

## **Nutrition and the Kidneys: Kidney Disease and Renal Diets**

*The kidneys are bean-shaped organs, each about the size of a fist and located on our backside just below the rib cage. They perform several important functions in the body, especially in keeping our blood clean.*

*Surprisingly, diseases of the kidney and urinary tract affect over 20 million people and over 50,000 people die each year due to kidney disease. Chronic kidney failure is the ninth leading cause of death in the United States and one of the costliest illnesses to treat. Therefore, keeping the kidneys functioning properly is vital to maintaining good health.*

### **What is a Renal Diet?**

A renal diet is one that has been carefully designed to help an individual with kidney disease reduce unfavorable symptoms and hopefully slow the progression of the disease. When the kidneys become diseased, it may lose all or only part of its ability to function properly. The goal of the renal diet is to help maximize the remaining ability of the kidneys to filter and excrete toxins in the blood, without overworking them too much. Some of the specifics of the diet will be discussed below.

### **What Do the Kidneys Do?**

The kidneys have three general, but very important, functions in the body: regulation, excretion, and synthesis. All the body's blood is filtered through the kidneys constantly, working to balance the levels of fluid and maintain the just the right environment in the blood for it to remain healthy. Each day, about 50 gallons of blood is filtered through the kidneys!

As the blood passes through a healthy kidney, it pulls out any toxic substances from the blood to keep the blood clean. The kidneys reabsorb what they need while excreting excess chemicals from the digestion of protein (like uric acid and ammonia) along with other elements like potassium, hydrogen, sodium and phosphorus when there is too much in the blood.

A normal kidney has an almost unlimited ability to regulate water balance and typically excretes more than 200 waste products through the urine. A healthy individual will produce about ½ gallon of urine each day. The kidneys are also involved in making and releasing certain hormones that help regulate blood pressure and produce red blood cells. They also function in making certain vitamins like Vitamin D, which is important in helping to absorb calcium for good bone health.

Humans have two kidneys that are constantly working, but we can live on one if necessary. When the kidneys become diseased, however, changes need to be

made to help decrease problems and slow the progression to complete kidney failure.

### **What is Kidney Disease?**

Kidney disease is a progressive condition, that can vary from mild to severe, to complete kidney failure. If the kidneys were to lose all function, toxins would remain in the blood, chemical imbalances would cause the heart and other organs to dysfunction, fluid would build up in the blood leading to increased blood pressure and heart problems - and the result would be fatal. This is why treatment – which includes medications, diet and other therapies – is so important at all stages of kidney disease.

### **What Causes Kidney Disease?**

In the United States, the two leading causes of kidney failure are diabetes and uncontrolled high blood pressure, together accounting for over 60% of all cases. When these two diseases are treated and controlled by lifestyle changes (diet, exercise, and behavioral practices) and medications, kidney disease can often be prevented or slowed.

However, if uncontrolled, kidney function can fail completely and be fatal – as evidenced by being the 9<sup>th</sup> leading cause of death in the U.S. Most patients with untreated End Stage Renal Disease (ESRD) eventually die from *heart problems* as a result of the kidney disease, contributing to our #1 killer in the U.S.

### **The Six Warning Signs of Kidney Disease**

The National Kidney Foundation list the following six early warning signs of possible kidney and urinary tract disease:

1. Burning or difficulty during urination;
2. More frequent urination, particularly at night;
3. Passage of bloody-appearing urine;
4. Puffiness around eyes, swelling of hands and feet, especially in children;
5. Pain in the small of the back just below the ribs;
6. High blood pressure.

Experiencing any of these signs does not guarantee a diagnosis of kidney disease or urinary tract problems, but are simply warning signs that the kidneys may not be working well, especially if a person experiences several of the items on the list simultaneously.

### **How is Kidney Disease Treated?**

Every individual with kidney disease is unique, and treatment is very individualized based on the cause, stage of progression, other coexisting health conditions, and medications. Some individuals in earlier stages of kidney disease can manage their condition with diet, exercise, and medications. A *predialysis renal diet* is prescribed to individuals who have reduced, but not yet more than 50% loss of kidney function. Many researchers have shown that

kidney functions can be improved or reversed through nutritional therapy at earlier stages of kidney failure.

When over 50% of the kidneys' function has been lost, progression to ESRD, or complete kidney failure, will eventually occur in most individuals. A *predialysis renal diet* can still help slow the decline and plays an important role in keeping adverse symptoms to a minimum.

Once 90% of the kidneys' ability to function is gone, however, treatment options turn to either regular dialysis (through an artificial kidney machine) or eventual kidney transplant. With dialysis, different nutritional recommendations are important and a *renal diet for patients on dialysis* is prescribed. The reason behind two distinct diets and set of nutritional considerations depending on the stage of lost renal function is because when a patient is being dialyzed, he or she is actually getting "help" from a machine or solution to filter out the toxins that accumulate in the blood. When a person is not on dialysis, he or she must rely on the remaining (reduced) function of the kidney in filtering the blood and excreting the excesses.

### **The Predialysis Renal Diet – Early Stages of Kidney Disease**

A specialized diet can aid in controlling the buildup of waste products and fluid in the blood and minimize the work of declining kidneys. The main focus of the diet is to keep the patient as healthy as possible. A renal physician (nephrologist) will often refer the patient to a Registered Dietitian who is specialized in kidney diseases (renal dietitian) with a recommendation for the type of diet to initiate. Each patient requires a specialized diet according to his or her unique medical condition and should see a health care professional for specific guidelines.

The main nutrients of concern in the early stages of kidney disease are protein, phosphorus, and sodium (if necessary). Total calories are also monitored to make sure that a person with kidney disease maintains a healthy weight.

#### *Protein*

Protein is an important nutrient for growth, building muscle and repairing tissues. When protein is digested, nitrogen products like urea and ammonia are formed. Normally, the kidneys filter and excrete these waste products in the urine. However, when a kidney has reduced function, it may not be able to work as efficiently to rid the blood of these products. A buildup of urea and ammonia can be toxic and lead to significant problems. Protein restriction (while not *always* advised) is a major, and usually the first, dietary recommendation in the early stages of kidney disease. Since protein is essential in the diet, however, it is important to still obtain enough for good health through high quality proteins like those found in meats and eggs. The general recommendation for persons with early stages of kidney disease is 0.6 to 0.8 grams protein per kilogram (0.3 to 0.4 grams per pound) of body weight per day.

### *Phosphorus*

When kidney function declines, they are not able to remove excess phosphorus from the blood. Too much phosphorus can cause calcium to be pulled from the bones, weakening the bones and increasing the risk of fractures. Therefore, phosphorus intake may also need restriction. Phosphorus is found in high levels in milk and milk products; most meats and seafood; whole grains, nuts, and seeds; certain beverages like beer, dark colas, and cocoa; some vegetables; and chocolate. Foods high in protein are also generally high in phosphorus, which often leads to restriction of both.

### *Sodium*

A restriction of sodium is sometimes, but not always, advised. Healthy kidneys can reabsorb about 99% of the sodium filtered by them, tightly controlling fluid levels in the blood – or blood pressure. The body is quite adept at adapting to variations of sodium intake in the diet from day-to-day, so restriction is not always necessary. The goal is to establish a level of sodium intake that avoids too much (high blood pressure) or too little (low blood pressure) fluid accumulation in the blood. Either extreme can lead to health problems.

### *Calories and Other General Dietary Advice*

Finally, calories are monitored because dietary restrictions can lead to undesirable weight loss. Too much weight loss can result in malnutrition and illness. Because the protein content is usually reduced in a predialysis (early stage) renal diet, calories may need to be replaced by other nutrients like carbohydrates and healthy fats. A Registered Dietitian specialized in kidney diseases can help determine the right caloric levels to maintain a healthy weight, while incorporating the necessary changes to help preserve kidney function.

Beside these modifications to the diet, the rest of the diet should follow the recommendations of the *USDA Food Guide Pyramid* and *Dietary Guidelines for Americans 2000* to ensure optimal nutrition and servings from each of the food groups on a regular basis. The renal dietitian may sometimes recommend vitamin and mineral supplementation if meeting nutrient needs become difficult due to dietary restrictions.

### **The Renal Diet for Patients on Dialysis – End Stage Renal Disease**

As with the earlier stages of kidney disease, a nephrologist and renal dietitian can assist a patient with ESRD in receiving adequate nutrition and maintaining good overall health. When 90% of kidney function has been lost, there is little hope of recovering kidney function. Options for treatment then turn to dialysis (artificial kidney machine) or eventual transplantation with a compatible, healthy kidney from another individual. Since transplantation is not often possible without a lengthy waiting period, many patients with ESRD decide to go on one of two types of dialysis: *hemodialysis* or *peritoneal dialysis*.

Dialysis is a treatment that simulates the function of healthy kidneys. When an individual's kidneys are no longer able to do their job adequately (85-90% loss of functioning), dialysis becomes necessary to remove waste, salt and extra water, while keeping normal levels of certain chemicals in the blood and helping control blood pressure. Most often, dialysis will become a regular activity for patients with ESRD for the rest of their lives, unless they are eligible and a suitable kidney becomes available for a transplant.

There are two kinds of dialysis that a patient can choose to undergo, and both come with specific nutritional recommendations. Hemodialysis is when an artificial kidney (a large machine in a clinic or hospital) is used to remove the waste and fluid from the blood. Usually, a patient is required to go to a dialysis center 3 times each week for sessions lasting approximately 3 to 4 hours in duration.

Peritoneal dialysis is a process where the blood is "cleaned" from inside the body. A plastic tube is surgically placed into the abdominal area called the peritoneal cavity (around the stomach) and the patient fills the space with a special fluid through the tube, usually 4-5 times each day at home or work. The fluid, called the dialysate, stays in the space around the stomach and makes an exchange with the blood, pulling the toxins into the peritoneal cavity. After 1 to 2 hours, the exchange is complete and the fluid is drained out of the abdominal space.

Dietary recommendations for patients with ESRD are fairly similar for both kind of dialysis, with two exceptions: **potassium** and **fluid**. Whereas protein, phosphorus, and sometimes sodium are the main nutrients of concern in individuals with early stages of kidney disease, individuals with ESRD *also* need to be concerned with potassium, fluid, and sometimes calcium.

### *Protein*

While individuals in the earlier stages of kidney disease may need to restrict protein slightly, patients on both kinds of dialysis need to **increase protein**. This is due to the fact that the process of dialyzing the blood is *similar* but not quite as good as the healthy kidneys' ability to regulate the contents of the blood. Therefore, dialyzing the blood causes excess losses of protein in the form of amino acids and peptides that would normally remain in the body for tissue repair and muscle building. Since retaining enough protein for these body functions is so important to overall health, lost protein has to be made up for by eating more by a patient on dialysis.

### *Phosphorus*

Phosphorus is restricted in patients on dialysis, but not as drastically as in earlier stages of kidney disease, because *some* phosphorus is pulled out of the blood during dialysis.

### *Potassium*

Potassium is a nutrient that is tightly controlled in patients on hemodialysis, but generally unrestricted in individuals on peritoneal dialysis (or in early stages of kidney disease). Patients with ESRD on hemodialysis typically must restrict their potassium to about 18 milligrams per pound of body weight per day. That is about 3,060 grams in a 170-pound male. One banana has about 450 milligrams, a medium artichoke has 1,062 milligrams and a cup of kidney beans has over 650 milligrams of potassium, so this nutrient can really add up quickly in the diet.

Potassium is a mineral found in many foods and plays a role in keeping the heart beating and the muscles working properly. When healthy, the kidneys carefully regulate the potassium levels in the blood. However, in ESRD, the patient must rely on the artificial kidney (dialysis) to remove excess potassium and with hemodialysis, this occurs only every other day. Potassium is found in most foods to some extent, so it can be very challenging to control. A renal dietitian will generally recommend avoiding foods that are *high* in potassium like dried fruits, bananas, honeydew, beans, artichokes, bran products, chocolate, coffee, ice cream, nuts and many other items. Blood levels of potassium are regularly monitored to make sure that normal levels are being maintained.

### *Fluid*

Fluid restriction is very important for patients with ESRD on hemodialysis, though less relevant for peritoneal dialysis patients who are dialyzed several times a day. Since the kidneys are the organs responsible for making and excreting urine along with its waste products, a patient with ESRD will typically produce very little or no urine. As a result, all the fluid that is consumed – even in the foods we eat – will remain in the body until it is dialyzed. Besides causing potentially serious problems like high blood pressure, strain on the heart and edema (swelling) in the tissues, excess fluid can cause a lot of weight gain between dialysis sessions. Within two days, a person on hemodialysis can gain up to 10 pounds or more in water weight if fluid is not restricted. This causes tremendous stress on the body.

Water is so essential to our bodies, composing more than 60% of its total weight. However, the recommendation for individuals on hemodialysis is about 4 cups of total fluid per day. This fluid recommendation includes the fluid in beverages, soups, fruits, vegetables, and sauces. Therefore, restricting fluid intake can become a big challenge for people on dialysis. Most patients on hemodialysis use tricks like sucking on ice cubes to try to quench their thirst while trying to limit fluid intake.

### *Calcium*

Calcium is monitored in the blood regularly and adjustments may be made for patients on dialysis, when necessary, to maintain bone health and healthy muscle function.

### *Sodium*

Sodium intake is set and adjusted to help minimize high or low blood pressure, while also aiming to avoid excess fluid retention during the days between dialysis. The recommendation is adjusted based on individual needs, but patients performing daily peritoneal dialysis can generally tolerate more salt intake since they are dialyzing daily.

### *Calories and Other General Dietary Advice*

Finally, calories are monitored because dietary restrictions can lead to undesirable weight loss and potential health problems. Calories become a more important factor in determining energy balance for individuals on dialysis, since actual body weight can vary so dramatically depending on the amount of fluid consumed. A Registered Dietitian specialized in kidney diseases can help determine the right caloric levels to maintain a healthy weight, while incorporating the necessary changes to help reduce other symptoms.

The rest of the diet should follow the recommendations of the *USDA Food Guide Pyramid* and *Dietary Guidelines for Americans 2000* for optimal nutrition and number of servings from each of the food groups. While the ideal goal is to obtain all one's nutrients from food sources each day, quite often a renal dietitian may recommend certain supplements to help ensure other vitamin and mineral needs are being met. Typically, vitamin and mineral supplementation will correspond to the levels of those nutrients lost during dialysis.

### **A Comparison of the General Diet Recommendations for Renal Patients**

The following table developed by the American Dietetic Association and National Kidney Foundation represents the general dietary recommendations for predialysis, hemodialysis and peritoneal dialysis patients. Every person's diet is then individualized based on their unique situation and other coexisting health conditions.

<b>Treatment</b>	<b>Early Stage (Pre-dialysis)</b>	<b>Hemodialysis</b>	<b>Peritoneal Dialysis</b>
Protein (grams/pound weight*)	0.3-0.4	0.5	0.5-0.6
Energy (Calories) (per pound weight*)	16-18	16	16
Phosphorus (mg/pound weight*)	3.6-5.4	≤8	≤8
Sodium (mg/day)	1000-3000 if necessary	2000-3000	2000-4000
Potassium (mg/pound weight)	Typically unrestricted	Approximately 18	Typically unrestricted
Fluid (cups)	Typically unrestricted	4 if anuric (produce no	8 +

		urine)	
Calcium (mg/day)	1200-1600	Depends on serum level	Depends on serum level

\* Original table has been adjusted to reflect nutrients *per pound* body weight instead of *per kilogram* body weight.

### **Adapting to a Renal Diet and Other Lifestyle Changes**

Following a specialized renal diet – whether in the early stages of kidney disease or when on dialysis – generally takes some time to adjust to and can be challenging. However, people who learn to tightly monitor their intake and follow the guidelines given to them by their nephrologist and renal dietitian can often continue to live relatively healthy, normal lives. Some adjustments must be made in one’s schedule and activities especially when traveling to a clinic for regular dialysis.

Significant research is being conducted and increasing information is available for the more than 260,000 Americans with chronic kidney disease today. The National Kidney Foundation, the American Dietetic Association and other organizations are dedicated to preventing kidney and urinary tract diseases and improving the health and overall wellness of people affected by kidney diseases. Working with an integrated team that includes a nephrologist, renal dietitian and other health care experts is the first step in designing a course of treatment that best suits each person’s individual needs for managing his or her kidney disease.

#### *References:*

The American Dietetic Association. (1993). *National Renal Diet: Professional Guide*. USA: The American Dietetic Association.

The American Dietetic Association. (1994). *Nutrition Care in End-Stage Renal Disease*. USA: The American Dietetic Association.

Escott-Stump, S. (1997). *Nutrition and Diagnosis-Related Care, 4<sup>th</sup> ed.* Baltimore: Williams & Wilkins.

National Kidney Foundation Web Site: <http://www.kidney.org>. (August 2001).

Shils, M.E., Olson, J.A., Shike, M., Ross, A.C., eds. *Modern Nutrition in Health and Disease*. 9<sup>th</sup> edition. Baltimore: Williams & Wilkins, 1999.

Zemen, FJ, Ney, DM. (1996). *Applications in Medical Nutrition Therapy, 2<sup>nd</sup> ed.* New Jersey: Prentice Hall, Inc.