



Overview of Kidney Diseases in Children

What are the kidneys, and what do they do?

The kidneys are two bean-shaped organs located near the middle of the back, just below the rib cage. When blood flows through the kidneys, waste products and extra water are removed from the blood and sent to the bladder as urine. The kidneys also regulate blood pressure, balance chemicals like sodium and potassium, and make hormones to help bones grow and keep the blood healthy by making new red blood cells.

Who is at risk?

In the general population, slightly more than 30 people in every 100,000 develop kidney failure each year. In the pediatric population—age 19 and under—the annual rate is only 1 or 2 new cases in every 100,000 children. In other words, adults are about 20 times more likely to develop kidney failure than children. The risk increases steadily with age.

African Americans in their late teens are three times more likely than Caucasians in the same age group to develop kidney failure. Diseases that damage the tiny blood vessels in the kidney are also more common in children of color. Moreover, boys are nearly twice as likely as girls to develop kidney failure from birth defects, polycystic kidney disease, or other hereditary diseases.

What are the causes of kidney failure in children?

Kidney failure may be acute or chronic. Acute diseases develop quickly and can be very serious. Although an acute disease may have long-lasting consequences, it usually lasts for only a short time and then goes away once the underlying cause has been treated. Chronic diseases, however, do not go away and tend to get worse over time. When the kidneys stop working, doctors use a treatment called dialysis to remove waste products and extra water from patients with chronic kidney failure.

Acute Kidney Diseases

Acute kidney disease may result from an injury or from poisoning. Any injury that results in loss of blood may reduce kidney function temporarily, but once the blood supply is replenished, the kidneys usually return to normal. Other kinds of acute kidney disease in children are

- **Hemolytic uremic syndrome.** This rare disease affects mostly children under 10 years of age and can result in kidney failure. Eating foods contaminated by bacteria leads to an infection in the digestive system, which in the first stages causes vomiting and diarrhea. When these symptoms subside, the child is still listless and pale. Poisons produced by the bacteria can damage the kidneys, causing acute kidney failure. Children with hemolytic uremic syndrome may need blood transfusion or dialysis for a short time. Most children,



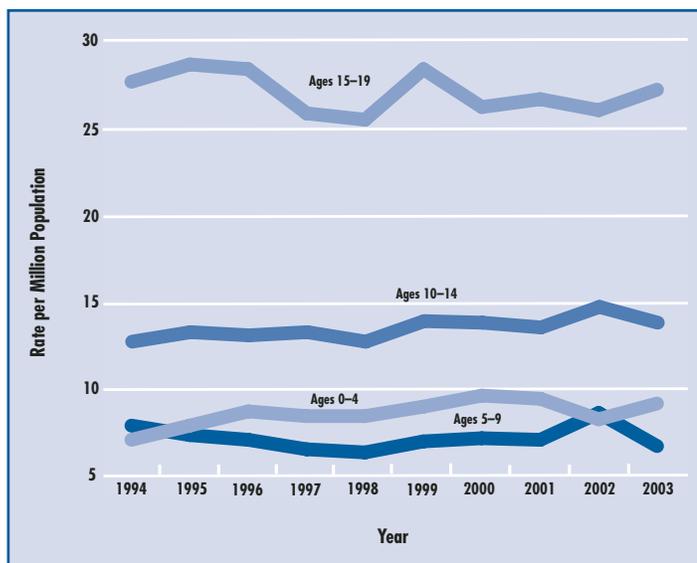
however, return to normal after a few weeks. Only a small percentage of children (mostly those who have severe acute kidney disease) will develop chronic kidney disease.

- **Nephrotic syndrome.** A child with this syndrome will urinate less often, so the water left in the body causes swelling around the eyes, legs, and belly. The small amount of urine the body makes contains high levels of protein. Healthy kidneys keep protein in the blood, but damaged kidneys let it leak from the blood into the urine. Nephrotic syndrome can usually be treated with prednisone to stop protein leakage, and sometimes a diuretic is used to help the child urinate and reduce the swelling. Usually, the child can take smaller and smaller doses of prednisone and eventually return to normal with no lasting kidney damage. This temporary condition is called minimal change disease. Relapses are common but usually respond to prednisone treatment.

Chronic Kidney Diseases

Unfortunately, the conditions that lead to chronic kidney failure in children cannot be easily fixed. Often, the condition will develop so slowly that it goes unnoticed until the kidneys have been permanently damaged. Treatment may slow down the progression of some diseases, but in many cases the child will eventually need dialysis or transplantation.

- **Birth defects.** Some babies are born without kidneys or with abnormally formed kidneys. The kidney abnormality is sometimes part of a syndrome that affects many parts of the body.
- **Blocked urine flow and reflux.** If blockage develops between the kidneys and the opening where urine leaves the body, the urine can back up and damage the kidney.
- **Hereditary diseases.** In polycystic kidney disease (PKD), children inherit defective genes that cause the kidneys to develop many cysts, sacs of fluid that replace healthy tissue and keep the kidneys from doing their job. In



New cases, by age, per million population, adjusted for gender and race.

Source: United States Renal Data System. 2005 Annual Data Report: Atlas of End-Stage Renal Disease in the United States. 2005.

Alport syndrome, the defective gene that causes kidney disease may also cause hearing or vision loss.

- **Glomerular diseases.** Some diseases attack the individual filtering units in the kidney. When damaged, these filters—which are called glomeruli—leak blood and protein into the urine. If the damage to the glomeruli is severe, kidney failure may develop.
- **Systemic diseases.** Diabetes and lupus can affect many parts of the body, including the kidneys in some people. In lupus, the immune system becomes overactive and attacks the body's own tissues. Diabetes leads to high levels of blood glucose that damage the glomeruli. Diabetes is the leading cause of kidney failure in adults. In children, however, diabetes is low on the list of causes because it usually takes many years of high blood glucose for the kidney disease of diabetes to develop. However, an increasing number of children have type 2 diabetes, which is usually associated with adults. As a result, we may see more children with chronic kidney failure caused by diabetes in the future.

From birth to age 4 years, birth defects and hereditary diseases are by far the leading causes of kidney failure. Between ages 5 and 14 years, hereditary diseases continue to be the most common causes, followed closely by glomerular diseases. In the 15- to 19-year-old age group, glomerular diseases are the leading cause, and hereditary diseases become rarer.

What are the treatments for kidney failure?

A child whose kidneys fail completely must receive treatment to replace the work the kidneys do. The two types of treatment are dialysis and transplantation.

Dialysis

Dialysis is a way to remove the waste products and extra water from the blood of patients with kidney failure. The two main types of dialysis are peritoneal dialysis and hemodialysis.

- **Peritoneal dialysis.** This method uses the lining of the child's abdominal cavity, the peritoneum, as a filter. A catheter placed in the child's belly is used to pour a solution containing dextrose (a sugar) into the abdominal cavity. While the solution is there, it pulls wastes and extra fluid from the blood. Later, the solution is drained from the belly, along with the wastes and extra fluid. The cavity is then refilled, and the cleaning process continues. Peritoneal dialysis can be performed in the home, usually while the child sleeps, without a health professional present. You and your child will receive extensive training before you start home treatments.
- **Hemodialysis.** This method uses a machine that carries the child's blood through a tube to a dialyzer, a canister that contains thousands of fibers that filter out the wastes and extra fluid. The cleaned blood is then returned to the child through a different tube. Hemodialysis is usually performed in a clinic under the supervision of a nurse and kidney specialist. It is generally required three times a week for about 3 to 4 hours each time.

Transplantation

Transplantation provides the closest thing to a cure for kidney failure. In this procedure, a surgeon places a healthy kidney in the child's body. The kidney may come either from a living donor or from someone who has just died.

- **Living donor.** Most people can donate a kidney without hurting their health. Many children receive a kidney from one of their parents, but the donor does not have to be a family member.
- **Deceased donor.** If no living donors are available, a child may be placed on a waiting list to receive a kidney from someone who has just died. The United Network for Organ Sharing (UNOS) maintains a computerized system for matching kidneys with appropriate recipients.

People who have transplants must take drugs to keep the body's immune system from rejecting the new organ. These immunosuppressive drugs can help maintain good function in the transplanted kidney for many years. However, they may have some undesirable side effects such as making a child vulnerable to infections.

For more information about dialysis and transplantation, see the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) fact sheet *Treatment Methods for Kidney Failure in Children*.

Hope Through Research

Through its Division of Kidney, Urologic, and Hematologic Diseases, the NIDDK supports several programs and studies devoted to improving treatment for patients with progressive kidney disease and kidney failure. The NIDDK maintains the **Pediatric Nephrology Program**, which supports research into the causes, treatment, and prevention of kidney diseases in children, including congenital malformations of the urinary tract, polycystic disease, primary glomerular disease, and postinfectious glomerulonephritis.

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Publications produced by the Clearinghouse are carefully reviewed by both NIDDK scientists and outside experts. NKUDIC would like to thank Barbara Fivush, M.D., and Kathy Jobs, M.D., of the American Society of Pediatric Nephrology (ASPN), for coordinating the review of this fact sheet by the ASPN's Clinical Affairs Committee: Tej Mattoo, M.D., William Primack, M.D., Joseph Flynn, M.D., Ira Davis, M.D., Ann Guillott, M.D., Steve Alexander, M.D., Deborah Kees-Folts, M.D., Alicia Neu, M.D., Steve Wassner, M.D., John Brandt, M.D., Manju Chandra, M.D. Frederick Kaskel, M.D., Ph.D., President, ASPN, and Sharon Andreoli, M.D., Secretary-Treasurer, ASPN, also provided comments and coordination.

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U.S. DEPARTMENT OF HEALTH
AND HUMAN SERVICES
National Institutes of Health

NIH Publication No. 06-5167
June 2006

