



## Genetic Fact Sheets for Parents

# Fatty Acid Oxidation Disorders

Screening, Technology, and Research in Genetics is a multi-state project to improve information about the financial, ethical, legal, and social issues surrounding expanded newborn screening and genetic testing – <http://www.newbornscreening.info>

**Disorder name:** Trifunctional protein deficiency

**Acronym:** TFP deficiency

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This fact sheet has general information about TFP deficiency. Every child is different and some of this information may not apply to your child specifically. Not all is known about TFP deficiency and, at present, there is no standard treatment plan. Certain treatments may be recommended for some children but not others. Children with TFP deficiency should be followed by a metabolic doctor in addition to their primary doctor.

## What is TFP deficiency?

TFP deficiency stands for “trifunctional protein deficiency”. It is one type of fatty acid oxidation disorder. People with TFP deficiency have problems breaking down fat into energy for the body.

## Fatty Acid Oxidation Disorders:

Fatty acid oxidation disorders (FAODs) are a group of rare inherited conditions. They are caused by enzymes that do not work properly.

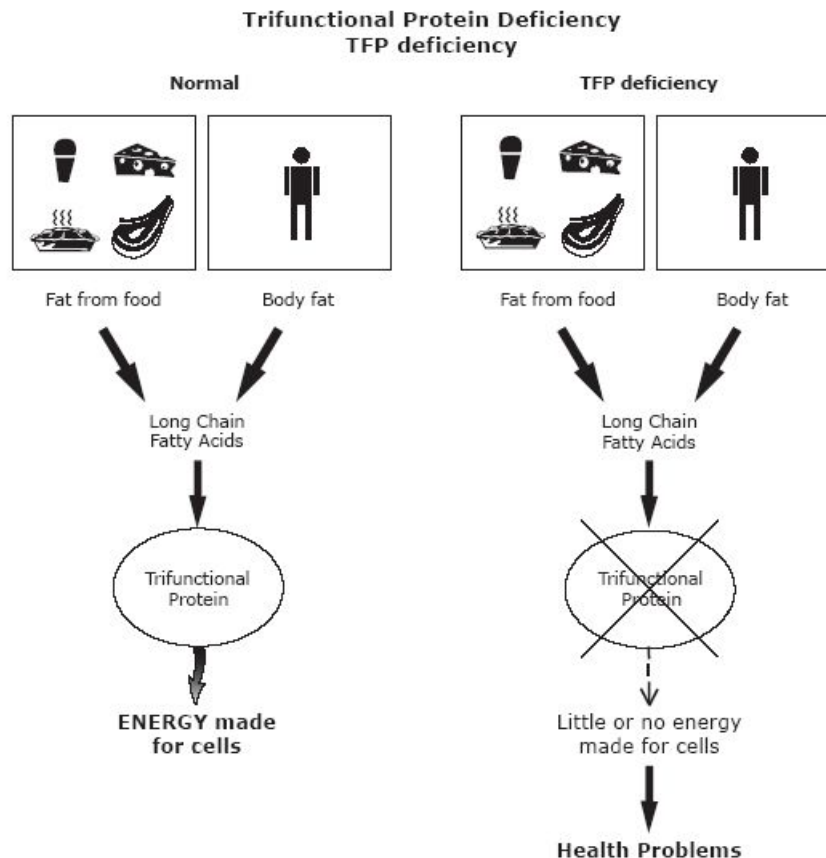
A number of enzymes are needed to break down fats in the body (a process called fatty acid oxidation). Problems with any of these enzymes can cause a fatty acid oxidation disorder. People with FAODs cannot properly break down fat from either the food they eat or from fat stored in their bodies.

The symptoms and treatment vary between different FAODs. They can also vary from person to person with the same FAOD. See the fact sheets for each specific FAOD.

FAODs are inherited in an autosomal recessive manner and affect both males and females.

## What causes TFP deficiency?

TFP deficiency occurs when a group of enzymes, called “trifunctional protein” (TFP), is either missing or not working properly. The job of TFP is to break down certain fats from the food we eat into energy. It also breaks down fat already stored in the body.



Energy from fat keeps us going whenever our bodies run low of their main source of energy, a type of sugar called glucose. Our bodies rely on fat when we don't eat for a stretch of time – like when we miss a meal or when we sleep.

When TFP is missing or not working well, the body cannot use fats for energy. Instead, it must rely solely on glucose. Although glucose is a good source of energy, there is a limited amount available. Once the glucose has been used up, the body tries to use fat without success. This leads to low blood sugar, called hypoglycemia, and to the build up of harmful substances in the blood.

## **If TFP deficiency is not treated, what problems occur?**

TFP deficiency can cause mild symptoms in some people or more serious health problems in others. There are three forms of TFP deficiency: “early”, “childhood” and “mild”.

Babies and children with early and childhood TFP deficiency have episodes of illness called metabolic crises. Some of the first symptoms of a metabolic crisis are:

- extreme sleepiness
- behavior changes
- irritable mood
- muscle weakness
- poor appetite

Some of these other symptoms may also follow:

- fever
- nausea
- diarrhea
- vomiting
- hypoglycemia
- increased levels of acidic substances in the blood, called metabolic acidosis

If a metabolic crisis is not treated, a child with TFP deficiency can develop:

- breathing problems
- seizures
- coma, sometimes leading to death

Periods of hypoglycemia can happen without other symptoms of metabolic crisis. Hypoglycemia causes:

- weakness
- shakiness
- dizziness
- clammy, cold skin

- if untreated, coma, and sometimes death

In children with TFP deficiency, either hypoglycemia or a metabolic crisis can happen:

- after going too long without food
- after long periods of exercise
- during illness or infection
- during times of stress, such as surgery

### **Early TFP deficiency**

Babies with early TFP deficiency usually show symptoms anywhere from birth through age two. The first symptoms are often:

- poor appetite
- sluggishness
- extreme sleepiness
- muscle weakness
- absent reflexes
- no response to pain
- delays in walking and learning

Babies with early TFP deficiency often have many episodes of metabolic crisis.

Other effects of early TFP deficiency can include:

- serious heart problems and enlarged heart
- build-up of fat in the liver and other liver problems
- breathing problems

Infants with early TFP who remain untreated usually die of heart or breathing problems by three years of age.

### **Childhood TFP deficiency**

Childhood TFP deficiency causes episodes of hypoglycemia and metabolic crisis. Between these episodes, children with TFP deficiency are usually healthy. However, repeated episodes can cause brain damage. This can result in learning problems or mental retardation.

Bouts of muscle weakness and pain happen in some children, especially after heavy exercise, stress or illness.

### **Mild/muscle TFP deficiency**

The mild form of TFP deficiency has been reported in a small number of people. Symptoms can begin anywhere from age two to adulthood.

Episodes of muscle weakness are common. Breakdown of muscle fibers can occur. This usually happens:

- after strenuous exercise or exertion
- during illness or infection
- after going without food for a long period of time

Signs of muscle breakdown are:

- muscle aches
- cramps
- weakness
- reddish-brown color to the urine
- breathing problems

If muscle symptoms are not treated, kidney failure can occur.

The mild form of TFP deficiency does not cause metabolic crises or heart or liver problems.

## **What is the treatment for TFP deficiency?**

Your baby's primary doctor will work with a metabolic doctor and a dietician to care for your child.

Certain treatments may be advised for some children but not others. When necessary, treatment is usually needed throughout life. The following are treatments often recommended for children with TFP deficiency:

### **1. Avoid going a long time without food**

Babies and young children with TFP deficiency need to eat often to avoid hypoglycemia and metabolic crisis. They should not go without food for more than 4 to 6 hours. Some babies need to eat even more often than this. It is important that babies be fed during the night. They need to be woken up to eat if they do not wake up on their own.

Young children with TFP deficiency should have a starchy snack before bed and another during the night. They need another snack first thing in the morning. Raw cornstarch mixed with water, milk or other drink is a good source of long-lasting energy. This is sometimes suggested for children older than one year of age. Your dietician can give you ideas for good night-time snacks.

When they are well, most teens and adults with TFP deficiency can go without food for up to 12 hours without problems. They do need to continue the other treatments throughout life.

### **2. Diet**

A low fat, high carbohydrate diet is often recommended. Carbohydrates give the body many types of sugar that can be used as energy. In fact, for children

needing this treatment, most food in the diet should be carbohydrates (bread, pasta, fruit, vegetables, etc.) and protein (lean meat and low-fat dairy foods). Any diet changes should be made under the guidance of a dietician.

People with TFP deficiency cannot use certain building blocks of fat called “long chain fatty acids”. Your dietician can help create a food plan low in these fats. Much of the rest of the fat in the diet will likely be in the form of medium chain fatty acids.

Ask your doctor if your child needs to have any changes in his or her diet.

### **3. MCT oil and L-carnitine**

Medium Chain Triglyceride oil (MCT oil) is often used as part of the food plan for people with TFP deficiency. This special oil has medium chain fatty acids that can be used in small amounts for energy. Your metabolic doctor or dietician can tell you how to use this supplement. You will need to get a prescription from your doctor to get MCT oil.

Some children may be helped by L-carnitine. This is a safe and natural substance that helps body cells create energy. It also helps the body get rid of harmful wastes. Your doctor will decide whether your child needs L-carnitine. Unless you are advised otherwise, use only L-carnitine prescribed by your doctor.

Do not use any medication without checking with your doctor.

### **4. Call your doctor at the start of any illness**

Always call your doctor when your child has any of the following:

- poor appetite
- low energy or excessive sleepiness
- vomiting
- diarrhea
- an infection
- a fever
- persistent muscle pain or weakness
- reddish-brown color to the urine

Ask your metabolic doctor if you should carry a special travel letter with medical instructions for your child’s care.

### **5. Avoid heavy exercise and extreme cold.**

Long periods of heavy exercise can trigger symptoms in people with TFP deficiency. Effects of exercise can include muscle aches, cramps and weakness. Muscle fibers may break down. This can turn the urine a reddish-brown color.

If muscle symptoms occur, prompt treatment is needed to prevent kidney damage. Children or adults with muscle symptoms should:

- drink fluids right away
- eat something starchy or sugary
- get to a hospital for treatment.

To prevent muscle symptoms:

- avoid prolonged or heavy exercise
- avoid extreme cold
- eat starchy or sugary foods before and during periods of moderate exercise or exertion

## **What happens when TFP deficiency is treated?**

### **Early TFP deficiency**

Most babies with early TFP deficiency die of heart or breathing problems, even when treated. However, treatment may help prolong life in some babies.

### **Childhood TFP deficiency**

With prompt and careful treatment, children with TFP deficiency can often live healthy lives with typical growth and development. However, some children continue to have episodes of hypoglycemia or metabolic crisis, even with treatment. This can cause permanent brain damage and may result in learning disabilities or mental retardation.

### **Mild/muscle TFP deficiency**

When treated, people with mild/muscle TFP deficiency usually remain healthy. This form does not affect intelligence.

## **What causes the trifunctional protein enzyme group to be absent or not working properly?**

Genes tell the body to make various enzymes. People with TFP deficiency have a pair of genes that do not work correctly. Because of the changes in this pair of genes, the TFP enzymes either do not work properly or are not made at all.

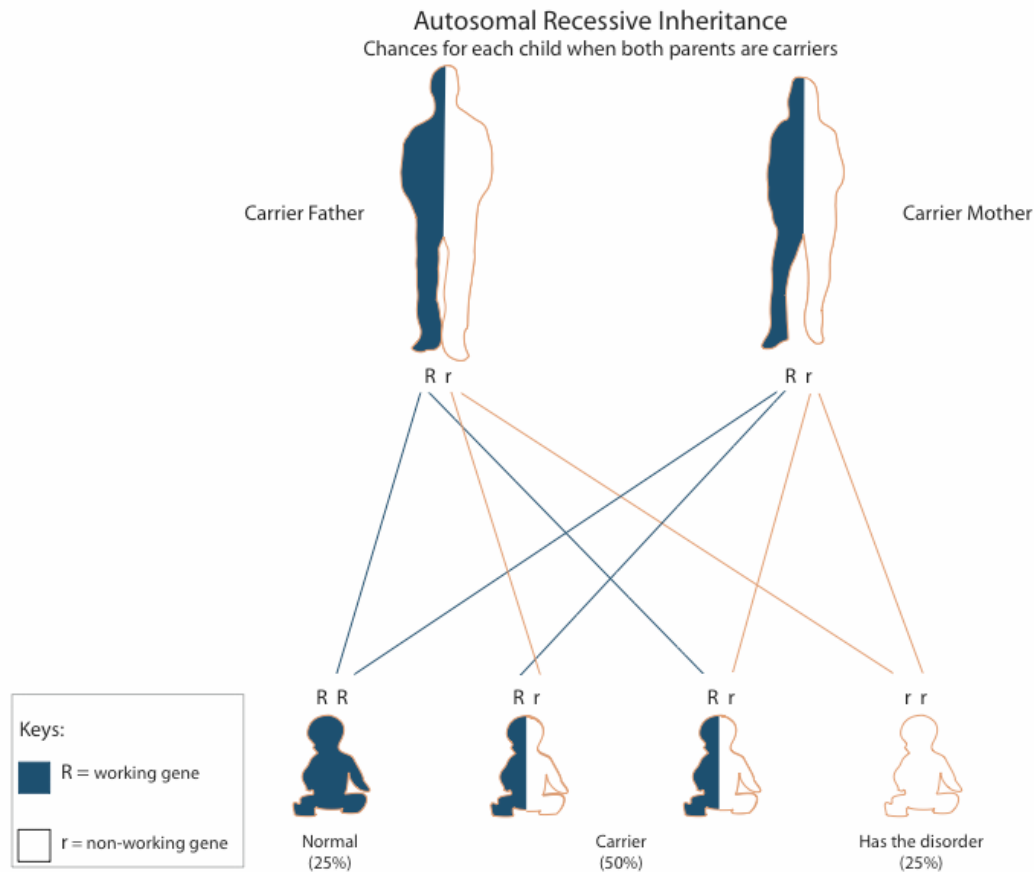
## **How is TFP deficiency inherited?**

TFP deficiency is inherited in an autosomal recessive manner. It affects both boys and girls equally.

Everyone has a pair of genes that make the TFP enzyme group. In children with TFP deficiency, neither of these genes works correctly. These children inherit one non-working gene for the condition from each parent.

Parents of children with TFP deficiency rarely have the disorder. Instead, each parent has a single non-working gene for TFP deficiency. They are called carriers. Carriers do not have TFP because the other gene of this pair is working correctly.

When both parents are carriers, there is a 25% chance in each pregnancy for the child to have TFP deficiency. There is a 50% chance for the child to be a carrier, just like the parents. And, there is a 25% chance for the child to have two working genes.



Genetic counseling is available to families who have children with TFP deficiency. Genetic counselors can answer your questions about how TFP deficiency is inherited, choices during future pregnancies, and how to test other family members. Ask your doctor about a referral to a genetic counselor.

### Is genetic testing available?

Genetic testing for TFP deficiency may be available. Genetic testing, also called DNA testing, looks for changes in the pair of genes that causes TFP deficiency.

Ask your metabolic doctor or genetic counselor about DNA testing for TFP deficiency.

DNA testing is not necessary to diagnose your child. It can be helpful for carrier testing or prenatal diagnosis, discussed below.

### **What other testing is available?**

TFP deficiency can be confirmed by special enzyme tests using a skin or muscle sample. Talk to your doctor or your genetic counselor if you have questions about testing for TFP deficiency.

### **Can you test during pregnancy?**

If both gene changes have been found in your child with TFP deficiency, DNA testing can be done during future pregnancies. The sample needed for this test is obtained by either CVS or amniocentesis.

If DNA testing would not be helpful, special enzyme tests can be during pregnancy using cells from the fetus. Again, the sample needed for this test is obtained by either CVS or amniocentesis.

Parents may either choose to have testing during pregnancy or wait until birth to have the baby tested. A genetic counselor can talk to you about your choices and answer questions about prenatal testing or testing your baby after birth.

### **Can other members of the family have TFP deficiency or be carriers?**

#### **Having TFP deficiency**

The brothers and sisters of a baby with TFP deficiency have a chance of being affected, even if they haven't had symptoms. Finding out whether other children in the family have TFP deficiency is important because early treatment may prevent serious health problems. Talk to your doctor or genetic counselor about testing your other children for TFP deficiency.

#### **TFP deficiency carriers**

Brothers and sisters who do not have TFP deficiency still have a chance to be carriers like their parents. Except in special cases, carrier testing should only be done in people over 18 years of age.

Each of the parents' brothers and sisters has a 50% chance to be a TFP deficiency carrier. It is important for other family members to be told that they

could be carriers. There is a small chance they are also at risk to have children with TFP deficiency.

Some states do not offer newborn screening for TFP deficiency. However, expanded newborn screening through private labs is available for babies born in states that do not screen for TFP deficiency. To learn more about expanded newborn screening, see [How to obtain MS/MS](#).

When both parents are TFP deficiency carriers, newborn screening results are not sufficient to rule out TFP deficiency in a newborn baby. In this case, special diagnostic testing should be done in addition to newborn screening.

During pregnancy, women carrying fetuses with TFP deficiency are at risk to develop serious medical problems. There is a small risk of:

- excess vomiting
- abdominal pain
- high blood pressure
- jaundice
- severe bleeding
- abnormal fat storage in the liver

All women with a family history of TFP deficiency should share this information with their obstetricians and other health care providers before and during any future pregnancies. Knowing about these risks allows early treatment.

## **Can other family members be tested?**

### **Diagnostic testing**

Brothers and sisters can be tested for TFP deficiency by DNA testing or special enzyme tests.

### **Carrier testing**

If both gene changes have been found in your child with TFP deficiency, other family members can have DNA testing to see if they are carriers.

## **How many people have TFP deficiency?**

TFP deficiency is a very rare disorder. The actual incidence is unknown.

## **Does TFP deficiency happen more often in a certain ethnic group?**

TFP deficiency does not happen more often in any specific race, ethnic group, geographical area or county.

## Does TFP deficiency go by any other names?

TFP deficiency is sometimes also called:

- mitochondrial trifunctional protein deficiency

## Where can I find more information?

Fatty Oxidation Disorders (FOD) Family Support Group

<http://www.fodsupport.org>

Organic Acidemia Association

<http://www.oaaneews.org>

United Mitochondrial Disease Foundation

<http://www.umdf.org>

Children Living with Inherited Metabolic Diseases (CLIMB)

<http://www.climb.org.uk>

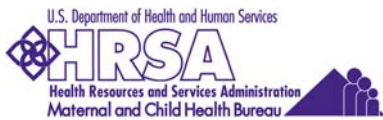
Genetic Alliance

<http://www.geneticalliance.org>

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