

# Chapter 21 : Nutrition for Patients with Kidney Disorders

# Kidney Functions

- Maintain normal blood volume and composition
  - By reabsorbing needed nutrients and excreting wastes through urine
- Blood pressure regulation through the action of **rennin**
- RBC production through the action of **erythropoietin** (stimulates the bone marrow to produce red blood cells)

# Kidney Functions

- help to regulate acid–base balance
  - by secreting **hydrogen ions** to increase pH and excreting **bicarbonate** to lower pH
- Maintaining normal metabolism of calcium and phosphorus.
  - Because vitamin D is converted to its active form in the kidneys

# Kidney Disorders

- NEPHROTIC SYNDROME
- CHRONIC KIDNEY DISEASE
- ACUTE RENAL FAILURE
- KIDNEY STONES

# NEPHROTIC SYNDROME

- A collection of symptoms that occurs when **increased capillary permeability** in the glomeruli  
→ allows serum proteins to leak into the urine.
- Major symptoms :
  - Proteinuria
  - Hypoalbuminemia
  - Hyperlipidemia (because of increased hepatic lipogenesis)
  - Edema

# NEPHROTIC SYNDROME

- Causes :
  - Diabetes
  - Autoimmune diseases (e.g., lupus, IgA nephropathy)
  - Infection
  - certain chemicals and medications

# Nutrition Therapy

- The goals of nutrition therapy are to :
  - minimize edema, proteinuria, and hyperlipidemia;
  - replace nutrients lost in the urine;
  - and reduce the risk of progressive renal damage and atherosclerosis.

# Nutrition Therapy

- A mild **protein “restriction”** of 0.8 to 1.0 g/kg of body weight
- Along with the use of an angiotensin-converting enzyme (ACE) inhibitor
  - decreases urinary protein losses



## Nutrition Therapy for Nephrotic Syndrome

Dietary Component	Recommendation	Rationale
Protein	0.8–1.0 g/kg/day; soy protein may be more beneficial than animal proteins	To minimize proteinuria; soy protein may decrease proteinuria more than high-biologic value proteins
Calories	35 cal/kg	To maintain weight and spare protein A lower calorie intake to promote weight loss is recommended if blood pressure or hyperlipidemia are problems
Sodium	1000–2000 mg	To help control edema; fluid restriction is generally not necessary
Fat and cholesterol	<30% of calories from total fat, <7% of calories from saturated fat, <200 mg cholesterol, and low trans fats	To improve hyperlipidemia 12 g of fish oil/day may be useful for IgA nephropathy
Vitamins and minerals	DRI amounts unless otherwise indicated	A multiple vitamin may be used to prevent nutrient deficiencies because many vitamins are bound to protein and are lost through proteinuria Vitamin D and calcium are given if vitamin D is deficient Iron is given if deficient

# CHRONIC KIDNEY DISEASE (CKD)

- Syndrome of progressive kidney damage and loss of function.
- Over time, a decrease in the number of functioning nephrons overburdens the remaining nephrons
  - and the kidney's ability to filter blood deteriorates, as measured by a decrease in **glomerular filtration rate (GFR)**

## Classification of Chronic Kidney Disease Stages

Stage	Description	GFR (mL/min/1.73 m <sup>2</sup> )
1	Kidney damage with normal or increased GFR	≥90
2	Kidney damage with mildly decreased GFR	60–89
3	Moderately decreased GFR	30–59
4	Severely decreased GFR	15–29
5	Kidney failure	<15 or dialysis

# CHRONIC KIDNEY DISEASE (CKD)

- For **stages 1 to 4**:
  - medical and nutrition therapy **can potentially delay the progression to stage 5.**
- Modifiable risk factors (reduce CKD damage) :
  - Smoking cessation
  - increase in physical activity
  - controlling blood lipid levels
- People with CKD that progresses to **stage 5** :
  - require **dialysis** or **kidney transplant** for survival.

# CKD : Causes

- Diabetes ( ~40% of cases).
- Cardiovascular disease
- Hypertension
- Obesity

# Impact on Nutrition

- As urine output **decreases**
  - fluid and electrolytes **accumulate** in the blood
    - producing symptoms of **overhydration** such as:
      - increased blood pressure
      - weight gain
      - Edema
      - shortness of breath
      - lung crackles

# Impact on Nutrition

- The retention of nitrogenous wastes leads to **uremic syndrome**.
  - **Uremic Syndrome:** a cluster of symptoms related to the retention of nitrogenous substances in the blood such as fatigue, decreased mental acuity, muscle twitches, cramps, anorexia, unpleasant nausea, vomiting, diarrhea, itchy skin, gastritis, and GI bleeding
- **Acidosis** occurs because the kidneys are unable to excrete excess acid produced through normal metabolic processes

# Impact on Nutrition

- Impaired synthesis of **rennin** can lead to
  - **high blood pressure**
- Impaired synthesis of **Erythropoietin** can lead to
  - **Anemia**
- Impaired synthesis of the **active form of vitamin D** can lead to:
  - **bone demineralization**



# Nutrition Therapy

- For stage 1-4 :
  - Protein is restricted to 0.6 – 0.75 g/kg
  - To reduce workload on the kidneys to delay or prevent further kidney damage
- For stage 5 (dialysis):
  - 50% more than the RDA
  - to account for the loss of serum proteins and amino acids in the **dialysate**.

# Nutrition Therapy

- High–biologic value proteins are emphasized
  - They provide **higher percentage of essential a.a** →
  - promote reuse of circulating nonessential amino acids for protein synthesis →
  - minimizes urea production

# Nutrition Therapy

- **Calories**

- adequate calories to **spare protein** from being used for energy, enabling it to be used for protein synthesis.

- Clients who must **limit their intake of protein** may be advised to increase their intake of **pure sugars** and **pure fats**

- to meet their calorie requirements while keeping protein intake low, even though they are not considered “nutritious.”



## Q U I C K B I T E

Examples of pure sugars and pure fats

Pure sugars: cotton candy, fruit rollups, jelly beans, lollipops, marshmallows, honey, jam, maple syrup, sweetened beverages (within fluid allowance)

Pure fats: butter, margarine, mayonnaise, oils, shortening

# Nutrition Therapy

- **Sodium and Fluid**

- Fluid is **unrestricted in stages 1 to 4** with normal urine output.

- For people on **hemodialysis:**

- Fluid allowance equals the volume of any urine produced plus 1000 mL.

- **Should be taught how to control their intake and thirst is vital**

## STRATEGIES TO RELIEVE THIRST

- Use ice or popsicles within the fluid allowance—very cold things are better at relieving thirst.
- Suck on hard candy or mints.
- Chew gum.
- Rinse your mouth without swallowing using refrigerated water.
- Rinse your mouth occasionally with refrigerated mouthwash.
- Suck on a lemon wedge.
- Eat bread with applesauce or jelly with margarine.
- Control blood glucose levels, as appropriate.
- Try frozen low-potassium fruit, such as grapes.
- Use small glasses instead of large ones.
- Apply petroleum jelly to the lips.

# Phosphorus and Calcium

- In stages 1 to 4:
  - Phosphorus allowance is based on laboratory values
  - calcium is limited to 1000 to 1500 mg/day.
- A low phosphorus intake is relatively easy to achieve because protein intake is also restricted in these stages and protein and phosphorus share similar dietary sources.
- When dialysis :
  - protein allowance increases, phosphorus intake correspondingly increases

## Calcium, Phosphorus, and Protein Content of Selected Foods

Item	Amount	Calcium (mg)	Phosphorus (mg)	Protein (g)
<b>Grains</b>				
White bread	1 slice	27	24	2
Whole wheat bread	1 slice	20	64	3
Long-grain rice	½ cup	10	81	3
Corn tortilla	1 med	44	79	1
<b>Vegetables</b>				
Artichoke, boiled	1 med	135	258	3
Kale, frozen, boiled	½ cup	90	18	2
Spinach, boiled	½ cup	122	50	3
Turnip greens, boiled	½ cup	99	21	1
<b>Fruits</b>				
Orange juice, calcium fortified	¾ cup	200	25	0
Avocado, raw	1 med	13	45	2
<b>Milk</b>				
Skim	1 cup	302	247	8
2%	1 cup	297	232	8
Chocolate milk (with 1% milk)	1 cup	287	256	8
Low-fat fruit-flavored yogurt	1 cup	314	247	8
Cheddar cheese	1 oz	214	145	7
<b>Meat and Beans</b>				
Ground beef, broiled	3½ oz	12	191	27
Ham, cured, roasted	3½ oz	6	224	19
Chicken breast, roasted	½	13	196	27
Salmon, Chinook	3 oz	24	316	22
Refried beans, canned	½ cup	45	109	7
Great northern beans, canned	½ cup	70	178	7
Egg, poached	1	25	89	6
Almonds, blanched	1 oz	73	150	6
Peanut butter	2 tbsp	12	101	7

grains  
vegetables  
milk  
meat and beans  
selected foods



## Choice Lists and Examples of Representative Foods

Choice Lists	Examples of Representative Foods
High-protein foods	Beef, fish, eggs, poultry, shellfish
High protein and high phosphorus	Cheese, dried peas and beans, milk, yogurt, tofu
High protein and high sodium	Canned tuna and salmon; cottage cheese; deli beef or turkey; vegetarian burgers
Vegetables	
Low potassium	Cabbage, carrots, corn, eggplant, green beans, onions
Medium potassium	Asparagus, broccoli, celery, peas, turnips, zucchini
High potassium	Avocado, Brussels sprouts, "greens," okra, potatoes, pumpkin, spinach, sweet potatoes, tomatoes, yams
Bread, cereal, and grain	Bagel, bread, pita, flour tortilla, low-salt ready-to-eat cereals, pasta, rice, unsalted crackers
Bread, cereal, and grain with added salt and phosphorus	Muffins, oatmeal, most ready-to-eat cereals, pancakes, waffles
Fruit	
Low potassium	Apples, blueberries, grapes, pineapples, watermelon
Medium potassium	Cherries, cantaloupe, papaya, prunes, raisins
High potassium	Apricots, bananas, nectarines, orange juice, prune juice
Fluids	Beverages, ice, soup, gelatin; ice cream and ice milk (each melt to ½ initial volume)
Calorie and flavoring	Gumdrops, hard candy, jelly, jelly beans, lifesavers, margarine, mayonnaise, sugar, syrup, vegetable oil
Salt	2 tbsp ketchup, 1/8 dill pickle, 1/8 tsp salt, ¾ tsp soy sauce, 3 tbsp taco sauce

choice list

high protien foods vegetablesfruit fluids salt

# ACUTE RENAL FAILURE (ARF)

- The sudden loss of renal function characterized by:
  - acute increase in serum creatinine
  - decrease in urine output
- It can develop over a period of hours or days, and the impairment can range from mild to severe

# ACUTE RENAL FAILURE (ARF)

- causes of ARF :
  - Severe infection
  - Trauma
  - Medications
  - Obstruction
- In most cases, patients who recover from the underlying illness are able to recover from ARF

# Nutrition Therapy

- It has **NOT** been proven that nutrition therapy for ARF promotes recovery of kidney function or improves survival
- But it is a way of supporting the patient until the underlying illness is controlled

## Nutrition Guidelines for Acute Renal Failure

Nutrient	Recommendations	Factors that Impact Actual Allowance
Protein	0.6–2.0 g/kg	Degree of catabolism Renal function Use of dialysis
Calories	35–50 cal/kg	Degree of stress Nutritional status
Sodium	1.1–3.3 g/day	Serum sodium levels Blood pressure Edema Urinary losses (in diuretic phase) Use of dialysis
Potassium	2.0–3.0 g/day	Serum potassium levels Urinary losses (in diuretic phase)
Phosphorus	Individualized	Serum phosphorus levels
Calcium	Individualized	Serum calcium levels
Fluid	500 mL + urine output	Urine output Type of dialysis, if any
Vitamins and minerals	DRI amounts	Level of catabolism

acute renal failure protien  
acute renal failure calories  
acute renal failur sodium  
acute renal failure potassium

# KIDNEY STONES

- Form when insoluble crystals precipitate out of urine
- Composition of the stones :
  1. calcium oxalate (75% of kidney stones)
  2. calcium phosphate, uric acid, or magnesium ammonium phosphate (the remaining)

# Kidney Stones : Risk Factors

- Dehydration
- low urine volume
- urinary tract obstruction
- Gout
- Chronic inflammation of the bowel
- Intestinal bypass or ostomy surgery

# Kidney Stones : Risk Factors

- Nutritionally :
  - inadequate fluid intake
  - Excessive intakes of oxalate, calcium, protein, and sodium
- may increase the risk of calcium oxalate stones in **susceptible people**.



# Fluid Intake

- *Fluid.*
  - A low fluid intake concentrates the urine, increasing the likelihood of chemicals precipitating out to form kidney stones—regardless of the composition of the stone.
- An adequate fluid intake helps keep urine dilute.

# Oxalate

- *Oxalate.*
  - Normally only 6% to 14% of **oxalate** consumed is absorbed
- Hyperoxaluria is a primary risk factor for the formation of calcium oxalate kidney stones
  - can be caused by genetic disorders, altered bowel function, or a high oxalate intake
- People who have **hyperoxaluria**, known as “super absorbers,” can absorb 50% more oxalate than nonstone formers

# Oxalate

- People who form **calcium oxalate stones** are advised to limit their intake of oxalate, which is found primarily in plants
- Because **megadoses** of vitamin C increase both oxalate absorption and oxalate synthesis in people prone to calcium oxalate stones, daily doses should be limited to less than 2000 mg/day

## FOODS HIGH IN OXALATE

Nuts: peanuts, almonds, pecans, cashews, walnuts

Nut butters

Tea

Instant coffee (more than 8 oz/day)

Rhubarb

Beets

Beans: green, wax, baked, and dried, such as kidney beans, garbanzo beans, pinto beans

Berries: blackberries, raspberries, strawberries, gooseberries

Chocolate

Concord grapes

Dark leafy greens

Oranges

Tofu

Sweet potatoes

Draft beer

# Oxalate and Ca intake

- Dietary calcium favorably binds with dietary oxalate in the intestines, forming an insoluble compound that the body cannot absorb
- When calcium intake is low, more oxalate is available for absorption and the risk of stone formation increases.
- A normal calcium intake consumed throughout the day is recommended to prevent stone formation.

- *Protein.* High intakes of animal protein increase urinary excretion of calcium, oxalate, and uric acid, and reduce urinary pH .
  - Protein intake in excess of the RDA is not recommended for people with a history of calcium oxalate kidney stones.
- *Sodium.* A high sodium intake promotes urinary calcium excretion by decreasing calcium reabsorption by the kidney .
  - Patients with hypercalciuria should limit their intake of sodium.