Update on Nutrition and Chronic Kidney Disease (CKD)

Theresa Kuracina, MS, RD, CDE

Presented by Indian Health Service (IHS)
Division of Diabetes Treatment and Prevention

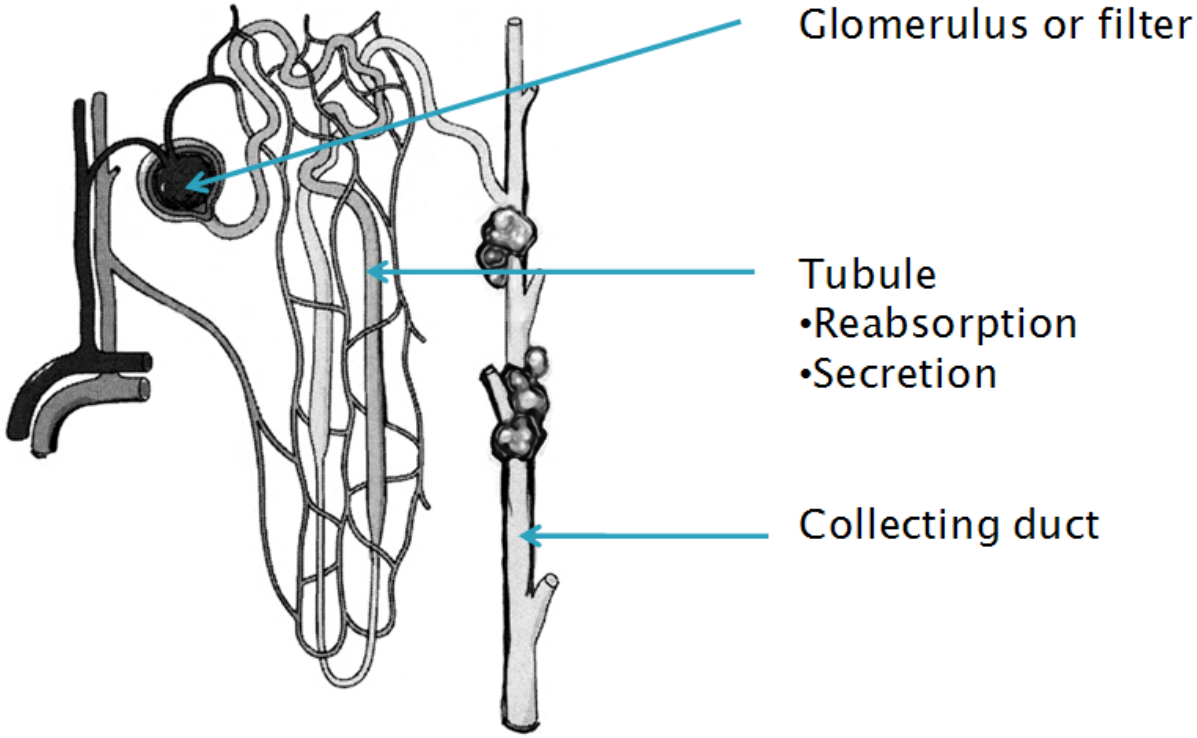
Objectives:

- Incorporate suggested guidelines for identifying and monitoring CKD into clinical practice.
- Describe new tools from the National Kidney Disease Education Program to enhance patient education.
- Incorporate key concepts in nutrition assessment, management and treatment into clinical practice.
- Briefly review diet recommendations for dialysis.
- Give one example of how you plan to change your practice as a result of this training.

Kidney Functions

- Regulate composition and volume of blood
- Remove wastes from blood into the urine:
  - Sodium, nitrogen, potassium, hydrogen, phosphorus, fluid and others
- Source for hormones
  - Active Vitamin D, erythropoietin, renin
- Involved in metabolism
  - Insulin, glucagon, gluconeogenesis

The Nephron



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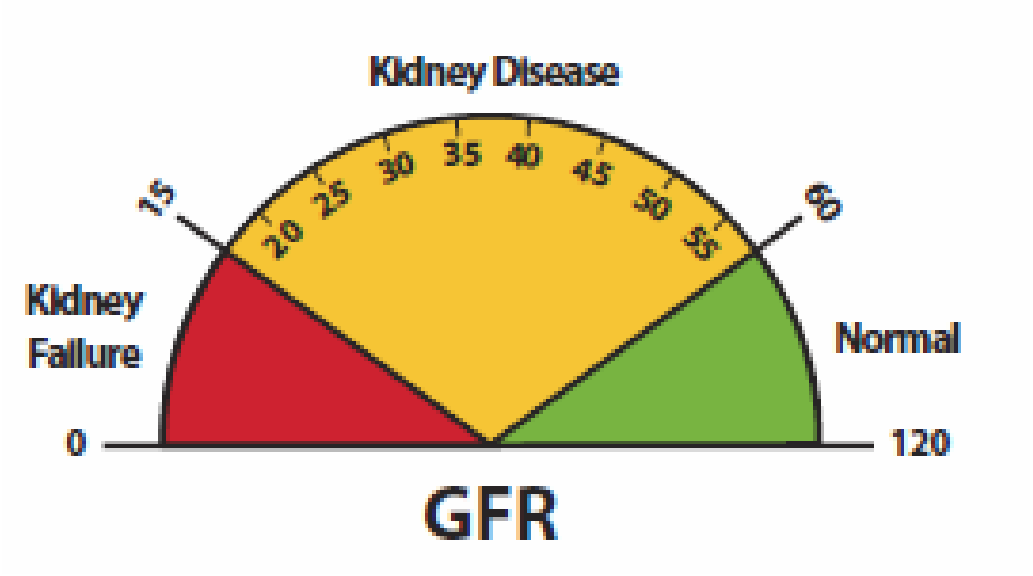
Identify and Monitor CKD

1. Kidney function
   - eGFR
2. Kidney damage
   - UACR

Identification and Monitoring



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Assess Kidney Function

- Estimated Glomerular Filtration Rate (eGFR)
  - How well the kidneys are filtering
  - Follow the trends
  - Stable levels may mean therapy is working
  - Rapid decline may mean rapid progression

  - Need serum creatinine, age, race and gender

Creatinine

- Product of muscle creatine catabolism
- Levels transiently increase after eating meat
- Filtered by glomerulus
- Secreted by tubules
  - Secretion *increases* with decreasing GFR
  - Total urinary excretion declines as kidney function declines

Serum Creatinine

- Used to use to monitor kidney function
- Levels affected by:
  - Muscle mass
  - Age
  - Gender
  - Race
- Normal level: 0.6-1.2 mg/dL

MDRD Equation for eGFR

- Uses creatinine, age, race and gender
- Serum creatinine assay
  - Isotope Dilution Mass Spectrometry (IDMS) provides more accurate estimate
- *Not* reliable with:
  - Rapidly changing creatinine levels
  - Extremes in muscle mass, body size or altered diet patterns
- Online calculators

Stevens et al. J Am Soc Nephrol 2007; 18:2749-2757
Poggio et al. Am J Kid Dis 2005;46:242-252
Verhave et al. Am J Kid Dis 2005;46:233-241

eGFR

GFR (mL/min/1.73 m^2) = **186** x $(S_{cr})^{-1.154}$ x $(Age)^{-0.203}$ x (0.742 if female) x (1.212 if African-American) (conventional units)

GFR (mL/min/1.73 m^2) = **175** x $(S_{cr})^{-1.154}$ x $(Age)^{-0.203}$ x (0.742 if female) x (1.212 if African American) (conventional units)

http://nkdep.nih.gov/professionals/gfr_calculators/index.htm

Original MDRD Equation

IDMS-Traceable

“Normal” Serum Creatinine 0.6 – 1.2 mg/dL

Subject	Creatinine	MDRD	IDMS
35 yo African American male	1.2	> 60	> 60
35 yo female	1.2	54	51
53 yo male	2.4	30	28
53 yo female	2.4	24	22
65 yo African American male	2.4	35	33
65 African American female	2.4	26	25
80 yo female	2.4	21	19

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How well are your kidneys working?

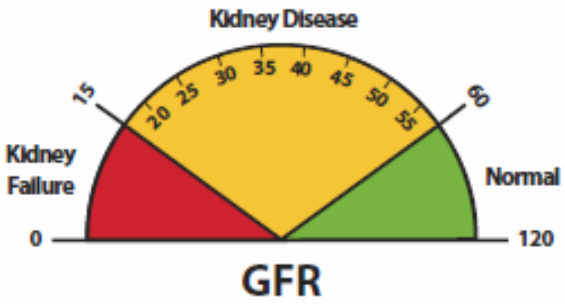
Explaining Your Kidney Test Results

Your GFR result on _____ was _____.
Date

☐ A GFR of *60 or higher* is in the normal range.

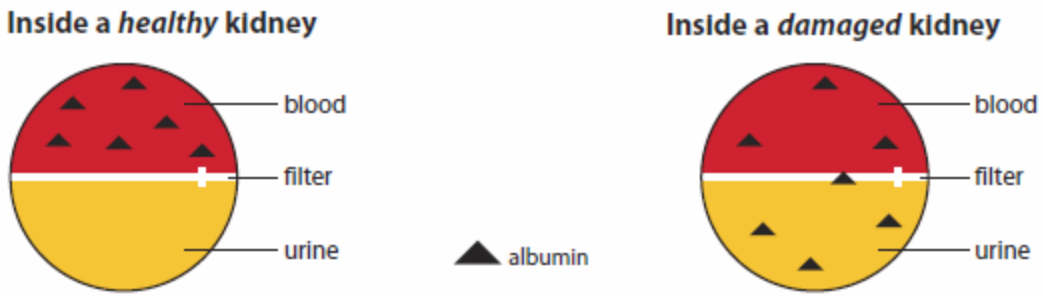
☐ A GFR *below 60* may mean kidney disease.

☐ A GFR of *15 or lower* may mean kidney failure.



What is GFR?

GFR stands for glomerular filtration rate. GFR is a measure of how well your kidneys filter blood.


Inside a *healthy* kidney
blood
filter
urine
albumin
Inside a *damaged* kidney
blood
filter
urine

Assess Kidney Damage

- Urine Albumin-to-Creatinine Ratio (UACR)
  - How much albumin is leaking into the urine
- Stable or lower UACR → therapy is working
- High levels associated with more rapid progression

UACR (mg/g)	
Normal :	0 – 29
Albuminuria :	$\geq$ 30

UACR (mg/g)

- Large amounts of albumin are not normally excreted into the urine
- Helps identify early kidney disease
- Use a “spot” urine
- Estimates 24 hr. urine albumin excretion
- Follow the trend
- Albuminuria = urine albumin

Your urine albumin result on _____ was _____.
Date

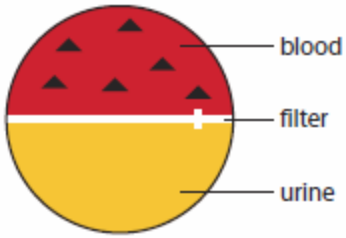
☐ A urine albumin result *below 30* is normal.

☐ A urine albumin result *above 30* may mean kidney disease.

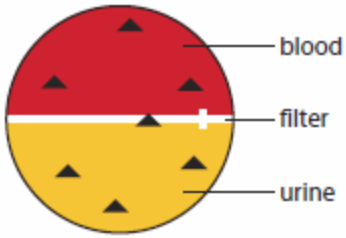
What is urine albumin?

Albumin is a protein found in the blood. A healthy kidney does not let albumin pass into the urine. A damaged kidney lets some albumin pass into the urine. The less albumin in your urine, the better.

Inside a *healthy* kidney



Inside a *damaged* kidney



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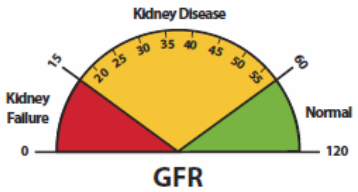

What is GFR?

GFR stands for glomerular filtration rate. GFR is a measure of how well your kidneys filter blood.

Your urine albumin result on _____ was _____.
Date

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What is urine albumin?

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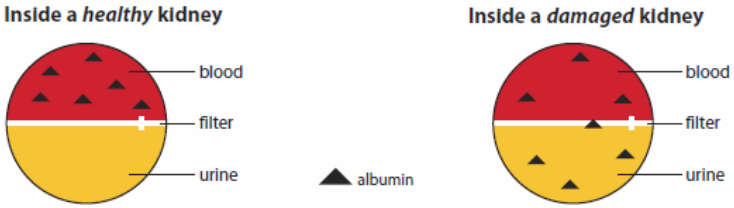

Your blood pressure result on _____ was _____.
Date

Keeping your blood pressure below 130/80 may help to protect your kidneys.

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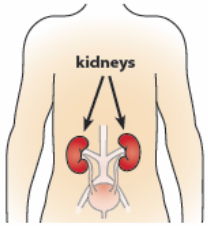
What your kidneys do

You have two kidneys. Their main job is to filter waste and extra water out of your blood and make urine.



How your kidneys are checked

Two tests are used to check for kidney disease.

- A blood test checks your GFR, which tells how well your kidneys are filtering.
- A urine test checks for albumin in your urine, a sign of kidney damage.

Why your kidneys are being checked

You need to have your kidneys checked because you can't feel kidney disease. Kidney tests are very important for people who have diabetes, high blood pressure, or heart disease. These conditions can hurt your kidneys.

What happens if you have kidney disease

Kidney disease can be treated. The sooner you know you have kidney disease, the sooner you can get treatment to help delay or prevent kidney failure. Treating kidney disease may also help prevent heart disease.

Treatment goals are to:

- Keep your GFR from going down
- Lower your urine albumin

No matter what your results are:

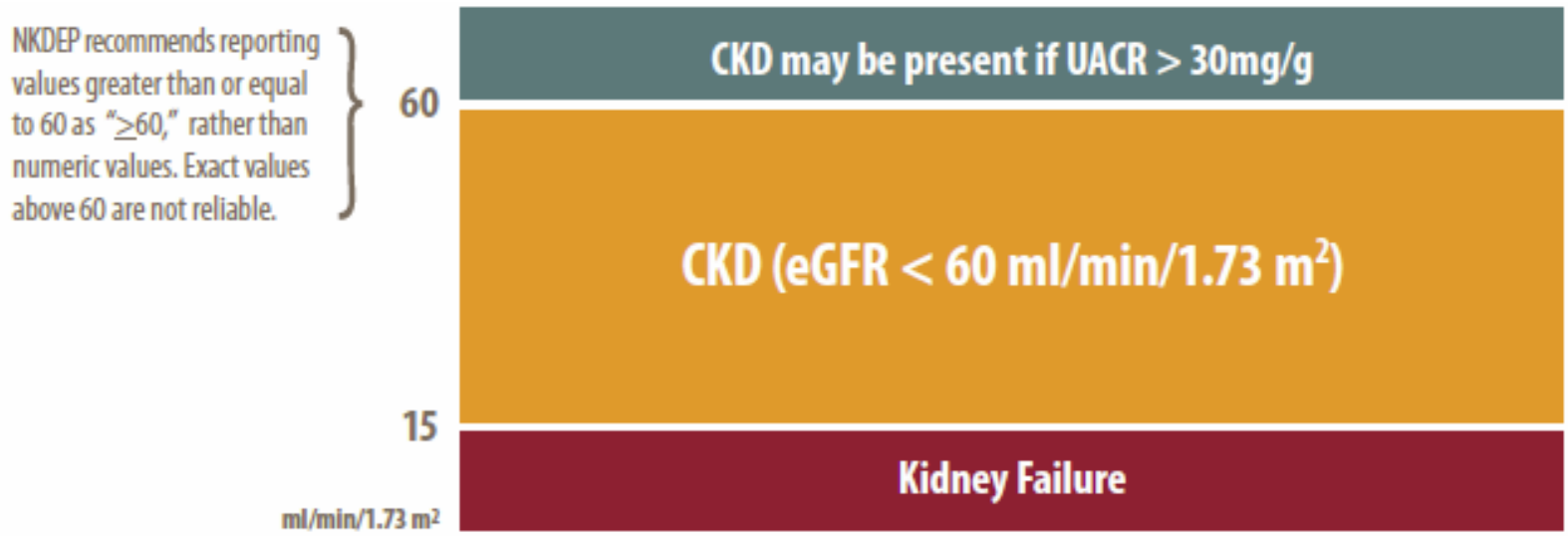
- Keep your blood pressure below 130/80.
- Keep your blood glucose and blood cholesterol in your target range.
- Eat foods that are healthy for your heart and cut back on salt.
- Be physically active.
- Stop smoking.
- Take medicines the way your provider tells you to.

Notes: _____

For more information, visit *www.nkdep.nih.gov* or call 1-866-4 KIDNEY (1-866-454-3639). The National Kidney Disease Education Program (NKDEP) is an initiative of the National Institutes of Health (NIH).

NIH Publication No. 10-6220 • Revised January 2010

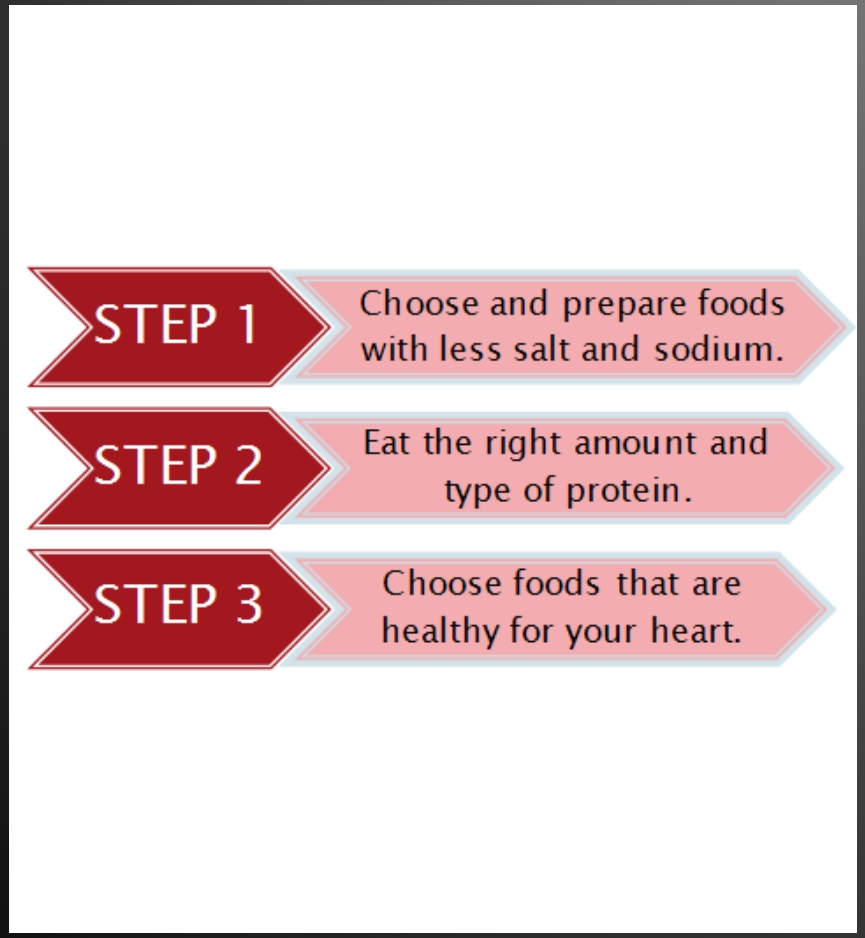
Identify and Monitor CKD

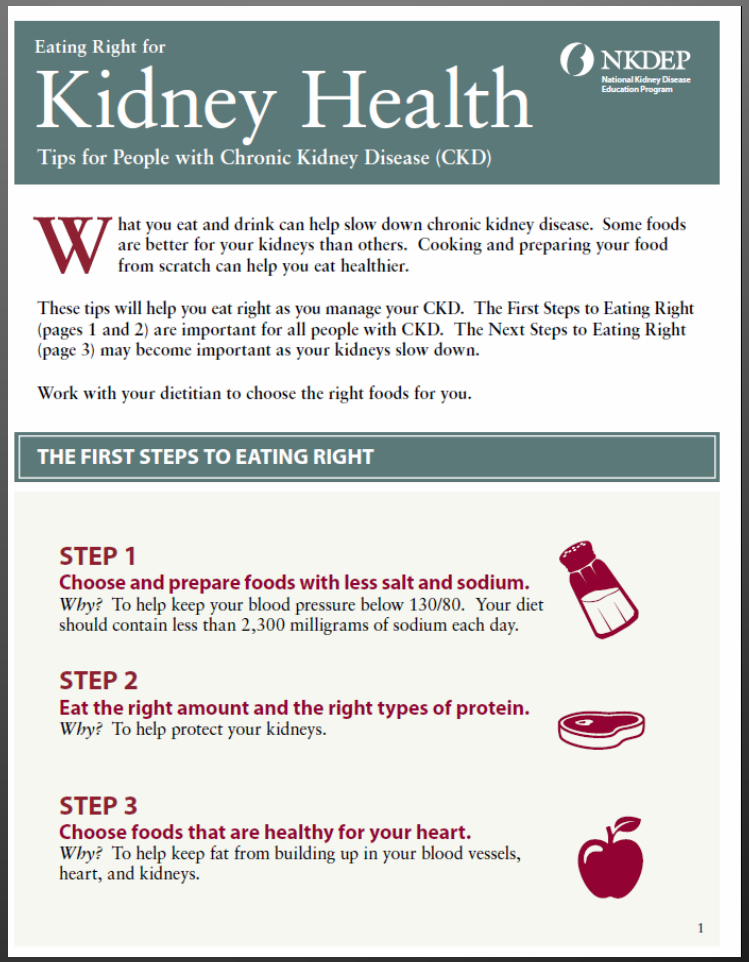


Patient Education Tools

- Eating Right for Kidney Health
- How to Read a Food Label
- Tips for People with CKD
- Sodium
- Protein
- Phosphorus
- Potassium
- Your Kidney Test Results
- Assessment, Management and Treatment

The FIRST STEPS to Eating Right





Eating Right for

Kidney Health

NKDEP National Kidney Disease Education Program

Tips for People with Chronic Kidney Disease (CKD)

What you eat and drink can help slow down chronic kidney disease. Some foods are better for your kidneys than others. Cooking and preparing your food from scratch can help you eat healthier.

These tips will help you eat right as you manage your CKD. The First Steps to Eating Right (pages 1 and 2) are important for all people with CKD. The Next Steps to Eating Right (page 3) may become important as your kidneys slow down.

Work with your dietitian to choose the right foods for you.

THE FIRST STEPS TO EATING RIGHT

STEP 1
Choose and prepare foods with less salt and sodium.
Why? To help keep your blood pressure below 130/80. Your diet should contain less than 2,300 milligrams of sodium each day.

STEP 2
Eat the right amount and the right types of protein.
Why? To help protect your kidneys.

STEP 3
Choose foods that are healthy for your heart.
Why? To help keep fat from building up in your blood vessels, heart, and kidneys.

1

STEP 1 Choose and prepare foods with less salt and sodium.

- Buy fresh food more often. Sodium (a part of salt) is added to many packaged foods.
- Use spices, herbs, and sodium-free seasonings in place of salt.
- Check the Nutrition Facts label on food packages for sodium. A Daily Value of 20% or more means the food is high in sodium.
- Try lower-sodium versions of frozen dinners and other convenience foods.
- Rinse canned vegetables, beans, meats, and fish with water before eating.

Look for Food Labels that Say
• Sodium free • Salt free • Very low sodium • Low sodium • Reduced or less sodium • Light in sodium • No salt added • Unsalted • Lightly salted

STEP 2 Eat the right amount and right types of protein.

- Eat small portions of protein foods.
- Protein is found in foods from plants and animals. Talk to your dietitian about how to choose the right combination for you.

Animal-protein Foods	Plant-protein Foods
• Chicken • Fish • Meat • Eggs • Dairy	• Beans • Nuts • Grains

STEP 3 Choose foods that are healthy for your heart.

- Grill, broil, bake, roast, or stir-fry foods, instead of deep frying.
- Cook with nonstick cooking spray or a small amount of olive oil instead of butter.
- Trim fat from meat and remove skin from poultry before eating.

Heart-healthy Foods
• Lean cuts of meat, like loin or round • Poultry without the skin • Fish • Beans • Vegetables • Fruits • Low-fat milk, yogurt, cheese

The NEXT STEPS…you *may* need to

How to Read a

Food Label

Tips for People with Chronic Kidney Disease (CKD)

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If you have CKD, you may need to limit some nutrients in your diet such as sodium, phosphorus, or potassium. You should limit saturated and trans fats, too. Read the food label to help make healthy food choices for your kidneys.

- Check the Nutrition Facts label for sodium.
- Check the ingredient list for added phosphorus and potassium.
- Look for claims on the label, like "low saturated fat" or "sodium free."

What Should I Look for on the Nutrition Facts Label?

Look for **sodium** on the Nutrition Facts label. Some Nutrition Facts labels will list **phosphorus** and **potassium**, too, but they do not have to.

Look for Sodium on the Nutrition Facts

The amount listed is for one 1-cup serving. If you eat two servings, the amount doubles.

Nutrition Facts

Serving Size: 1 cup (228g)

Servings Per Container: 2

Amount Per Serving	
Calories: 260 **Calories from Fat:** 120	
	% Daily Value*
Total Fat 13g	20 %
Saturated Fat 5g	25 %
Trans Fat 2g	
Cholesterol 30mg	10 %
Sodium 660mg	28 %
Total Carbohydrate 31g	10%
Dietary Fiber 0g	0 %
Sugars 5g	
Protein 5g	

Vitamin A	4%	Vitamin C	2%
Calcium	15%	Iron	4%

* Percent Daily Values are based on a 2,000 calorie diet.

This package has two 1-cup servings.

One serving has 28% Daily Value of sodium.

- 5% or less is low.
- 20% or more is high.

For this food label, 28% Daily Value is **high** for sodium.

One serving has 660 milligrams of sodium.

Look at the Ingredient List

What Should I Look for on the Ingredient List?

1. Look for **phosphorus**, or for words with PHOS, on the ingredient list. Many packaged foods have phosphorus. Choose a different food when the ingredient list has PHOS on the label.

> **Ingredients:** Rehydrated potatoes (Water, Potatoes, Sodium acid pyro**phos**phate), Beef (Beef, Water, Salt, Sodium **phos**phate), Wine...
>
> *This ingredient list shows that the food has added phosphorus.*

2. Look for **potassium** on the ingredient list. For example, potassium chloride can be used in place of salt in some packaged foods, like canned soups and tomato products. Limit foods with potassium on the ingredient list.

> **Ingredients:** Tomato juice, Vegetable juice blend, **Potassium** chloride, Sugar, Magnesium, Salt, Vitamin C (Ascorbic acid), Citric acid, Spice extract, Flavoring, Disodium inosinate, Disodium guanylate.
>
> *This ingredient list shows that the food has added potassium.*

Chronic Kidney Disease (CKD) and Diet:
Assessment, Management, and Treatment

Treating CKD Patients Who Are Not on Dialysis

An Overview Guide for Dietitians

April 2010

Assessment, Management, and Treatment

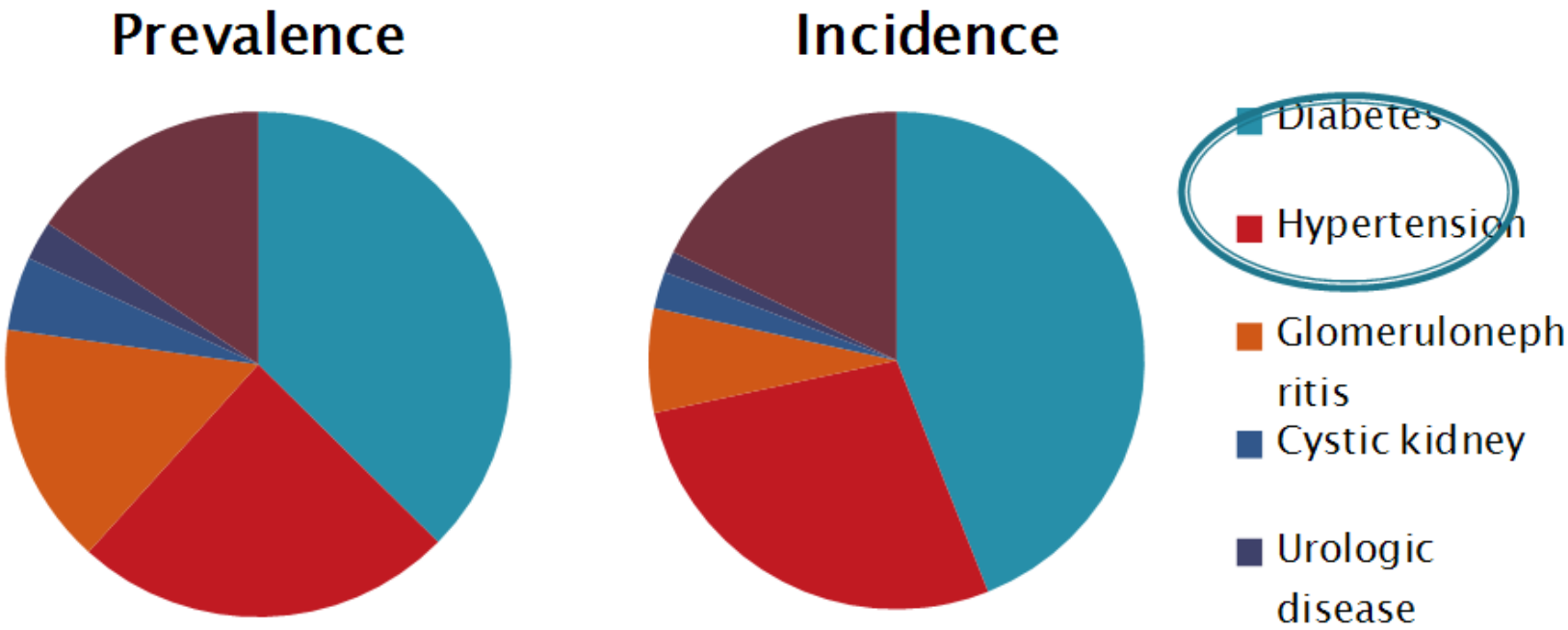
- Intended for Registered Dietitians
  - Provide guidance for nutrition in CKD

  - Assessment (eGFR and UACR)
  - Slow orogression
  - Prevent, monitor and treat complications

Slow progression

- Control blood pressure
- Reduce albuminuria
- Manage diabetes

End Stage Renal Disease, 2007



NIH Publication No. 10-3895

III. Slow Progression

Therapeutic Goal and Its Relevance	Ranges/Goals	Dietary Intervention
Control Blood Pressure Blood pressure control slows progression of CKD and lowers CVD risk. Sodium plays a large role in blood pressure control in CKD as a result of alterations in sodium excretion by the kidneys.	Goal < 130/80 mm Hg	• Limit sodium intake to 2,300 mg a day or less (Sacks, 2001). • Weight reduction may be beneficial. • Monitor serum potassium in patients on renin angiotensin system (RAS) antagonists; limit dietary potassium intake when serum potassium > 5 mEq/L. **Additional Information** For patients with hypertension, reduction of dietary sodium has been associated with improved blood pressure control in clinical trials and epidemiological studies. Multiple medications may be required to control blood pressure. RAS antagonists, such as angiotensin-converting enzyme inhibitors (ACEi) or angiotensin receptor blockers (ARBs), are often used to control blood pressure, delay progression, reduce albuminuria, and protect against heart disease. Diuretics are prescribed to treat fluid overload and high blood pressure, and may help control serum potassium levels.
Reduce Albuminuria Decreased albuminuria is associated with slower progression of CKD, particularly in diabetics. Limiting dietary protein may reduce albuminuria and improve blood glucose control, hyperlipidemia, blood pressure, renal bone disease, and metabolic acidosis.	Reduce or stabilize the amount of albumin lost in the urine (see UACR above on page 2).	Limit excessive dietary protein as follows: • Nondiabetic: 0.8 g protein/kg/day • Diabetic: 0.8-1.0 g protein/kg/day Evidence suggests that further lowering to 0.6 g protein/kg/day in nondiabetic patients may be beneficial, but adherence is difficult. Some patients may be able to achieve this level with intensive counseling. **Additional Information** Limiting excessive protein may activate adaptive responses that decrease albuminuria and increase serum albumin, without increasing risk for protein malnutrition.

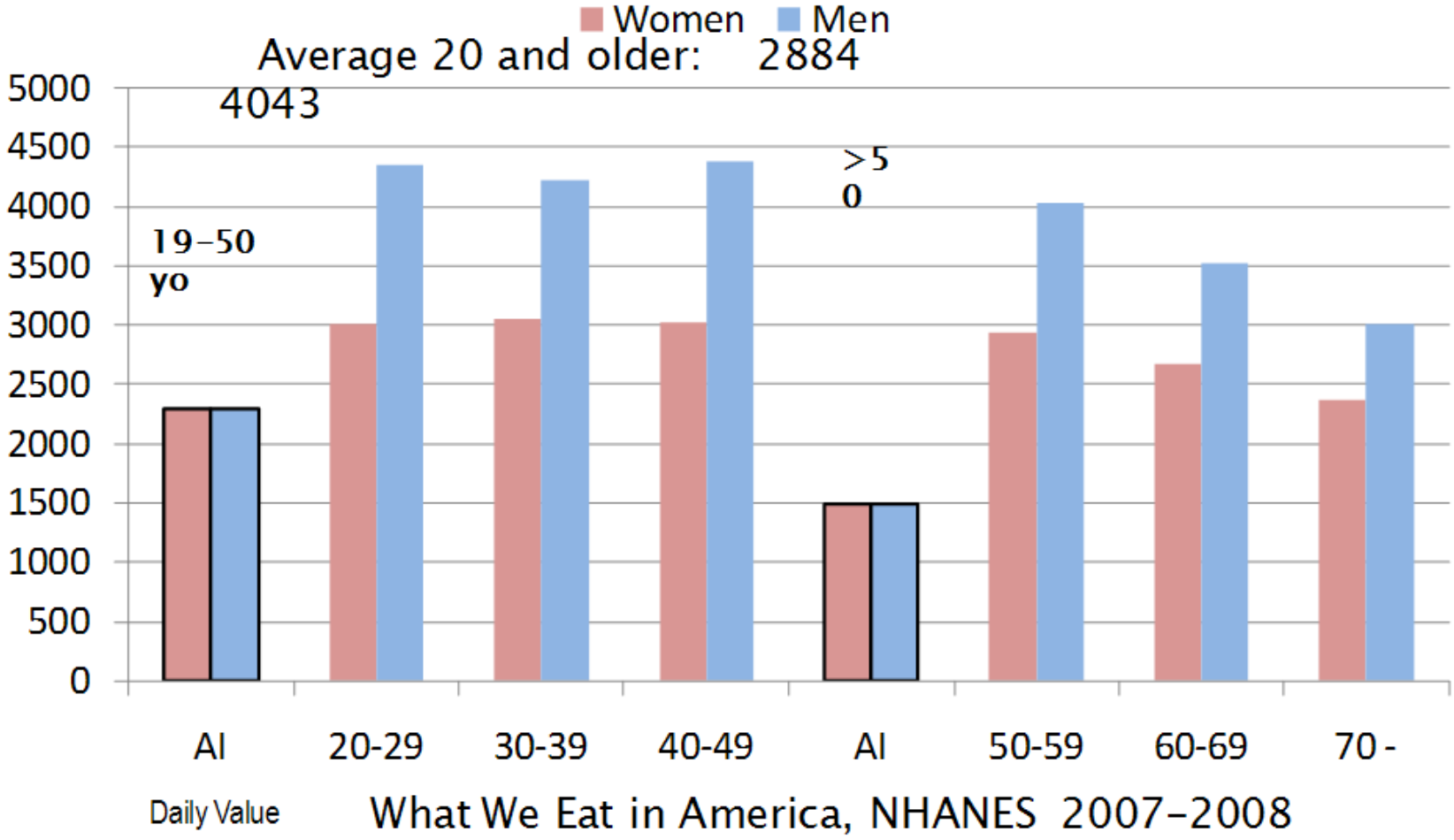
Slow Progression

- Control blood pressure
  - Target < 130/80
  - Limit sodium to ≤ 1,500 mg per day
- Reduce albuminuria
  - Decrease dietary protein, if excessive, to RDA
    - 0.8 g/kg for non-DM
    - 0.8-1.0 g/kg for DM
- Manage diabetes
  - A1c ≤ 7.0%

Control Blood Pressure

- Limit sodium to $\leq$1,500 mg/day
  - Salt substitutes are not recommended due to potassium content
- Weight reduction may be beneficial
- May need multiple medications to control
  - Monitor potassium levels with use of Angiotensin-Converting Enzyme Inhibitor (ACEi) and Angiotensin Receptor Blocker (ARBs)

Sodium (mg/d)


Women
Men
Average 20 and older: 2884
4043
19–50 yo
>50
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
AI
20-29
30-39
40-49
AI
50-59
60-69
70 -
Daily Value
What We Eat in America, NHANES 2007–2008

Sodium

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Tips for People with Chronic Kidney Disease (CKD)

What Is Sodium?

Sodium is a part of salt. Sodium is found in many canned, packaged, and "fast" foods. It is also found in many condiments, seasonings, and meats.

Why Is Sodium Important for People with CKD?

Eating less sodium helps lower blood pressure and may slow down CKD. Your blood pressure goal should be below 130/80.

One of the kidneys' important jobs is to filter sodium out of the body and into the urine. Damaged kidneys cannot filter as well as healthy kidneys can. This can cause sodium to stay in your body and make your blood pressure go up. If your blood pressure is too high, you may need to lower the amount of sodium in your diet.

How Much Sodium Should I Eat Every Day?

Your diet should contain less than 2,300 milligrams each day, or the amount of sodium in one teaspoon of salt. Much of the sodium you eat does not come from a salt shaker. Sodium is added to the prepared foods you buy at the supermarket or eat at restaurants.

Foods *Lower* in Sodium

- Fresh or frozen fruits and vegetables • Rice, noodles • Cooked cereal without added salt
- Fresh meat, poultry, seafood • Low-fat, low-sodium cheese • Unsalted nuts
- Low- and reduced-sodium frozen dinners, peanut butter, salad dressings • Air-popped popcorn

Foods *Higher* in Sodium

- Bacon, corned beef, ham, hot dogs, luncheon meat, sausage • Bouillon, canned, and instant soups
- Boxed mixes, like hamburger meals and pancake mix • Canned beans, chicken, fish and meat
- Canned tomato products, including juice • Canned and pickled vegetables, vegetable juice
- Cottage cheese • Frozen meals • Frozen vegetables with sauce • Olives, pickles, relish
- Pretzels, chips, crackers, salted nuts • Salt and salt seasonings, like garlic salt
- Seasoning mix and sauce packets • Soy sauce • Salad dressings, bottled sauces, marinades
- Some ready-to-eat cereals, baked goods, breads • Ready-to-eat boxed meals and side dishes

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How Do I Lower the Sodium in My Diet?

- Buy fresh foods more often.
- Cook foods from scratch, instead of eating prepared foods, "fast" foods, frozen dinners, and canned foods that are higher in sodium.
- Use spices, herbs, and sodium-free seasonings in place of salt. Check with your healthcare provider about using salt substitutes.
- Rinse canned vegetables, beans, meats, and fish with water to remove extra sodium.

Always read the Nutrition Facts label to compare foods. Choose foods with the lowest Percent Daily Value (%DV) for sodium. The %DV lets you see if a food is high or low in sodium. 5% or less is low and 20% or more is high.

- Check the label on fresh meats and poultry. Sodium additives can be used to make meat last longer.

- Look for foods labeled: sodium free, salt free, very low sodium, low sodium, reduced or less sodium, light in sodium, no salt added, unsalted, and lightly salted.

Nutrition Facts

Serving Size: 1 cup (228g)
Servings Per Container: 2

There may be more than one serving in the package, so be sure to check serving size.

Amount Per Serving

Calories: 260	**Calories from Fat:** 120
	% Daily Value*
Total Fat 13g	20 %
Saturated Fat 5g	25 %
Trans Fat 2g	
Cholesterol 30mg	10 %
Sodium 660mg	28 %
Total Carbohydrate 31g	10%
Dietary Fiber 0g	0 %
Sugars 5g	
Protein 5g	

Vitamin A 4% • Vitamin C 2%
Calcium 15% • Iron 4%

* Percent Daily Values are based on a 2,000 calorie diet.

This number tells you the % DV for sodium in one serving.

Check the Ingredient Label for Added Sodium

- Salt (sodium chloride) • Monosodium glutamate or MSG • Baking soda (sodium bicarbonate)
- Baking powder • Sodium nitrate • Sodium sulfite • Sodium phosphate • Sodium alginate
- Sodium benzoate • Sodium hydroxide • Sodium propionate

For more information, visit *www.nkdep.nih.gov* or call 1-866-4 KIDNEY (1-866-454-3639).

The National Kidney Disease Education Program (NKDEP) encourages people to get tested for kidney disease and educates those with kidney disease and their providers about treatments that can help delay or prevent kidney failure. NKDEP is a program of the National Institutes of Health.

U.S. Department of Health and Human Services
National Institutes of Health

NIDDK National Institute of Diabetes and Digestive and Kidney Diseases

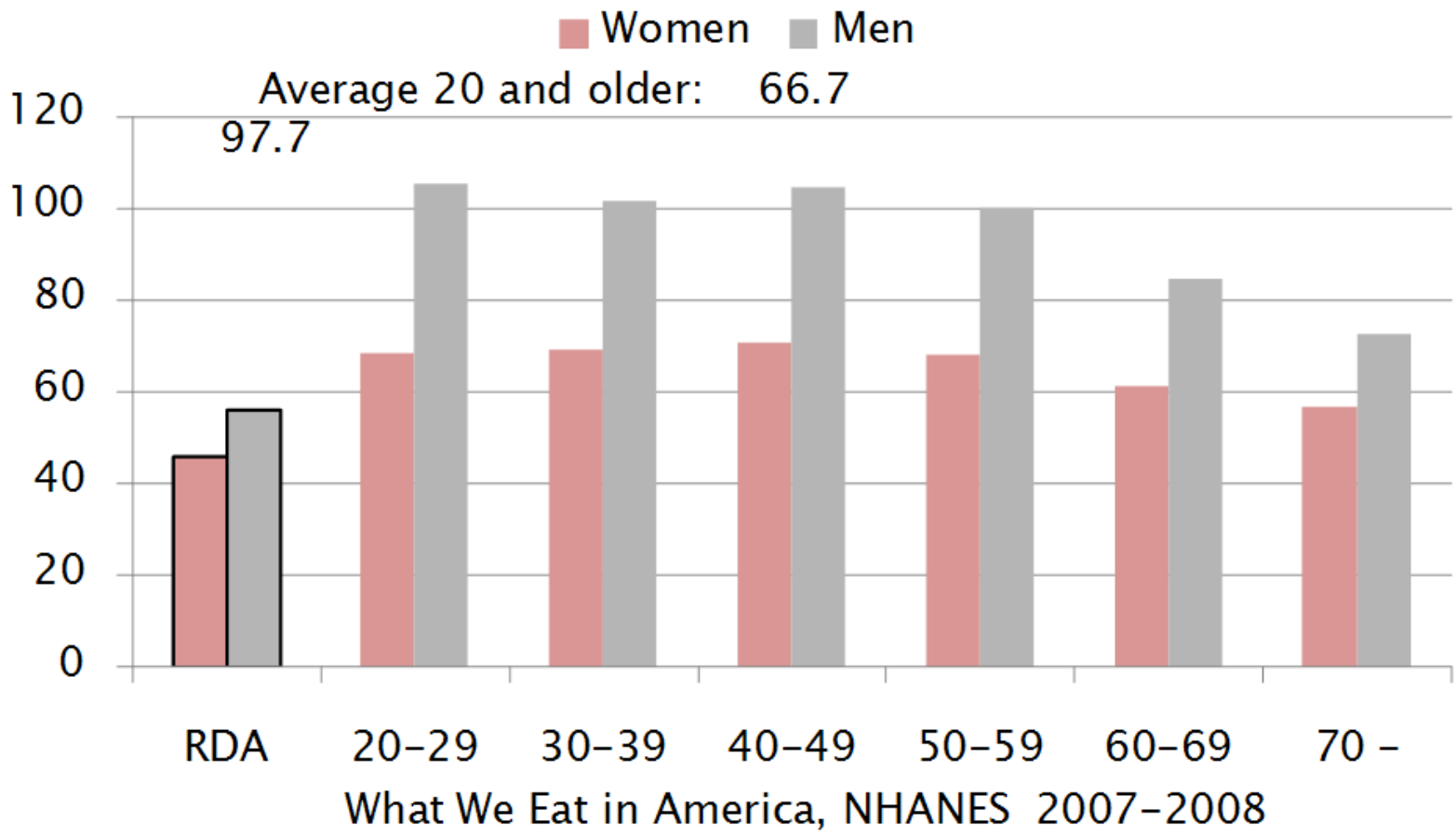
NKDEP National Kidney Disease Education Program

NIH Publication No. 10-7407 • April 2010

Reduce Albuminuria

- Lower dietary protein may lower urine albumin
- Average protein intake: 1.3–1.4 g/kg
  - RDA: 0.8 g/kg body weight
  - Non-diabetes: 0.8 g/kg body weight
  - For diabetes: 0.8–1.0 g/kg body weight

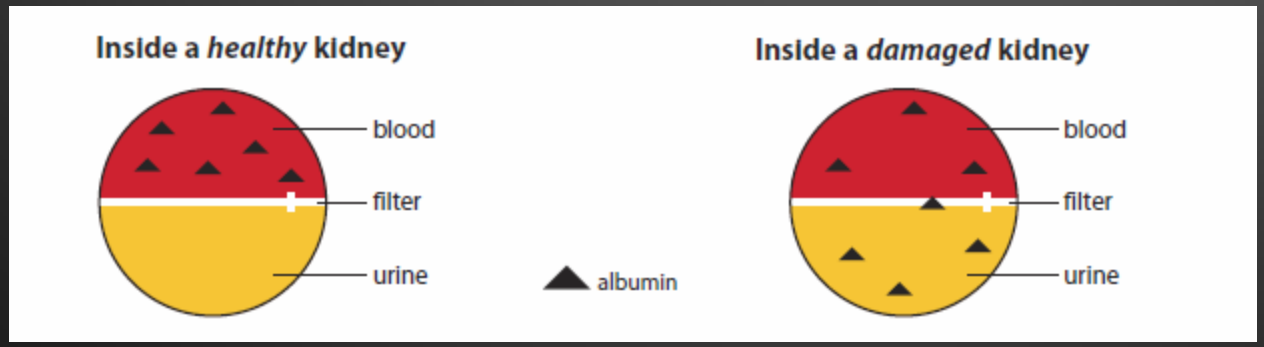
Protein (g/day)



Albuminuria: Risk Factors

- Hypertension
- Diabetes
- Obesity
- Smoking

- ? Hyperlipidemia
- ? High salt diet
- ? High protein diet



If (when) Excessive Protein

- Spontaneous decrease in intake with CKD
- Taste aversion for “meat” is common as eGFR declines
- May need to *increase* protein intake if not eating enough protein
  - Find protein they will eat

Protein

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Tips for People with Chronic Kidney Disease (CKD)

What Is Protein?

Protein is in many foods that you eat. Protein can be found in foods from animals and from plants. Most diets include both types of protein. Protein provides the building blocks that help maintain and repair muscles, organs, and other parts of the body.

Animal-protein Foods

- Meat, such as pork, beef, chicken, turkey, duck
- Eggs
- Dairy products, such as milk, yogurt, cheese
- Fish

Plant-protein Foods

High Protein

- Beans, peas, lentils
- Soy foods, such as soy milk, tofu
- Nuts and nut spreads, such as almond butter, peanut butter, soy nut butter
- Sunflower seeds

Low Protein

- Bread, tortillas
- Oatmeal, grits, cereals
- Pasta, noodles, rice
- Rice milk (not enriched)

Why Is Protein Important for People with CKD?

When your body uses protein, it produces waste. This waste is removed by the kidneys. Too much protein can make the kidneys work harder, so people with CKD may need to eat less protein.

Animal protein includes all of the building blocks that your body needs. Plant proteins need to be combined to get all of the building blocks that your body needs.

1

Protein metabolism produces acid (hydrogen) and nitrogenous waste

How Do I Eat the Right Amount of Protein?

Your dietitian will tell you what amount and types of protein are right for you. Here is some general information about protein types and serving sizes:

- Eat smaller portions of meat and dairy. This will also help you lower the amount of phosphorus in your diet, because phosphorus is found in meat and dairy foods.
  - **Meat, poultry, and fish:** A cooked portion should be about 2 to 3 ounces or about the size of a deck of cards.
  - **Dairy foods:** A portion is ½ cup of milk or yogurt, or one slice of cheese.
- Plant proteins should make up the rest of the protein that you eat. A serving is:
  - ½ cup of cooked beans
  - ¼ cup of nuts
  - a slice of bread
  - ½ cup of cooked rice or noodles

What if I Am a Vegetarian?

There are many good sources of protein for people who do not eat meat or dairy foods. Talk to your dietitian about how to combine plant proteins to be sure you are getting all of the building blocks your body needs.

Notes: _____

For more information, visit *www.nkdep.nih.gov* or call 1-866-4 KIDNEY (1-866-454-3639).

The National Kidney Disease Education Program (NKDEP) encourages people to get tested for kidney disease and educates those with kidney disease and their providers about treatments that can help delay or prevent kidney failure. NKDEP is a program of the National Institutes of Health.

U.S. Department of Health and Human Services
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NKDEP National Kidney Disease Education Program

NIH Publication No. 10-7407 • April 2010

SERVING SIZE:
Size of deck of cards or smaller

Manage Diabetes

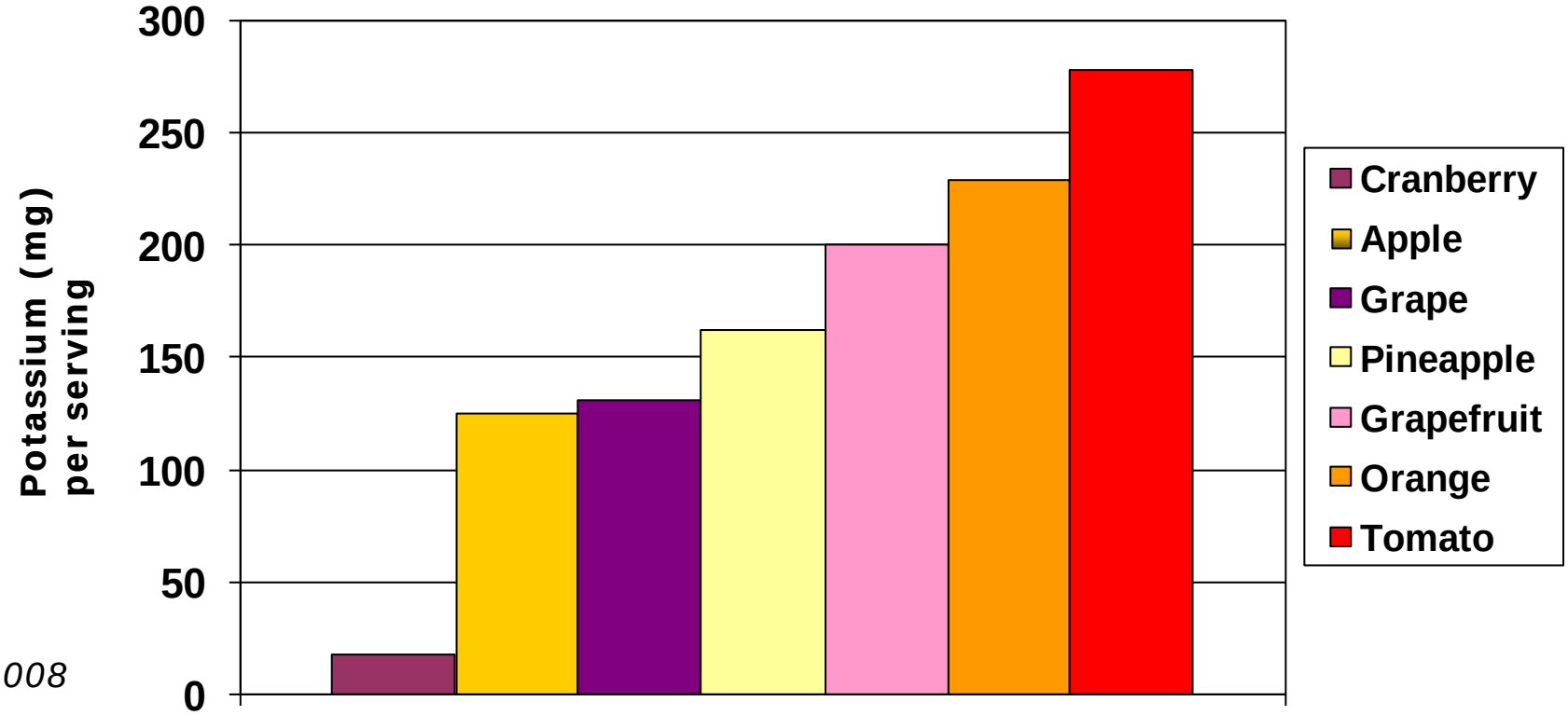
- A1c $\leq$ 7%
  - *Less stringent control with elderly, severe hypoglycemia or multiple comorbid conditions*
  - DCCT and UKPDS showed DM control may help prevent albuminuria
  - Some DM meds are metabolized by the kidneys
  - Spontaneous improvement in DM control may indicate progression of kidney disease

Treat Hypoglycemia Appropriately

- *Any* kind of juice can treat hypoglycemia
- May need to use ½ cup low potassium juice or 3-4 glucose tabs or 10 jelly beans

- Juice counts as fluid for hemodialysis

Potassium in "Juice" (4 oz.)



USDA 2008

Prevent, Monitor, and Treat Complications

Part 1

- Your Kidney Test Results
- Malnutrition
- Metabolic acidosis
- Hyperkalemia (potassium)

Part 2

- Bone disorders (phosphorus)
- Anemia
- Cardiovascular disease

Your Kidney Test Results

NKDEP
National Kidney Disease Education Program

Name: _____ Date: _____

Chronic Kidney Disease (CKD) Tests	Results	Why It Is Important
Glomerular Filtration Rate (GFR)	CKD is less than 60 **Your Result:**	GFR estimates how well your kidneys are filtering blood. Your goal is to keep your GFR from going down.
Urine Albumin-to-Creatinine Ratio (UACR)	CKD is more than 30 **Your Result:**	Urine albumin checks for kidney damage. The lower the result, the better.

Other Important Tests	Results	Why It Is Important
Blood Pressure	Goal: Below 130/80 **Your Result:**	High blood pressure makes the heart work harder and can damage blood vessels in the kidneys.
Serum Albumin	Normal: 3.4 to 5.0* **Your Result:**	Albumin is a protein that helps measure how well you are eating.
Bicarbonate	Normal: More than 22 **Your Result:**	Bicarbonate measures the acid level in your blood.
Blood Urea Nitrogen (BUN)	Normal: Less than 20 **Your Result:**	BUN checks how much urea, a waste product, is in your blood.
Potassium	Normal: 3.5 to 5.0* **Your Result:**	Potassium affects how your nerves and muscles are working. High or low levels can be dangerous.
Calcium	Normal: 8.5 to 10.2* **Your Result:**	Calcium keeps your bones strong and your heart rhythm steady. CKD can lower the amount of calcium in your bones.
Phosphorus	Normal: 2.7 to 4.6* **Your Result:**	Phosphorus is important for strong bones and healthy blood vessels. High levels may cause soft bones, hard blood vessels and itchy skin.
Parathyroid Hormone (PTH)	Normal: Less than 65 **Your Result:**	PTH controls the calcium and phosphorus levels in your blood. It is needed to keep bones and blood vessels healthy.
Vitamin D	Normal: More than 30 **Your Result:**	Vitamin D is important for bones and heart health.

*Normal ranges may vary.

Your Kidney Test Results

Other Important Tests, continued	Results	Why It Is Important
A1C (for patients with diabetes)	Goal: Less than 7 **Your Result:**	A1C measures average blood sugar levels over 2 – 3 months.
Total Cholesterol	Normal: Less than 200 **Your Result:**	Cholesterol measures the amount of fat in your blood. Too much cholesterol can clog blood vessels or arteries in the heart and kidneys.
HDL Cholesterol	Normal: More than 40 **Your Result:**	HDL is the good cholesterol and clears bad fats out of your arteries.
LDL Cholesterol	Normal: Less than 100 **Your Result:**	LDL is the bad cholesterol and can clog your arteries.
Triglycerides	Normal: Less than 150 **Your Result:**	Triglyceride is a type of fat in the blood.
Hemoglobin (Hgb)	Normal: 12 to 17* **Your Result:**	Low hemoglobin is a sign of anemia. Anemia occurs when you don't have enough red blood cells and feel tired.

*Normal ranges may vary.

Malnutrition (Serum Albumin)

- Appetite decreases
- May see aversion to high-protein foods
  - Particularly animal protein
- Need adequate calories and protein
- Monitor serum albumin
  - Target serum albumin > 4.0 g/dL
  - Affected by albuminuria, inflammation, infection, metabolic acidosis, uremia, edema

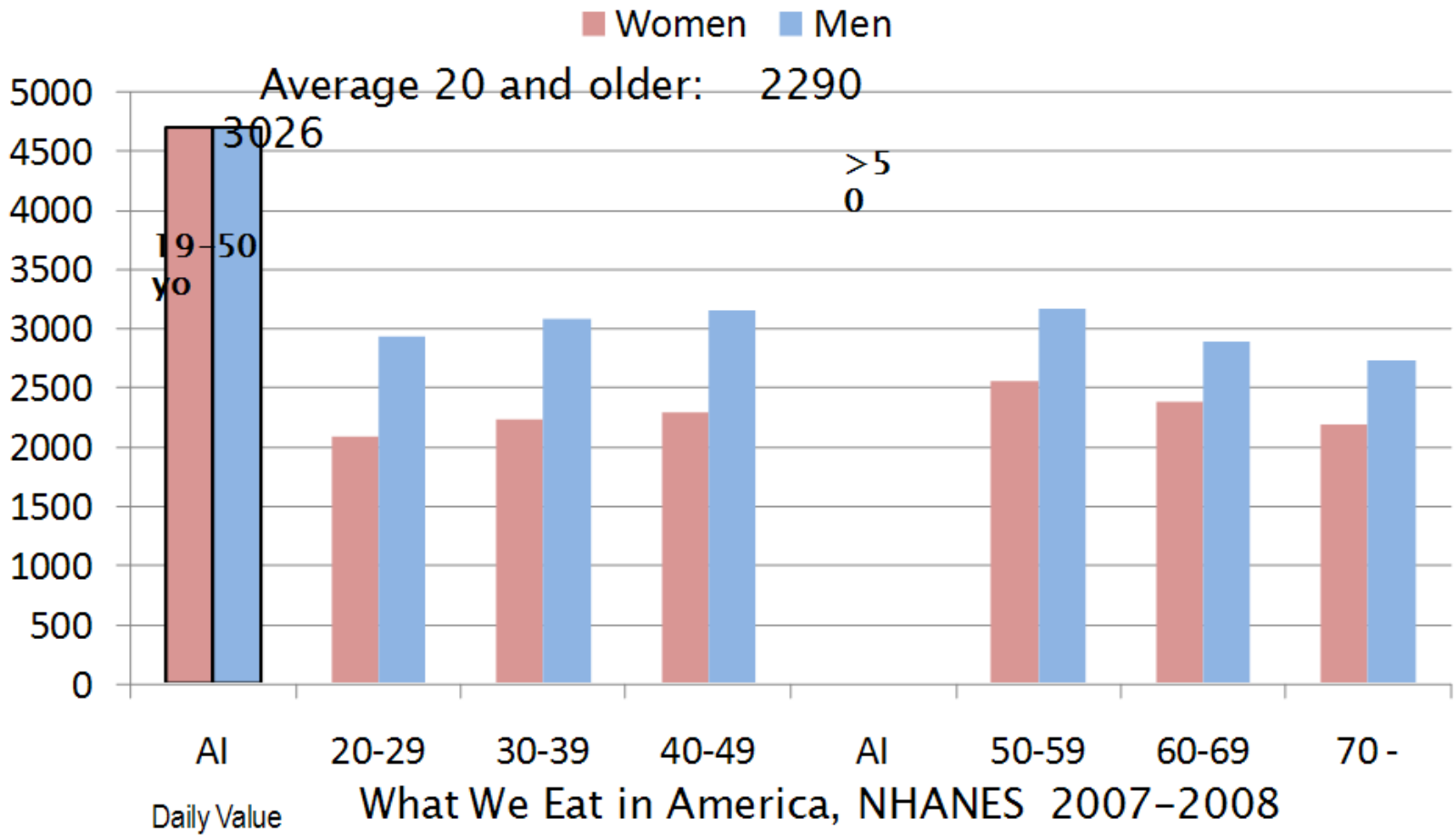
Metabolic Acidosis (Bicarbonate)

- "Too much acid in the blood" – kidneys are not excreting hydrogen (acid)
- Serum CO2 < 22 mEq/L may indicate metabolic acidosis (normal range: 21–28 mEq/L)
- Dietary protein is a source of metabolic acid
- Lowering dietary protein may improve CO2
- Sodium bicarbonate may help correct CO2 level, but adds to sodium load

Hyperkalemia (Potassium)

- May see at higher eGFR in diabetes, and with use of ACEi and ARBs
- Restrict potassium when serum K $\geq$ 5 mEq/L
- Normal range: 3.5–5.0 mEq/L
- Read the Ingredient List for potassium additives such as potassium chloride
- KDOQI (2007) recommends 2400 mg/day
  - *Not* evidence based

Potassium (mg/d)



Potassium

NKDEP
National Kidney Disease Education Program

Tips for People with Chronic Kidney Disease (CKD)

What Is Potassium?

Potassium is a mineral that helps your nerves and muscles work the right way.

Why Is Potassium Important for People with CKD?

In some people with CKD, the kidneys may not remove extra potassium from the blood. Some medicines also can raise your potassium level. Your food choices can help you lower your potassium level.

How Do I Know My Potassium Is High?

People often do not feel any different when their potassium is high. Your health care provider will check the level of potassium in your blood and the medicines you take. The level of potassium in your blood should be between 3.5 to 5.0.*

How Do I Lower Potassium in My Diet?

- Use spices and herbs in cooking and at the table. Salt substitutes often contain potassium and should not be used.
- Drain canned fruits and vegetables before eating.
- **Potassium chloride** can be used in place of salt in some packaged foods, like canned soups and tomato products. Limit foods with potassium chloride on the ingredient list.
- If you have diabetes, choose apple, grape, or cranberry juice when your blood sugar goes down.

Eat These Foods	Instead of These Foods
• White rice	• Brown and wild rice
• White bread and pasta	• Whole wheat bread and pasta
• Cooked rice and wheat cereals	• Bran cereals
• Rice milk (not enriched)	• Cow's milk

*Normal ranges may vary.

1

Refined grains are lower in potassium

How Do I Lower Potassium in My Diet? (continued)

- Choose fruits and vegetables that are lower in potassium. Have very small portions of foods that are higher in potassium, like one slice of tomato on a sandwich, a few slices of banana on cereal, or half of an orange.

Fruits and Vegetables *Lower* in Potassium (200 mg or less*)

FRUITS: Apples/apple juice/applesauce • Apricots (canned)/apricot nectar • Berries • Cranberry juice • Fruit cocktail • Grapes/grape juice • Grapefruit/grapefruit juice • Honeydew melon • Lemons and limes • Mangoes • Papayas • Pears • Peaches • Plums • Pineapple • Rhubarb • Tangerines • Watermelon

VEGETABLES: Alfalfa sprouts • Bell peppers • Bamboo shoots (canned) • Broccoli (fresh) • Cabbage • Carrots • Cauliflower • Celery and onions (raw) • Corn • Cucumber • Eggplant • Green beans • Kale • Lettuce • Mushrooms (fresh) • Okra • Summer squash (cooked)

Fruits and Vegetables *Higher* in Potassium (More than 200 mg*)

FRUITS: Apricots (fresh) • Bananas • Cantaloupe • Dates • Nectarines • Kiwi • Prunes/prune juice • Oranges/orange juice • Raisins

VEGETABLES: Acorn and butternut squash • Avocado • Baked beans • Beet and other greens • Broccoli (cooked) • Brussels sprouts (cooked) • Chard • Chile peppers • Mushrooms (cooked) • Potatoes • Pumpkin • Spinach (cooked) • Split peas, lentils, beans • Sweet potatoes, yams • Vegetable juice • Tomatoes/tomato juice/tomato sauce

*Potassium level is based on one serving. One serving of fruit is one small piece; ½ cup fresh, canned, or cooked fruit; ¼ cup dried fruit; or ½ cup juice. One serving of vegetables is ½ cup fresh or cooked vegetables, 1 cup raw leafy vegetables, or ½ cup juice.

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Prevent, Monitor and Treat Complications – Part 2

CKD and Bone Disorders

- Kidneys fail to maintain serum calcium and phosphorus levels
  - Serum levels are maintained until eGFR is low
- Bones may decalcify
- Extraskeletal tissue may calcify
  - Including vascular system

Renal Bone Diseases

High Bone Turnover

- Secondary hyperparathyroidism
  - Elevated Ca, P, iPTH, alkaline phosphatase (alk phos)

Low Bone Turnover

- Osteomalacia
  - Elevated Ca; normal or elevated P, iPTH, alk phos
- Adynamic bone disease
  - Normal or elevated Ca and P; normal to low iPTH and alk phos

Mixed

- Features of both low and high bone turnover

Bone Disease Basics

- Kidneys "activate" Vitamin D → 1,25 (OH)2D
  - Needed for calcium absorption
  - Increases phosphorus absorption

- Measured as 25(OH)D
  - "Sufficiency" 30 ng/mL or higher
- May need supplement, if using:
  - Monitor for hypercalcemia and hyperphosphatemia

Parathyroid and PTH

- Helps maintain serum calcium levels
- Normal serum level: < 65 pg/dL (intact PTH)
  - Levels vary by kidney function and type of bone disease
- PTH secretion is stimulated by:
  - Hypocalcemia
  - Low levels of 1,25$(OH)_2$D (inverse relationship)
  - Hyperphosphatemia

PTH

- PTH stimulates
  - 1,25$(OH)_2$D formation
    - ↑ Ca absorption in the intestines
    - ↑ P absorption in the intestines
  - ↑reabsorption of Ca in the kidneys
  - ↑ excretion of P by the kidneys
    - Serum phosphorus within normal range
  - **Bone resorption** of calcium and phosphorus
  - Serum Ca within normal range

Serum Calcium

- 8.5-10.2 mg/dL
  - Normal ranges may vary
- 40% transported on albumin
- If hypoalbuminemia, use corrected calcium

  Corrected calcium (mg/dL) =

  serum calcium (mg/dL) + 0.8(4.0-serum albumin g/dL)

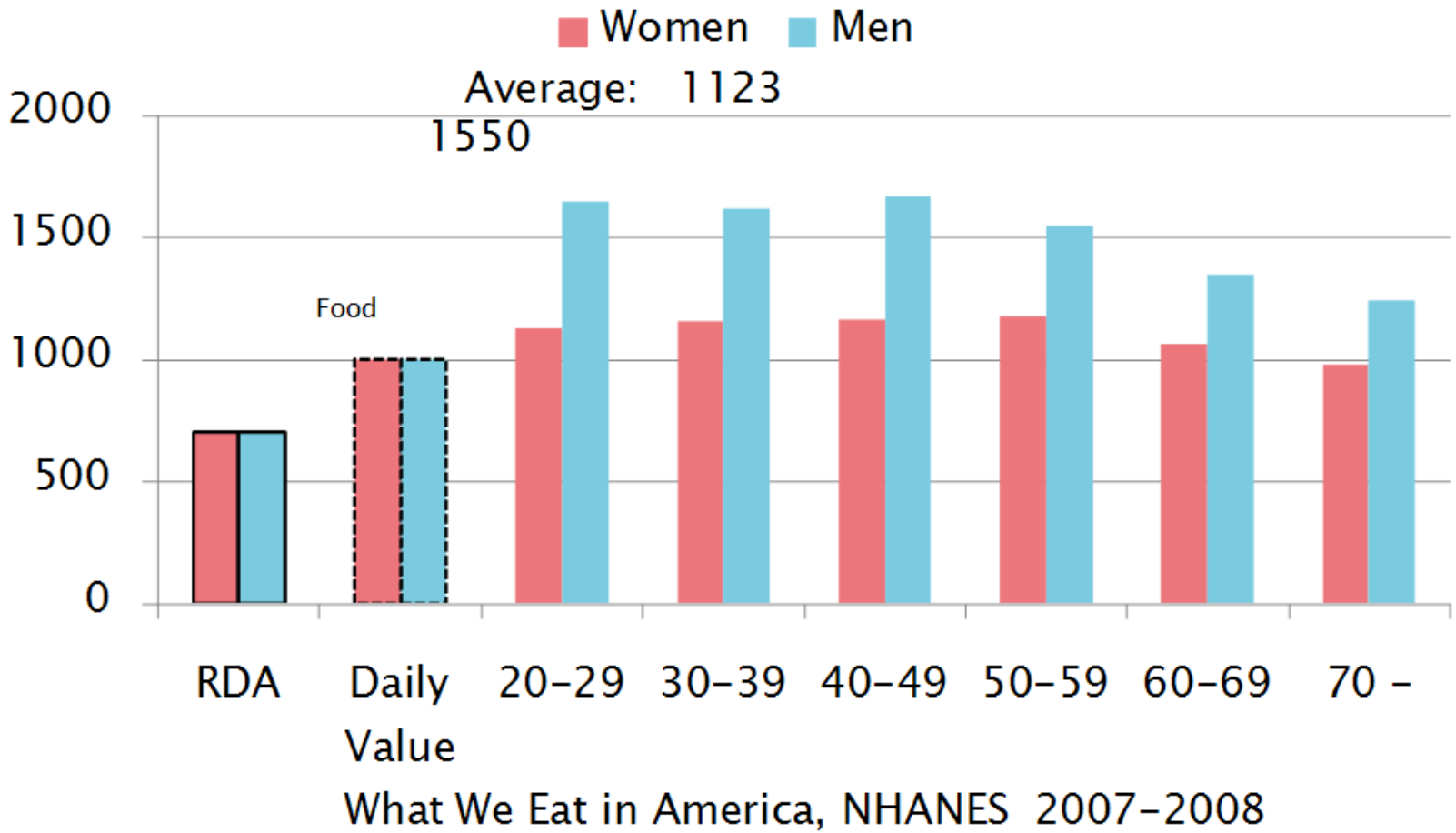
Phosphorus

- Normal range: 2.7–4.6 mg/dL
- Absorption increases with active Vitamin D
- Levels may be normal until CKD is advanced
- Specific restriction for dietary phosphorus has not been determined for CKD
- RDA = 700 mg/day
- May need phosphorus binder (with meals)

Phosphorus (Continued)

- Foods with protein have phosphorus
  - Phytate (in plants) decreases absorption
- Also added to food as an additive
  - Inorganic phosphorus is thought to be absorbed more efficiently than in whole foods
- Read the ingredient list for “phos” to find added phosphorus–and limit, if possible

Phosphorus (mg/d)



Phosphorus

NKDEP
National Kidney Disease Education Program

Tips for People with Chronic Kidney Disease (CKD)

What Is Phosphorus?

Phosphorus is a mineral that helps keep your bones healthy. It also helps keep blood vessels and muscles working. Phosphorus is found naturally in foods rich in protein, such as meat, poultry, fish, nuts, beans, and dairy products. Phosphorus is also added to many processed foods.

Why Is Phosphorus Important for People with CKD?

When you have CKD, phosphorus can build up in your blood, making your bones thin, weak, and more likely to break. It can cause itchy skin, and bone and joint pain. Most people with CKD need to eat foods with less phosphorus than they are used to eating.

Your health care provider may talk to you about taking a phosphate binder with meals to lower the amount of phosphorus in your blood.

Foods *Lower* in Phosphorus

- Fresh fruits and vegetables
- Rice milk (not enriched)
- Breads, pasta, rice

- Corn and rice cereals
- Light-colored sodas/pop
- Home-brewed iced tea

Foods *Higher* in Phosphorus

- Meat, poultry, fish
- Dairy foods
- Beans, lentils, nuts

- Bran cereals and oatmeal
- Colas
- Some bottled iced tea

How Do I Lower Phosphorus in My Diet?

- Know what foods are lower in phosphorus (see page 1).
- Eat smaller portions of foods high in protein at meals and for snacks.
  - **Meat, poultry, and fish:** A cooked portion should be about 2 to 3 ounces or about the size of a deck of cards.
  - **Dairy foods:** Keep your portions to ½ cup of milk or yogurt, or one slice of cheese.
  - **Beans and lentils:** Portions should be about ½ cup of cooked beans or lentils.
  - **Nuts:** Keep your portions to about ¼ cup of nuts.
- Eat fresh fruits and vegetables—if you have not been told to watch your potassium.
- Many packaged foods have added phosphorus. Look for phosphorus, or for words with PHOS, on ingredient labels, like the one below. Choose a different food when the ingredient list has PHOS on the label.

> **Ingredients:** Potatoes, Vegetable Oil (Partially Hydrogenated Soybean Oil), Salt, Dextrose, Disodium Dihydrogen Pyrophosphate…

Examples of Foods that May Have Added Phosphorus

- Fresh* and frozen uncooked meats and poultry
- Chicken nuggets
- Baking mixes
- Frozen baked goods
- Cereals, cereal bars
- Instant puddings and sauces

*Ask the butcher to show you which fresh meats do not have added phosphorus.

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Eating less protein helps lower phosphorus

Check ingredient list for "phos" additives

Bone Disease–Maintain Serum Levels

Calcium

- 8.5–10.2 mg/dL
- Use formula to correct calcium level with hypoalbuminemia

Phosphorus

- 2.7–4.6 mg/dL
- May need phosphorus restriction
- May need phosphate binder

iPTH

- < 65 pg/mL
- Measured as intact PTH

Vitamin D

- 30 ng/dL
- Measured as 25(OH)D
- If using active Vitamin D supplement, monitor for hypercalcemia and hyperphosphatemia

Anemia

- Target Hgb: Normal 12 – 17 g/dL (varies by gender)
- Due to inadequate synthesis of erythropoietin (and inflammation, uremia, lack of iron…)
- Effectiveness of treating in CKD is under debate
- Check iron status first, if treating with erythropoiesis stimulating agents (ESAs)
  - Ferritin > 100 (storage iron)
  - TSAT > 20% (iron in circulation)
- May need oral or intravenous iron to replete

Cardiovascular Disease

- Consider patients with CKD at high risk
- Leading cause of mortality in CKD
- Total cholesterol < 200 mg/dL
- LDL < 100
- HDL > 40
- Triglycerides < 150
- Limit saturated and trans fats

Dialysis Diets and Summary

Individualize	Hemodialysis (3 x/week)	Peritoneal Dialysis (daily)
•Need more protein •At least 50% high biologic value	> 1.2 g/kg	1.2 – 1.3 g/kg
Calories per kg	< 60 years 30–35 > 60 years 30	< 60 years 30–35 > 60 years 30 •Calories in PD solutions
Sodium	2,000 mg	2,000–3,000 mg
Potassium	2,000–3,000 mg	3,000–4,000 mg
Phosphorus	800–1,000 mg	800–1,000 mg
Calcium	< 2,000 mg (binders)	< 2,000 mg (binders)
Fluid	Output + 1,000 cc	As needed

SUMMARY

- Monitor eGFR and UACR
- The FIRST STEPS
  - $\leq$1,500 mg sodium (control blood pressure)
  - Reduce protein, if excessive (lower albuminuria)
  - Control diabetes (may need low K juice)
  - Choose heart healthy fats
- The NEXT STEPS
  - Phosphorus – check ingredient list for “phos”
  - Potassium – check ingredient list for potassium