])	63 ± 15	74 ± 10	76 ± 11	<0.001
No comorbidities (%)	34 (18)	9 (7)	6 (6)	<0.001
≥2 comorbidities (%)	93 (50)	100 (82)	75 (68)	<0.001
Diabetes (%)	69 (37)	59 (48)	20 (18)	<0.001
Neoplasia (%)	15 (8)	15 (12)	32 (29)	<0.001
Ischemic heart disease (%)	45 (24)	48 (39)	63 (57)	<0.001
CKD: nephrosclerosis (%)	56 (30)	77 (63)	55 (50)	<0.001
CKD: Glomerulonephritis (%)	35 (19)	3 (2)	4 (4)	<0.001
sCr (mg/dL; median [range])	3.2 (0.84–16)	2.5 (1.1–6.4)	2.45 (1.97–5)	<0.001
GFR-EPI (mL/min; median [range])	17 (3–108)	23 (7–71)	22 (10–30)	<0.001
Proteinuria (g/24 h; median [range])	1.43 (0.01–18)	0.7 (0.04–8)	0.1 (0.1–5)	<0.001

Results

- LPD-KA patients were younger, had less comorbidities and more severe kidney disease
  - Evidenced by lower GFR and higher proteinuria levels
- **Vascular nephropathy and DM were the leading CKD causes in older patients**
- **Glomerulonephritis was the leading CKD cause in younger adults**
- Good compliance of daily protein intake
  - 0.7 g/kg at 6 months in both groups
- **Hyperkalemia and pulmonary edema were primary reasons starting dialysis**
- ~$65,400/year (hospital), $39,100/year (home) for dialysis treatments

Conclusion

- **Suggest LPD-ACF to older patients** who don't want to change dietary habits
- **Suggest LPD-KA to younger patients** who are motivated to change
- Moderate protein intake allowed survival results comparable to those of dialysis
- Cost of dietary interventions are more economical than dialysis
- Further research needed to assess long-term results

Evaluating the Research

Strengths

- Large sample size
- 6-year study, 5-year follow-up period
- Study groups were comparable
- Free from bias
- Valid and reliable measurements
  - Completed within 24- hours

Weaknesses

- Observational study is limited in comparison to RCT
- Single-center design
- Italian, affecting cultural norms
- No blinding

RD Practice Recommendations

- Diet trends are on the rise
  - Respect ethical, cultural and/or religious views
  - Older population= Standard Diet
  - Younger population= Vegetarian/Vegan
- Educate on plant-based proteins that also follow phosphorus recommendations
  - Tofu, soymilk

Research Article References

- Research Article #1

Chen, X., Wei, G., Jalili, T., Metos, J., Giri, A., Cho, M. E., ... Beddhu, S. (2016). The Associations of Plant Protein Intake With All-Cause Mortality in CKD. *American Journal of Kidney Diseases*, *67*(3), 423–430. doi: 10.1053/j.ajkd.2015.10.018

- Research Article #2

Piccoli, G. B., Deagostini, M. C., Vigotti, F. N., Ferraresi, M., Moro, I., Consiglio, V., ... Porpiglia, F. (2014). Which low-protein diet for which CKD patient? An observational, personalized approach. *Nutrition*, *30*(9), 992–999. doi: 10.1016/j.nut.2014.01.004

General References

Campos-Collado, A. X., Reyes-López, M. A., Orozco-Guillén, A., Muñoz-Manrique, C., & Perichart-Perera, O. (2016). Medical Nutrition Therapy for Chronic Kidney Disease in Pregnancy: A Case Report. *Journal of the Academy of Nutrition and Dietetics*, *116*(2), 213–218. doi: 10.1016/j.jand.2015.08.023

Dietary protein and chronic kidney disease CKD. (n.d.). Retrieved October 22, 2019, from https://www.davita.com/diet-nutrition/articles/basics/dietary-protein-and-chronic-kidney-disease.

Escott-Stump, S. (2015). *Nutrition and diagnosis-related care* (8th ed.). Philadelphia: Wolters Kluwer.

Fast Stats - Leading Causes of Death. (2017, March 17). Retrieved October 21, 2019, from https://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm.

Ko, G. J., Obi, Y., Tortorici, A. R., & Kalantar-Zadeh, K. (2017). Dietary protein intake and chronic kidney disease. *Current opinion in clinical nutrition and metabolic care*, *20*(1), 77–85. doi:10.1097/MCO.0000000000000342

Poulton , C. (2017). Glomerular Disease. Retrieved October 21, 2019, from https://unckidneycenter.org/kidneyhealthlibrary/glomerular-disease/.

Schmidt , A. (2019, February). *MNT II . MNT* . Menomonie.

Zha, Y., & Qian, Q. (2017, February 27). Protein Nutrition and Malnutrition in CKD and ESRD. Retrieved October 21, 2019, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5372871/.