



# Childhood Nephrotic Syndrome

## What is nephrotic syndrome?

**N**ephrotic syndrome is a set of signs or symptoms that may point to kidney problems. The kidneys are two bean-shaped organs found in the lower back. Each is about the size of a fist. They clean the blood by filtering out excess water and salt and waste products from food. Healthy kidneys keep protein in the blood, which helps the blood soak up water from tissues. But kidneys with damaged filters may leak protein into the urine. As a result, not enough protein is left in the blood to soak up the water. The water then moves from the blood into body tissues and causes swelling.

Both children and adults can have nephrotic syndrome. The causes of and treatments for nephrotic syndrome in children are sometimes different from the causes and treatments in adults. For information about nephrotic syndrome in adults, see the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) publication *Nephrotic Syndrome in Adults*.

Childhood nephrotic syndrome can occur at any age but is most common between the ages of 1½ and 5 years. It seems to affect boys more often than girls.

A child with nephrotic syndrome has these signs:

- high levels of protein in the urine, a condition called proteinuria
- low levels of protein in the blood
- swelling resulting from buildup of salt and water
- less frequent urination
- weight gain from excess water

Nephrotic syndrome is not itself a disease. But it can be the first sign of a disease that damages the kidney's tiny blood-filtering units, called glomeruli, where urine is made.

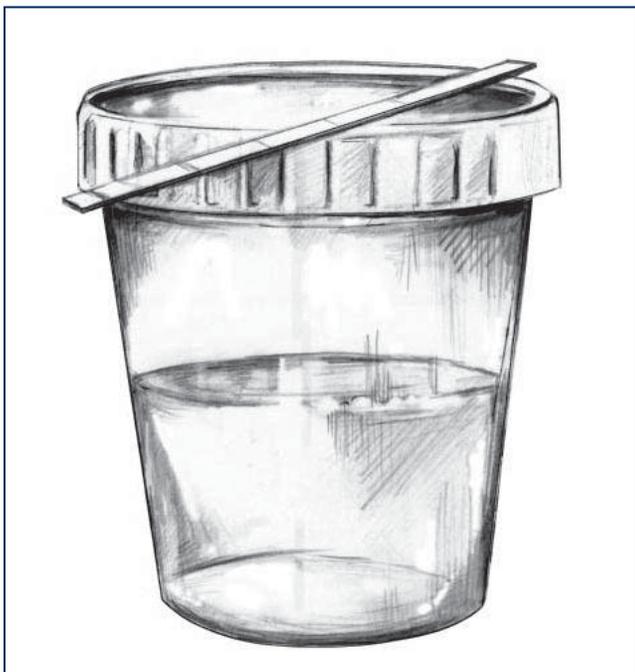
## How is childhood nephrotic syndrome diagnosed?

To diagnose childhood nephrotic syndrome, the doctor may ask for a urine sample to check for protein. The doctor will dip a strip of chemically treated paper into the urine sample. Too much protein in the urine will make the paper change color. Or the doctor may ask for a 24-hour collection of urine for a more precise measurement of the protein and other substances in the urine.



The doctor may take a blood sample to see how well the kidneys are removing wastes. Healthy kidneys remove creatinine and urea nitrogen from the blood. If the blood contains high levels of these waste products, some kidney damage may have already occurred. But most children with nephrotic syndrome do not have permanent kidney damage.

In some cases, the doctor may want to examine a small piece of kidney tissue with a microscope to see if something specific is causing the syndrome. The procedure of collecting a small tissue sample from the kidney is called a biopsy, and it is usually performed with a long needle passed through the skin. The child will be awake during the procedure and receive calming drugs and a local painkiller at the site of the needle entry. A child who is prone to bleeding problems may require open surgery for the biopsy. General anesthesia will be used if surgery is required. For any biopsy procedure, the child will stay overnight in the hospital to rest and allow the health care team to address quickly any problems that might occur.



A strip of chemically treated paper will change color when dipped in urine with too much protein.

## What conditions are associated with childhood nephrotic syndrome?

### Minimal Change Disease

The condition most commonly associated with childhood nephrotic syndrome is minimal change disease. Doctors do not know what causes it. The condition is called minimal change disease because children with this form of the nephrotic syndrome have normal or nearly normal appearing kidney biopsies. If a child is diagnosed with minimal change disease, the doctor will probably prescribe prednisone, which belongs to a class of drugs called corticosteroids. Prednisone stops the movement of protein from the blood into the urine, but it does have side effects that the doctor will explain. Following the doctor's directions exactly is essential to protect the child's health. The doctor may also prescribe another type of drug called a diuretic, which reduces the swelling by helping the child urinate more frequently.

When protein is no longer present in the urine, the doctor will begin to reduce the dosage of prednisone. This process takes several weeks. Some children never get sick again, but most experience a relapse, developing swelling and protein in the urine again, usually following a viral illness. However, as long as the child continues to respond to prednisone and the urine becomes protein free, the child has an excellent long-term outlook without kidney damage.

Children who relapse frequently, or who seem to be dependent on prednisone or have side effects from it, may be given a second type of drug called a cytotoxic agent. The agents most frequently used are cyclophosphamide and chlorambucil. After reducing protein in the urine with prednisone, the doctor may prescribe the cyclophosphamide or chlorambucil for 8 to 12 weeks. Alternatively, cyclosporine,

a drug also used in transplant patients, may be given. Treatment with cyclosporine frequently continues over an extended period.

In recent years, doctors have explored the use of mycophenolate mofetil (MMF) instead of cytotoxic agents for children who relapse frequently. MMF is an immunosuppressant used to treat autoimmune diseases and to keep the body from rejecting a transplanted organ. MMF has not been tested for treating minimal change disease in large clinical trials, but doctors report promising results with small numbers of patients. MMF has milder side effects than cytotoxic agents, but taking immunosuppressants can raise the risk of infection and other diseases. The good news is that most children outgrow minimal change disease by their late teens with no permanent damage to their kidneys.

### Focal Segmental Glomerulosclerosis (FSGS) and Membranoproliferative Glomerulonephritis (MPGN)

In about 20 percent of children with nephrotic syndrome, a kidney biopsy reveals scarring or deposits in the glomeruli. The two most common diseases that damage these tiny blood-filtering units are FSGS and MPGN.

Because prednisone is less effective in treating these diseases than it is in treating minimal change disease, the doctor may use additional therapies, including cytotoxic agents. Recent experience with another class of drugs called ACE inhibitors, usually used to treat high blood pressure, indicates these drugs can help decrease the amount of protein leaking into the urine and keep the kidneys from being damaged in children with FSGS or MPGN.

### Congenital Nephropathy

Rarely, a child may be born with congenital nephropathy, a condition that causes nephrotic syndrome. The most common form of this condition is congenital nephropathy of the Finnish type (CNF), inherited as an autosomal recessive trait—meaning the gene for CNF must be inherited from both parents.

Another condition that causes nephrotic syndrome in the first months of life is diffuse mesangial sclerosis (DMS). The pattern of inheritance for DMS is not as clearly understood as the pattern for CNF, although the condition does appear to be genetic.

Since medicines have little effect on congenital nephropathy, transplantation is usually required by the second or third year of life, when the child has grown enough to receive a kidney. To keep the child healthy, the doctor may recommend infusions of the protein albumin to make up for the protein lost in urine and prescribe a diuretic to help eliminate the extra fluid that causes swelling. The child's immune system may be weakened, so antibiotics should be given at the first sign of infection.

Congenital nephropathy can disturb thyroid activity, so the child may need the substitute hormone thyroxine to promote growth and help bones mature. Some children with congenital nephropathy have excessive blood clotting, or thrombosis, which must be treated with a blood thinner like warfarin.

A child with congenital nephropathy may need tube feedings to ensure proper nutrition. In some cases, the diseased kidneys may need to be removed to eliminate proteinuria. Dialysis will then be required to replace kidney function until the child's body is big enough to receive a transplanted kidney. Peritoneal dialysis is preferable to hemodialysis for young children.

In peritoneal dialysis, a catheter is surgically placed in the abdomen and then used to introduce a solution into the abdominal cavity, or peritoneum. The solution draws wastes and extra fluid from the bloodstream. After a few hours, the solution is drained and replaced with a fresh supply. The drained solution carries the wastes and extra fluid out of the body.

## Points to Remember

- Nephrotic syndrome is a set of signs or symptoms that may point to kidney problems.
- Childhood nephrotic syndrome is most common between the ages of 1½ and 5 years.
- Nephrotic syndrome causes proteinuria, low levels of protein in the blood, less frequent urination, and swelling and weight gain from the buildup of fluid.
- Diagnosis of nephrotic syndrome requires urine and blood samples and may include a kidney biopsy.
- Most cases of childhood nephrotic syndrome result from minimal change disease.
- The two most common diseases that damage the kidneys' tiny blood-filtering units and cause nephrotic syndrome are focal segmental glomerulosclerosis (FSGS) and membranoproliferative glomerulonephritis (MPGN).
- Congenital nephropathy is a rare condition that causes nephrotic syndrome in newborns.

## Hope through Research

The NIDDK conducts and supports research to help people with kidney disease, including children. The NIDDK's Division of Kidney, Urologic, and Hematologic Diseases (DKUHD) maintains the Pediatric Nephrology Program, which supports research into the causes, treatment, and prevention of kidney disease in children. In 2002, the DKUHD initiated the Focal Segmental Glomerulosclerosis Clinical Trial to learn more about the best way to treat FSGS. Then, in 2003, the DKUHD began the Prospective Study of Chronic Kidney Disease in Children to learn more about the negative effects of pediatric kidney disease, including cardiovascular disease and neurocognitive impairment.

People interested in participating in clinical trials of new treatments for nephrotic syndrome can find a list of centers recruiting patients at [www.ClinicalTrials.gov](http://www.ClinicalTrials.gov).

## For More Information

**Kidney & Urology Foundation of America**  
152 Madison Avenue, Suite 201  
New York, NY 10016  
Phone: 1.800.633.6628  
Fax: 212.629.5652  
Internet: [www.kidneyurology.org](http://www.kidneyurology.org)

You may also find additional information about this topic using the following databases:

The NIDDK Reference Collection is a collection of thousands of materials produced for patients and health care professionals, including fact sheets, brochures, and audiovisual materials. Visit [www.catalog.niddk.nih.gov/resources](http://www.catalog.niddk.nih.gov/resources).

MedlinePlus brings together a wealth of information from the National Library of Medicine, the National Institutes of Health, and other government agencies and health-related organizations. MedlinePlus offers easy access to medical journal articles, a medical dictionary and medical encyclopedia, health information in Spanish, hospital and physician directories, drug and supplement lists, interactive patient tutorials, links to hundreds of clinical trials, and the latest health news. Visit [www.medlineplus.gov](http://www.medlineplus.gov).

The U.S. Government does not endorse or favor any specific commercial product or company. Trade, proprietary, or company names appearing in this document are used only because they are considered necessary in the context of the information provided. If a product is not mentioned, the omission does not mean or imply that the product is unsatisfactory.

This publication may contain information about medications used to treat a health condition. When this publication was prepared, the NIDDK included the most current information available. Occasionally, new information about medication is released. For updates or for questions about any medications, please contact the U.S. Food and Drug Administration at 1-888-INFO-FDA (463-6332), a toll-free call, or visit their website at [www.fda.gov](http://www.fda.gov). Consult your doctor for more information.

## National Kidney and Urologic Diseases Information Clearinghouse

3 Information Way  
Bethesda, MD 20892-3580  
Phone: 1-800-891-5390  
Fax: 703-738-4929  
Email: [nkudic@info.niddk.nih.gov](mailto:nkudic@info.niddk.nih.gov)  
Internet: [www.kidney.niddk.nih.gov](http://www.kidney.niddk.nih.gov)

The National Kidney and Urologic Diseases Information Clearinghouse (NKUDIC) is a service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). The NIDDK is part of the National Institutes of Health of the U.S. Department of Health and Human Services. Established in 1987, the Clearinghouse provides information about diseases of the kidneys and urologic system to people with kidney and urologic disorders and to their families, health care professionals, and the public. The NKUDIC answers inquiries, develops and distributes publications, and works closely with professional and patient organizations and Government agencies to coordinate resources about kidney and urologic diseases.

Publications produced by the Clearinghouse are carefully reviewed by both NIDDK scientists and outside experts. The NKUDIC would like to thank Barbara Fivush, M.D., and Kathy Jabs, M.D., of the American Society of Pediatric Nephrology (ASPN), for coordinating the review of this publication 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.; and 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.

This publication is not copyrighted. The Clearinghouse encourages users of this fact sheet to duplicate and distribute as many copies as desired.

This fact sheet is also available at [www.kidney.niddk.nih.gov](http://www.kidney.niddk.nih.gov).



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

NIH Publication No. 08-4695  
February 2008

