

Maple Syrup Urine Disease (MSUD)

What is Maple Syrup Urine Disease (MSUD)?

Maple syrup urine disease (also known as MSUD) is an inherited condition that affects the way a person's body uses certain parts of protein. A person with MSUD cannot use the components of protein called leucine, isoleucine, and valine. Leucine, isoleucine, and valine are amino acids needed for proper growth and development, but too much can cause serious health problems. These three amino acids are also called branch chain amino acids (BCAAs). In the case of MSUD, too much of these BCAAs build up in the blood and penetrate and damage the brain. The high levels of BCAAs ultimately cause mental retardation and other serious health problems.

About one baby in 230,000 in the United States is born with MSUD. The condition occurs in all ethnic groups, but it is most common in individuals of Mennonite ancestry.

How Does MSUD Affect a Child?

The symptoms of this condition vary from mild to very severe. The most severe form of this condition is known as Classic MSUD. Infants with Classic MSUD develop symptoms within the first several days of life. Without treatment, these children experience periods of poor feeding, lack of energy, high pitch crying, low muscle tone, excessive muscle tension, low blood sugar, vomiting and the characteristic maple syrup smell to the urine. These episodes can become serious enough to lead to permanent mental retardation, seizures, coma, and even death.

A less severe form of MSUD is Intermediate MSUD. Individuals with intermediate MSUD can generally tolerate very small amounts of BCAAs. However, when a child is ill (for example a virus, cold, or flu) or has skipped a meal, the symptoms can be as serious as Classic MSUD. For this reason, treatment is very similar for Classic MSUD.

Two less common forms of MSUD are Intermittent MSUD and Thiamine Responsive MSUD. Intermittent MSUD is a milder form and symptoms generally do not appear until the child is 12-24 months of age. Special attention to periods of illness and a similar treatment for Classic and Intermediate MSUD may be followed. Thiamine Responsive MSUD is the least severe form. Generally, prescribed doses of thiamine helps the body break down BCAAs and a moderate diet is followed.

What Causes MSUD?

MSUD is a genetic condition caused by changes in one of three pairs of genes. The genes associated with MSUD are BCKDHA (Branched Chain Keto acid Dehydrogenase Alpha polypeptide), BCKDHB (Branched Chain Keto acid Dehydrogenase Beta polypeptide), and DBT (Dihydrolipoamide Branched chain Transacylase) gene. These genes are responsible for making the enzymes called 2-oxoisovalerate dehydrogenase alpha, 2-oxoisovalerate dehydrogenase beta, and lipoamide acyltransferase, respectively. These enzymes break down the BCAAs. When there is an alteration in these genes, enzyme levels go down and BCAAs build up in the blood stream.

MSUD is inherited in an autosomal recessive pattern, which means two copies of a gene must be changed for a person to be affected with MSUD. Most often, the parents of a child with an autosomal recessive condition are not affected because they are "carriers," with one copy of the changed gene and one copy of the normal gene.

When both parents are carriers, there is a one-in-four (or 25%) chance that both will pass a changed gene on to a child, causing the child to be born with the condition. There also is a one-in-four (or 25%) chance that they will each pass on a normal gene, and the child will be free of the condition. There is a two-in-four (or 50%) chance that a child will inherit a changed gene from one parent and a normal gene from the other, making that child a carrier like the parents. These chances are the same in each pregnancy with the same parents.

Is There a Test for MSUD?

Yes. Babies are tested through newborn screening for MSUD before they leave the hospital. The baby's heel is pricked and a few drops of blood are taken. The blood is sent to the state laboratory to find out if it has more than a normal amount of BCAAs. Approximately half of the states screen newborns for MSUD, and Tennessee is one of them.

Can MSUD Symptoms Be Prevented?

In most cases, the symptoms of MSUD can be prevented by a diet very low in BCAAs. This depends on the type of MSUD and the gene involved. This diet should begin as soon as possible following a diagnosis. Children and adults with MSUD require follow-up care at a medical center or clinics that specialize in this condition. BCAA content in foods is different, so an experienced dietician or nutritionist will recommend a special diet that includes certain vegetables, fruits, grains, and a metabolic formula (medical replacement food) that provides protein without BCAAs. Some rare forms may be difficult to treat and may require thiamine. In addition, regular blood tests are used to monitor BCAA levels.

DISCLAIMER: The information contained on this page is not intended to replace the advice of a genetic metabolic medical professional.

Resources:



Organic Acidemia Association
13210 - 35th Avenue North
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Phone: 763-559-1797
Fax: 763-694-0017
Email: oaanews@aol.com
www.oaanews.org



MSUD Family Support Group
24806 SR 119
Goshen, IN 46526
Phone: 574-862-2992
Fax: 574-862-2012
E-mail: msud-support@characterlink.net
www.msud-support.org

Association for Neuro-Metabolic Disorders
5223 Brookfield Lane
Sylvania OH 43560-1809
Phone: 419-885-1497

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References:

- American Academy of Pediatrics (1996): Newborn Screening Fact Sheets (RE9632). Pediatrics 98:473-501.
<http://aappolicy.aappublications.org/cgi/reprint/pediatrics;98/3/473.pdf>
- GeneTests (The Organic Acidemias) <http://www.genetests.org>
- Online Mendelian Inheritance in Man (OMIM topics 248600, 248610, 248611)
<http://www.ncbi.nlm.nih.gov/Omim>
- Scriver, C.R. and Kaufman, S (2001) Maple Syrup Urine Disease (Branched Chain Ketoaciduria). In: Scriver, C.R., Kaufman, S., Eisensmith, E., Woo S.L.C., Vogelstein, B. Childs, B. (eds) The Metabolic and Molecular Bases of Inherited Disease, 8th ed. McGraw-Hill, New York, Ch.87.