

Advanced Nutritional Strategies for Managing Polycystic Kidney Disease: Insights for Renal Dietitians

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Disclosures

No Disclosures

Key Objectives

- Evaluate Evidence-Based Dietary Interventions for PKD Management.
- Develop and apply tailored nutritional guidelines and strategies to effectively manage PKD, addressing common dietary challenges and optimizing patient care.

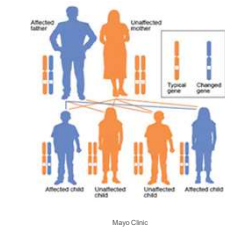
What is Polycystic Kidney Disease (PKD)

- Genetic disorder characterized by cyst formation in the both kidneys
 - Can lead to enlargement and progressive kidney function loss
- Affects close to 12 million people worldwide
 - 600,000 people in the United States
- Varies in severity and is multisystemic
- Caused by a genetic mutation affecting the function of polycystin 1 or 2



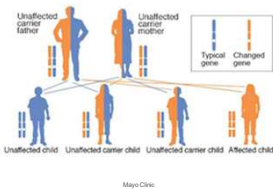
ADPKD - Autosomal Dominant Inheritance

- Most common
 - ~90% of all PKD cases
- Adult PKD
 - signs and symptoms develop in adulthood
- Two branches
 - ADPKD 1
 - More common and more severe
 - Average age of kidney failure being around 58 yrs old
 - ADPKD 2
 - Less common and less severe
 - Average age of kidney failure is 79 yrs old



ARPKD - Autosomal Recessive Inheritance

- Much more rare
 - Affects 1 in 20,000
- Infantile PKD
 - Symptoms appear as early as infancy
- Liver and kidney cysts
- More severe and can be fatal



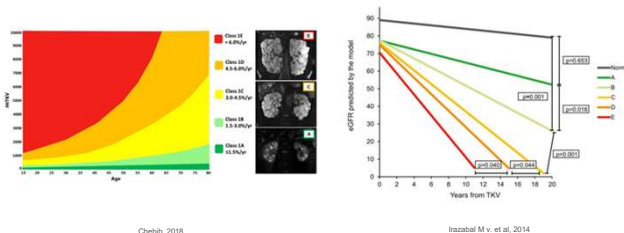
A Little Bit About PKD

- Fourth leading cause of kidney failure in the US
 - Accounts for 5% of all cases
- Men and women are equally at risk
- Affects all races
 - ESRD from PKD is more prevalent in White population
- Can be asymptomatic in some cases
 - More than half of all people with PKD reach kidney failure by 60 yrs old
- Third leading cause of dialysis
 - Accounts for 10,000+ patients starting dialysis every year

Risk Factors for Faster GFR Decline

- Those with PKD1 vs PKD2
 - PKD1 is associated with...
 - Earlier age of diagnosis
 - Higher number of kidney cysts
 - Earlier onset of hypertension
 - Faster progression to ESRD
 - Larger kidneys
 - More kidney-related complications
 - Cyst growth is slower and there is overall less total cysts with PKD2
- Men
- HTN before age 35
- Higher blood pressure = much faster decline
- Hematuria
- Larger kidneys

Mayo Imaging Classification (MIC)



Slide 7

- 1 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7261500/> says 6th decade of life
Brooke Nichols, 9/18/2024

Common Complications

- Hypertension
- Chronic pain
 - Back, sides, and/ or abdomen
 - Associated with UTI or kidney stones, cyst rupture, cyst infection, and bleeding cysts
- Urinary Tract
 - Kidney stones
 - Urinary tract infections
 - Hematuria



Common Complications Cont.

- Pregnancy
 - More likely to develop pre-eclampsia, premature delivery, and low-birth-weight babies.
- Vascular System
 - Brain aneurysms
 - Valve abnormalities
- Gastrointestinal
 - Pancreas and liver cysts



Interventions of PKD

- Management of other existing comorbidities
- Pharmacological
 - Medications
 - Blood pressure control
 - Angiotensin-converting enzyme inhibitors (ACEI)
 - Angiotensin II receptor blockers (ARBs)
 - Tolvaptan - Vasopressin receptor inhibitor
- Lifestyle - the sooner the better!
 - Diet
 - Exercise
 - Smoking cessation



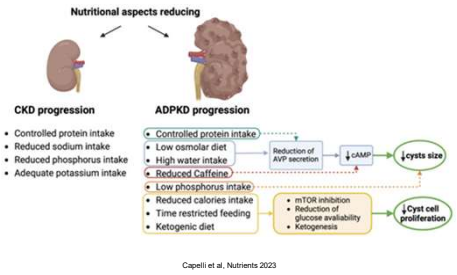
2 Discuss importance of heart healthy diet in these patients

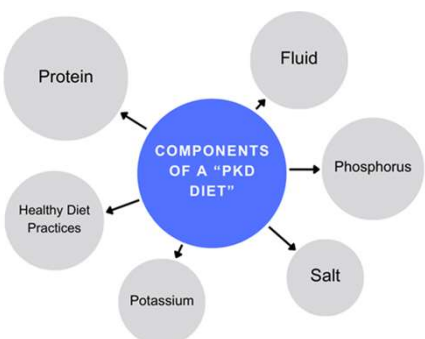
" I don't think many people know about all these other manifestations of PKD. Maybe make a note here (and in the nutrition part at the end) of how important a heart healthy diet is given the HIGH risk of stroke and HTN?"

Brooke Nichols, 8/27/2024

Care Team of a Patient with PKD

- Nephrology
- Endocrinology
- **Nutrition**
- Hepatology
- Geneticist
- Pain management
- Urology
- Cardiology
- Liver surgeons
- Neurosurgeons/ neurologists
- Obstetricians (high-risk pregnancy specialization)
- Psychologists/ Psychiatrists
- Social Workers
- Transplant surgeons





Fluid

- Increased fluid needs
 - Goal of 3L daily to start
- Water is the best choice!
 - Limit sugar-sweetened beverages
- Caffeine
 - Preclinical models suggest caffeine increases cAMP and can raise blood pressure
 - Clinical studies on ADPKD showed no significant differences in TKV or eGFR from caffeine intake
 - <200-250 mg daily
- If fluid retention is present
 - Dietary sodium is the first intervention before limiting fluid



Maintaining Adequate Fluid Intake



Protein

- Moderate protein needs 0.8 - 1.0 g/kg/day
- Restriction needed with:
 - Dx of CKD 3-5
 - 2020 KDOQI: 0.55 - 0.6 g/kg/day
 - 2024 KDIGO: 0.6 - 0.8 g/kg/day
 - Dx of CKD 3-5 and DM - 0.6 - 0.8 g/kg/day to offset carbohydrate intake
 - Use adjusted weight for higher BMI
- Plant-based proteins
 - Improved labs when following **plant-based diet**
 - Improved blood pressure, glycemic control, lipid panel, and weight control
- Other considerations
 - Any other conditions that may require high protein intake

CKD Stage	eGFR	Daily Amount of Protein
Stage 1	>90 mL/min	
Stage 2	90-59 mL/min	0.8 mg/kg/die
Stage 3a	45-59 mL/min	
Stage 3b	30-44 mL/min	0.6 mg/kg/die
Stage 4	15-29 mL/min	0.8 mg/kg/die or
Stage 5	<14 mL/min	0.4-0.3 mg/kg/die + laboratory request


Capelli et al, Nutrients 2023

Slide 18

- 3 figure out what to say for this slide
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Protein Serving Sizes

Animal-Based Proteins



3 to 4 ounces
The size of the palm of your hand

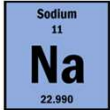
Plant-Based Proteins



1/2 cup
The size of your clenched fist

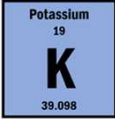
Sodium

- High sodium intake promotes cyst growth and disease progression
 - Increase renin angiotensin aldosterone system (RAAS) activity
 - Increase vasopressin release
 - Blood pressure
 - Goal to preserve GFR and limit growth in TKV
 - Low sodium diet is recommended
 - <2300 mg of sodium daily



Potassium

- Reduce dietary acid load
- Benefits blood pressure control
- No restriction unless elevated lab values and CKD is present
 - ≤ 4,700mg/day
- Causes of hyperkalemia outside of dietary intake
 - Acidosis
 - Medications (ACEI and ARBs)
 - Blood glucose control
 - Constipation



Food Type	Absorption rate	Notes
Plant-based foods	50%–60%	Plant-based foods may have low absorption rate, net alkalinizing effect, and carbohydrate content encourages K ⁺ shifts into intracellular space, minimizing impacts on serum K ⁺
Animal-based foods	70%–90%	Animal-based protein has higher absorption and net acid effect results in higher amounts of K ⁺ remaining in serum
Processed foods	90%	Potassium salts (often found in processed foods) absorption rate has been reported to be 90%

KDIGO 2024

Phosphorus

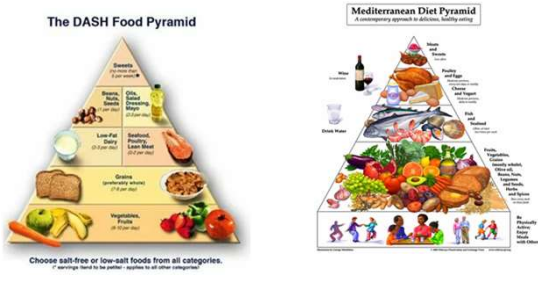
- Tubular injury can result from high phosphorus
 - Increases cyst growth
- Restrict only if hyperphosphatemia is present
- Focus intake on WHERE the phosphorus is coming from
 - First intervention is to reduce foods containing phosphorus additives i.e. ultra-processed foods

Primary natural sources of phosphorus

Animal products	Plant products
Fish Meat & Poultry Milk	Nuts Sunflower seeds Whole grains

- 4 LETF OFF HERE
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Diets That Align with PKD Diet



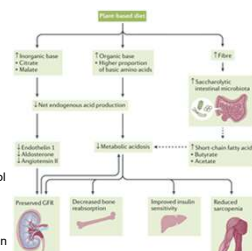
Plant-Based Diet

- Strong emphasis on whole plant foods
 - Fruits/vegetables
 - Nuts, seeds, and oils
 - Whole grains, legumes, and beans
- Low in processed and refined foods
- Meat or animal-based food are still a part of the diet
 - Proportionally smaller than plant sources
 - Less than 50%
- Not vegan or vegetarian
 - More similar to flexitarian



Benefits of Plant-Based Diet

- Fruits and vegetables are renoprotective
 - Animal-based protein is acid producing
 - Fruits and vegetables are base producing
 - Leads to lower net acid load = slower progression
- Improved labs
 - Lower BMI, blood pressure, HbA1C, and cholesterol levels
- In mouse models, lowering animal-based protein has been shown to slow cyst growth and disease progression



Carero et al. Nature Reviews Nephrology 2020

- 5 heart healthy diets VERY important d/t high risk of CVD - Why??
Brooke Nichols, 8/28/2024

Benefits of Plant-Based Diet Cont.

- Increased fruit and vegetable intake
 - Polyphenol rich
 - Improved GI motility - reduced constipation which can lead to decreased retention of uremic toxins & potassium
- Little to no risk for hyperkalemia
 - Studies have observed that an increase in plant foods specifically resulted in no significant changes to serum potassium
- Improved hyperphosphatemia management
 - Lower intake of dietary phosphorus
- More enjoyable and overall less restrictive than previous renal diet recommendations

Kidney Stones in PKD

Calcium Oxalate

- Oxalate crystals can advance PKD
- No real research to prove low oxalate diet can help manage PKD
 - Calcium intake = strongest intervention
 - 1000 - 1200 mg calcium daily
 - Calcium source with meals
- Low oxalate diets can be harmful and not proven to be beneficial for kidney stones or PKD
- Consider low oxalate diet as a LAST resort
 - Spinach, rhubarb, almonds, beets, etc.

Uric Acid

- Formed when urine has a low pH or high concentration of uric acid
- Dietary interventions
 - Consider limiting purine-rich foods
 - Red meats
 - Processed meats
 - Seafood
 - Alcohol - beer and distilled liquor
 - High-fructose products
 - High intake of fruits and vegetables
 - Fruits and vegetables with high purine content are ok

Stone Risk Factors / Cystine Screening:

DATE	REPORT ID	Wt 24	SS CaOx	Ca 24	Ox 24	Ca 24	SS CaP	pH	SS UA	UA 24
05/05/19		2.13	3.93	157	35	549	1.27	6.485	0.23	0.644
05/16/19		0.68	13.42	239	22	222	5.47	6.134	1.17	0.526
05/16/19		1.01	11.04	258	30	281	1.49	5.640	2.21	0.611

Dietary Factors

DATE	REPORT ID	Wt 24	K 24	Mg 24	P 24	NH4 24	O 24	Sul 24	UEN 24	PCR
05/05/19		185	45	132	1.047	32	154	39	8.66	0.8
05/16/19		147	22	116	0.799	30	125	18	7.28	0.7
05/16/19		223	33	133	0.960	29	190	37	8.95	0.9

Renal Function Normalized Values

DATE	REPORT ID	Cr 24	Cr 24/Mg	C Cr	Cr 24/Mg	Cr 24/PO 24
05/05/19		54.1	1943	23.2	1.9	81
05/16/19		81.8	1974	24.1	2.9	121
05/16/19		81.8	1914	23.4	3.2	135

AJKD, 2018

Slide 29

6 maybe make into two slides?

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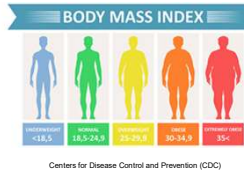
Slide 30

7 importance of a 24 hour urine test, as there are different interventions for the same type of stone

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Maintaining a Healthy Weight

- Body Mass Index (BMI)
 - Not the best indicator of overall body composition and health - just a tool
- Lower BMI is associated with slower kidney growth
 - Specifically in those with overweight or obese BMI
- Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines
 - 35 kcal per kg body weight for those younger than 60 years of age
 - 30-35 calories per kg of body weight for those older than 60 years of age



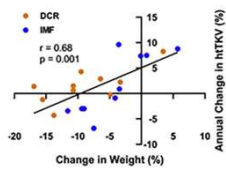
Weight loss and cystic disease progression in autosomal dominant polycystic kidney disease

Katharina Meese^{1,2}, Barbara A. Combs³, Heidi Davies⁵, Shantha L. Dias^{4,6}, Wei Ding⁷, Zhong Dou⁷, Daniel S. Haugen⁸, James Hogg⁹, Tamasz P. Kovesly⁴, George G. Johnson¹⁰, Matthew S. Jackson¹¹, Yuhang Jiang⁸, Corinna N. Janda¹, Natalia J. Sanchez¹, Paul J. MacLean¹, Robert A. Nemeroff¹², Benjamin Glazer¹, Nicole Gonzalez¹³ and Kenneth L. Baulieu^{1,14}

Associated Data
 • Supplementary Materials
 • Data Availability Statement

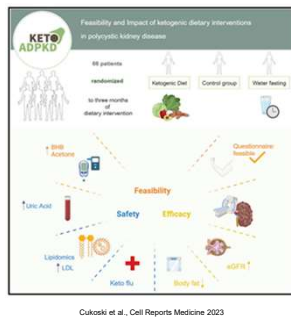
Summary
 Progression of autosomal dominant polycystic kidney disease (ADPKD) is modified by metabolic defects and obesity. Indeed, reduced food intake slows cyst growth in preclinical rodent studies. Here, we demonstrate the feasibility of daily caloric restriction (DCR) and intermittent fasting (IMF) in a cohort of overweight or obese patients with ADPKD. Clinically significant weight loss occurred with both DCR and IMF; however, weight loss was greater and adherence and tolerability were better with DCR. Further, slowed kidney growth correlated with body weight and visceral adiposity loss independent of dietary regimen. Similarly, we compared the therapeutic efficacy of DCR, IMF, and time-restricted feeding (TRF) using an orthologous ADPKD mouse model. Only ADPKD animals on DCR lost significant weight and showed slowed cyst growth compared to ad libitum, IMF, or TRF.

- Intermittent fasting (IMF) and daily caloric restriction (DCR) achieved clinically significant weight loss
- DCR was better tolerated and more effective than IMF



KETO-ADPKD

- Reduced signaling in the mechanisms that allow for disease progression
 - Fewer, smaller cysts
- Ketogenic diet = low carbohydrate (5-10%), moderate protein (1.0 g/kg), and high fat intake (55%-65% of dietary macronutrients)
- Ketogenic diets can benefit ADPKD patients
 - Can lower weight and reduce fat mass
 - Raise GFR
- Limitations
 - Small number of patients
 - Short
 - Long trial is needed to confirm safety and effectiveness



Other Considerations

- Fats
 - Healthy, unsaturated fats
 - <10% of daily caloric intake from saturated fats
- Carbohydrates
 - No recommendation for PKD
 - Usually a higher intake when on LPD
 - Manage DM if present
- Fiber
 - 25 g per day women
 - 38 g per day men
- Fruits & Vegetables
 - 2-4 cups per day - 5 servings at least



Most Common Dietary Challenges for PKD

- Maintaining adequate fluid intake
- Meeting protein goals
- Mineral balance
 - Understanding sources of potassium and/ or phosphorus
 - Following a low sodium diet
- Building kidney-friendly meal
- Weight loss
- Finding reputable sources for information



8 Edit

Brooke Nichols, 8/7/2024

Questions

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