



St. Jude Children's  
Research Hospital<sup>®</sup>

Finding cures. Saving children.

ALSAC • DANNY THOMAS, FOUNDER

# Trait Counseling Manual:

Sickle Cell Trait  
and Hemoglobin C Trait



# Trait Counseling Manual:

## Sickle Cell Trait and Hemoglobin C Trait

Produced by St. Jude Children's Research Hospital, Departments of Hematology, Patient Education, and Biomedical Communications. Funds were provided by St. Jude Children's Research Hospital, ALSAC, and a grant from the Plough Foundation.

This document is not intended to replace counseling by a trained health care professional or genetic counselor. Our aim is to promote active participation in your care and treatment by providing information and education. Questions about individual health concerns or specific treatment options should be discussed with your doctor.

Copyright © 2008 St. Jude Children's Research Hospital  
Revised 11/2019



# Hemoglobin Trait

Hemoglobin (HEE-muh-glow-bin) is the main ingredient inside red blood cells. Hemoglobin helps red blood cells carry oxygen from the lungs to other parts of the body.

Some people have an abnormal kind of hemoglobin in their red blood cells mixed with normal hemoglobin. These people have a trait condition that is inherited (in-HAIR-uh-ted) from parents, just like eye color or hair color.

## Trait Condition vs. Disease

Trait is not disease. Normally a trait condition will not make you sick.

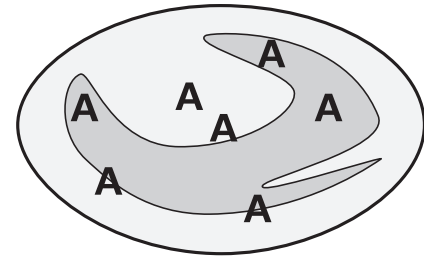
If you have a hemoglobin trait; you can pass it to your child. If both you and your partner have a hemoglobin trait, you can have a child with disease, so it is important to know your hemoglobin status.

## In this booklet, we will:

- Show how normal red blood cells carry oxygen to the body;
- Describe sickle cell trait and hemoglobin C trait and how they affect red blood cells; and
- Explain how 2 people with these trait conditions can have a child with sickle cell disease or hemoglobin C disease.

## Inside Red Blood Cells

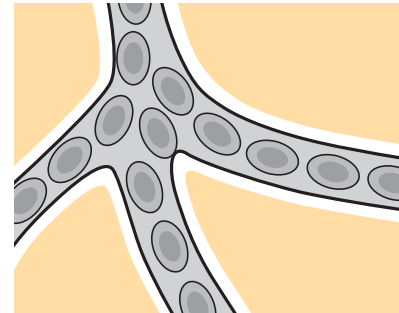
Normal blood cells contain only hemoglobin A. People who do not have a hemoglobin trait condition have only hemoglobin A inside their red blood cells.



Normal red blood cell

## Movement of Normal Red Blood Cells

Hemoglobin A makes red blood cells soft and round. This helps red blood cells pass easily through blood vessels, carrying oxygen throughout the body.



Some people have hemoglobin A and an abnormal hemoglobin in their red blood cells. This is a hemoglobin trait condition. It is inherited, like eye color or hair color. Two of the most common hemoglobin traits are:

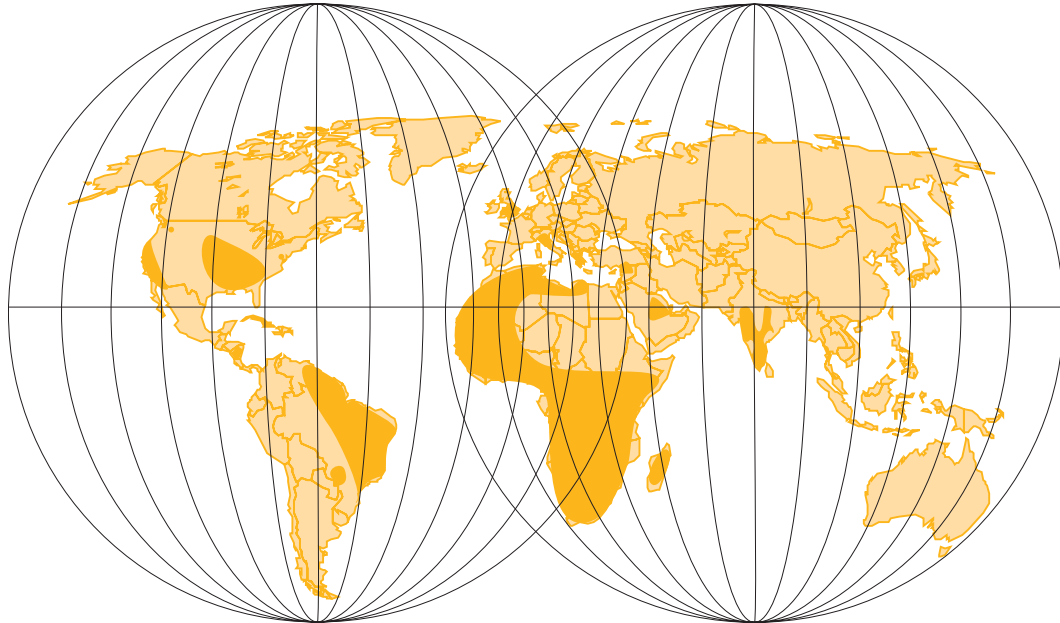
- Sickle cell trait; and
- Hemoglobin C trait.

First, let's look at sickle cell trait.

# Sickle Cell Trait

It is possible for a person of any race or nationality to have sickle cell trait, but it is very common in African-Americans. About one (1) out of every 12 African-Americans has sickle cell trait. It also affects Hispanics, and people whose ancestors came from Africa, Latin America, Asia, India, and the Mediterranean region.

It is believed that sickle cell trait first appeared long ago in areas of the world where people were sick with malaria. Usually, a person with sickle cell trait has increased protection against malaria.

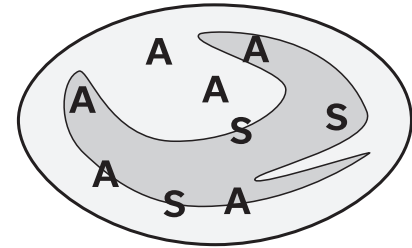


Shaded areas on the map represent places where a higher portion of the population have sickle cell trait.

People with sickle cell trait have red blood cells that hold normal hemoglobin A and an abnormal hemoglobin. The abnormal hemoglobin is called hemoglobin S.

People with sickle cell trait have slightly more hemoglobin A than hemoglobin S. They have enough hemoglobin A to help their red blood cells carry oxygen to the body. Only in extreme cases would this trait cause health problems.

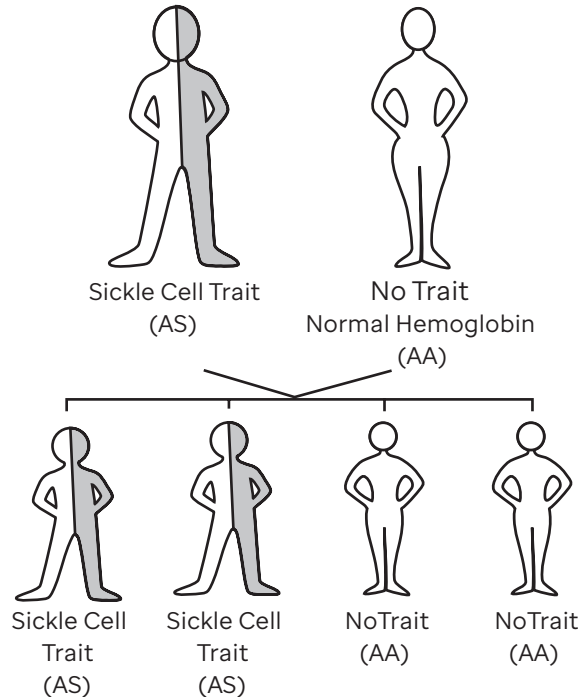
People with sickle cell trait **do not** have sickle cell disease. They cannot develop sickle cell disease later in life. They can pass sickle cell trait to their children.



Sickle Cell Trait Red Blood Cell

## How Sickle Cell Trait is Inherited

Sickle cell trait is inherited from one's parents, like hair color or eye color. If one (1) parent has sickle cell trait and the other parent has normal hemoglobin, there is a 50 percent (1 in 2) chance with each pregnancy of having a child who has sickle cell trait.





## Recap: Sickle Cell Trait Facts

People with sickle cell trait usually do not have any health problems caused by the trait. Sickle cell trait may cause health problems in some people under certain conditions, for example:

- Dehydration – a lack of water in the body
- Low oxygen – can be caused by very strenuous exercise
- Problems with high altitudes – can be caused by a lack of oxygen in the thin air, such as in the mountains

People with sickle cell trait can never develop sickle cell disease.

People with sickle cell trait can have a child with sickle cell trait.

## Why is it Important to Know if I Have Sickle Cell Trait?

Parents who have sickle cell trait can have a child with sickle cell disease. Sickle cell disease can cause serious health problems. That is why it is important to understand how sickle cell trait is passed on and how it can affect the health of your children and grandchildren.

# What is Sickle Cell Disease?

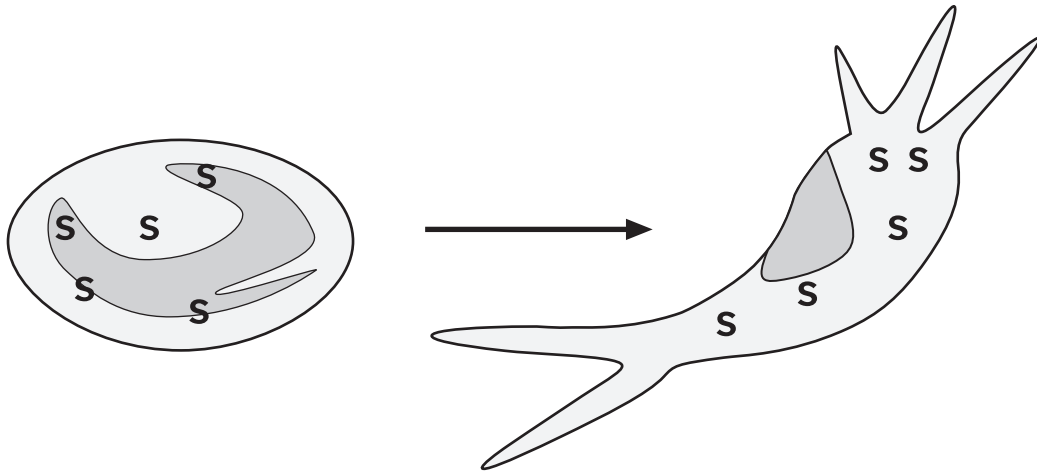
Sickle cell disease is the name for a group of illnesses. These lifelong illnesses make it hard for red blood cells to get oxygen to the body. They can cause pain and lead to serious health problems. There are many types of sickle cell disease. Two of the most common types are:

- Sickle cell anemia (also known as hemoglobin SS disease); and
- Sickle-hemoglobin C disease (also known as hemoglobin SC disease).

Let's look first at sickle cell anemia.

# Sickle Cell Anemia and Red Blood Cells

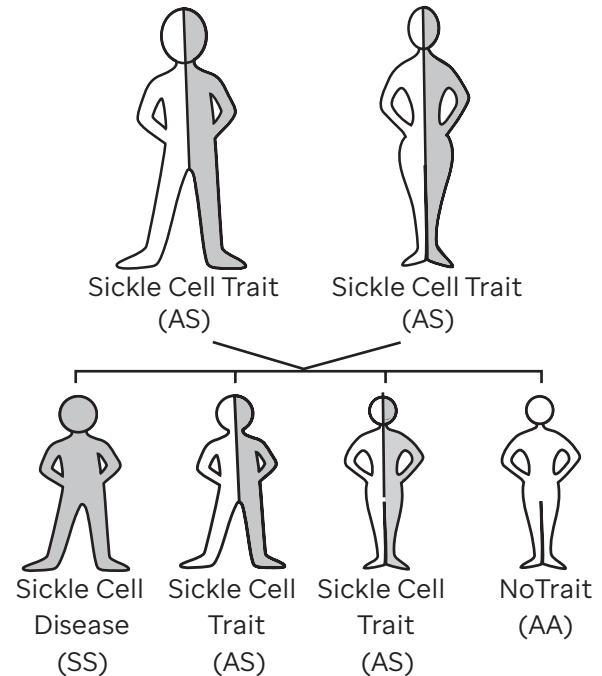
People who have sickle cell anemia have red blood cells that contain mostly hemoglobin S. Under certain conditions, these red blood cells harden and take on a sickle (or banana) shape. Their shape and texture make it hard for these cells to flow through small blood vessels and to deliver oxygen to some parts of the body. This can cause cell damage and pain.



Red Blood Cell in People with Sickle Cell Anemia

If both parents have sickle cell trait, they can have a child with sickle cell anemia. These are the possible outcomes with each pregnancy.

- 50 percent (1 in 2) chance of having a child with sickle cell trait
- 25 percent (1 in 4) chance of having a child with sickle cell anemia
- 25 percent (1 in 4) chance of having a child without sickle cell trait and without sickle cell anemia



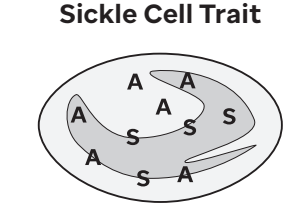
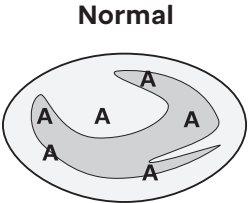
## Review – How Sickle Cell Trait and Sickle Cell Anemia are Inherited

If one (1) parent has sickle cell trait and the other parent has normal hemoglobin, there is a 50 percent (1 in 2) chance with each pregnancy of having a child with sickle cell trait.

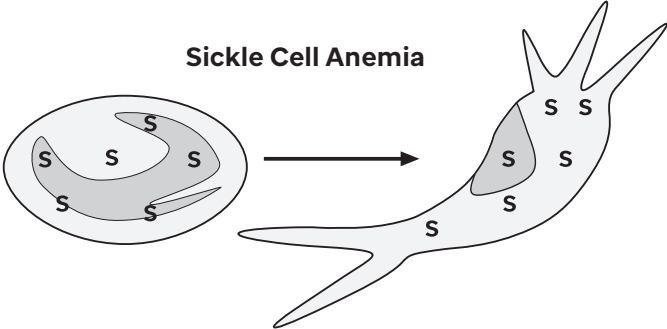
If both parents have sickle cell trait, there is a 25 percent (1 in 4) chance with each pregnancy of having a child with sickle cell anemia.

The only way to know if you have sickle cell trait is to have a simple blood test.

# Review - Sickle Cell Trait and Sickle Cell Anemia



No serious health problems, except in rare circumstances

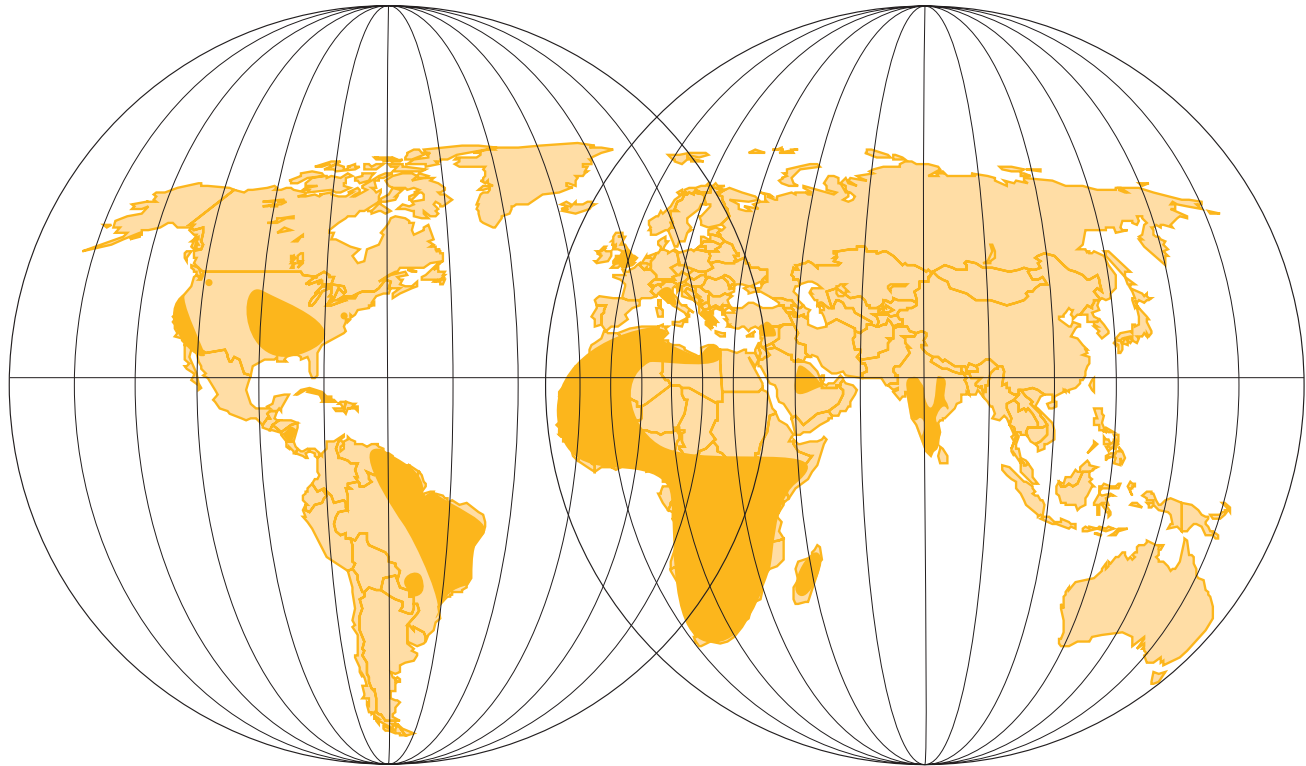


Sickle-shaped cells block normal blood flow causing serious health problems

# Hemoglobin C Trait

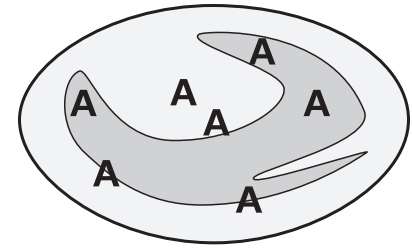
Another trait condition is called hemoglobin C trait. About one (1) out of every 40 African-Americans has hemoglobin C trait.

This trait also affects people whose ancestors came from Italy, Greece, Africa, Latin America, and the Caribbean region.



Shaded areas on the map represent places where a higher portion of the population have hemoglobin C trait.

To understand hemoglobin C trait, it helps to remember that normal red blood cells contain hemoglobin A. People who do not have hemoglobin C trait (or another trait condition) have only hemoglobin A inside their red blood cells.



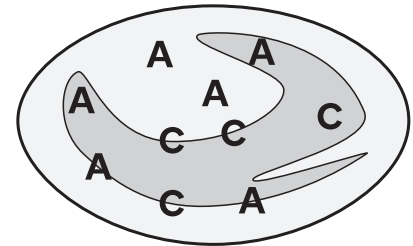
Normal red blood cell

## Hemoglobin C Trait and Red Blood Cells

People with hemoglobin C trait have red blood cells that hold normal hemoglobin A and an abnormal hemoglobin. The abnormal hemoglobin is called hemoglobin C.

People with hemoglobin C trait have slightly more hemoglobin A than hemoglobin C. They have enough hemoglobin A to help their red blood cells carry oxygen to the body.

People with hemoglobin C trait **do not** have sickle cell disease. They do not have hemoglobin C disease. They cannot develop these diseases later in life. They can pass hemoglobin C trait to their children.



Hemoglobin C trait red blood cell

## How Hemoglobin C Trait is Inherited

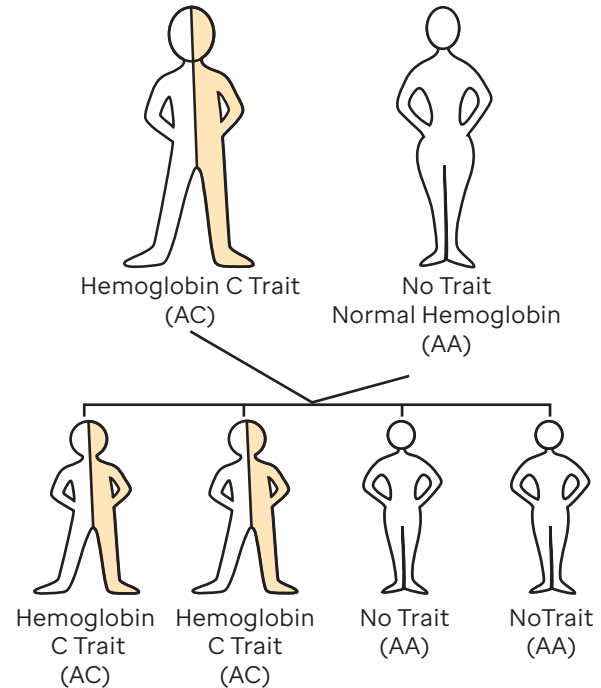
Hemoglobin C trait is inherited from one's parents, like hair color or eye color. If one (1) parent has hemoglobin C trait and the other parent has normal hemoglobin, there is a 50 percent (1 in 2) chance with each pregnancy of having a child who has hemoglobin C trait.

## Recap: Hemoglobin C Trait Facts

People with hemoglobin C trait usually do not have any health problems caused by the trait.

People with hemoglobin C trait can never develop sickle cell disease or hemoglobin C disease.

People with hemoglobin C trait can have a child with hemoglobin C trait.



## Why is it Important to Know if I Have Hemoglobin C Trait?

Hemoglobin C trait is an inherited condition. That means you can pass it on to your children, and they can pass it on to their children.

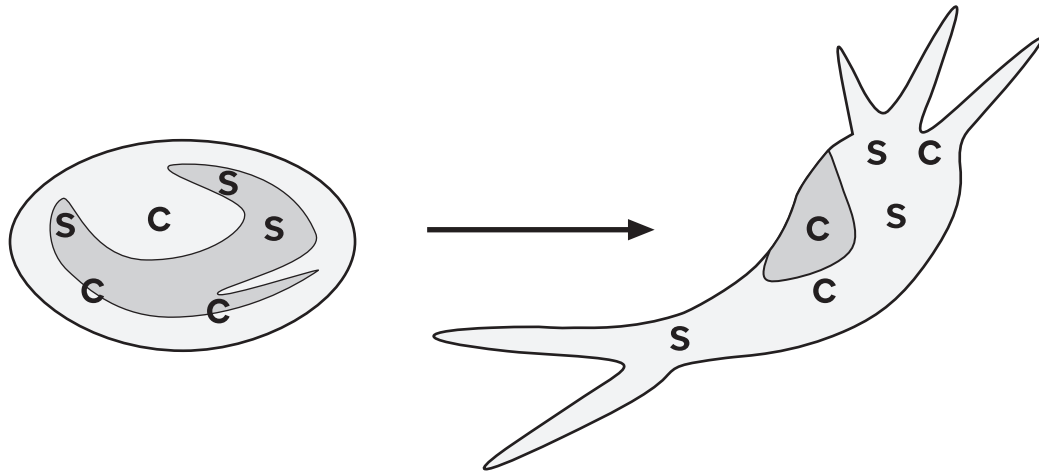
People who have hemoglobin C trait also can have a child with a form of sickle cell disease called sickle-hemoglobin C disease. Sickle-hemoglobin C disease (also known as hemoglobin SC disease) is a lifelong illness that can cause serious health problems.



## Sickle-Hemoglobin C Disease and Red Blood Cells

People who have sickle-hemoglobin C disease, also known as hemoglobin SC disease, have red blood cells that contain both hemoglobin S and hemoglobin C.

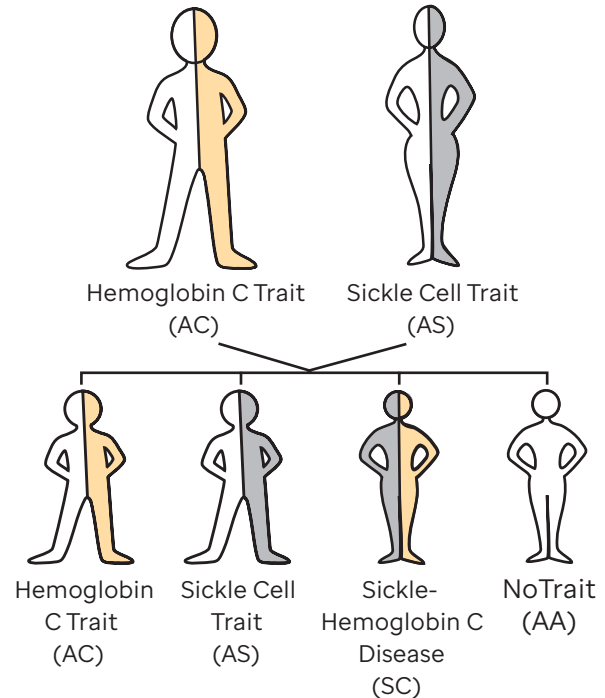
Under certain conditions, these red blood cells harden and take on a sickle (or banana) shape. Their shape and texture make it hard for these cells to flow through small blood vessels and deliver oxygen to some parts of the body. This can cause cell damage and pain.



Red blood Cell in People with Sickle-Hemoglobin C Disease

If one (1) parent has sickle cell trait and the other parent has hemoglobin C trait, they can have a child with sickle-hemoglobin C disease. These are the possible outcomes with each pregnancy.

- 25 percent (1 in 4) chance of having a child with hemoglobin C trait
- 25 percent (1 in 4) chance of having a child with sickle cell trait
- 25 percent (1 in 4) chance of having a child with sickle-hemoglobin C disease
- 25 percent (1 in 4) chance of having a child without trait and without sickle-hemoglobin C disease



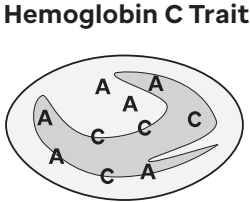
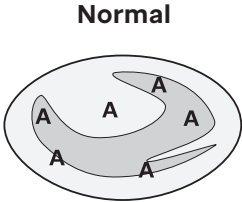
## Review – How Hemoglobin C Trait and Sickle-Hemoglobin C Disease are Inherited

If one (1) parent has hemoglobin C trait and the other parent has normal hemoglobin, there is a 50 percent (1 in 2) chance with each pregnancy of having a child with hemoglobin C trait.

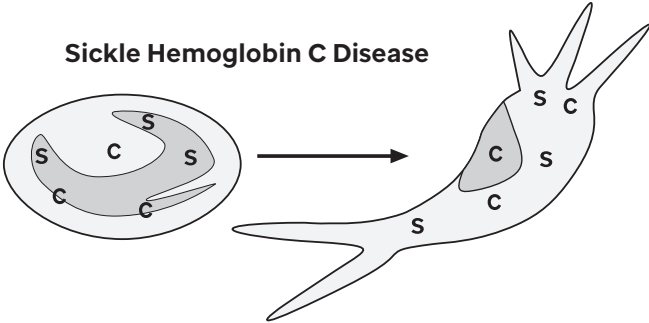
If one parent has sickle cell trait and the other parent has hemoglobin C trait, with each pregnancy there is a 25 percent (1 in 4) chance of having a child with sickle-hemoglobin C disease (a form of sickle cell disease). This is a lifelong illness that can cause serious health problems.

The only way to know if you have hemoglobin C trait is to have a simple blood test.

# Review - Hemoglobin C Trait and Sickle-Hemoglobin C Disease



No health problems

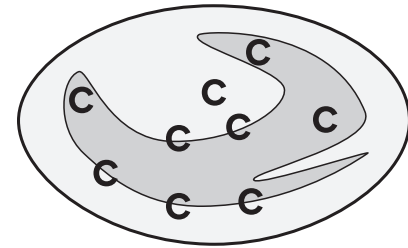


Sickle-shaped cells block normal blood flow causing serious health problems

## Hemoglobin C Disease

People with hemoglobin C trait also can have a child with hemoglobin C disease. Hemoglobin C disease is **not** a form of sickle cell disease.

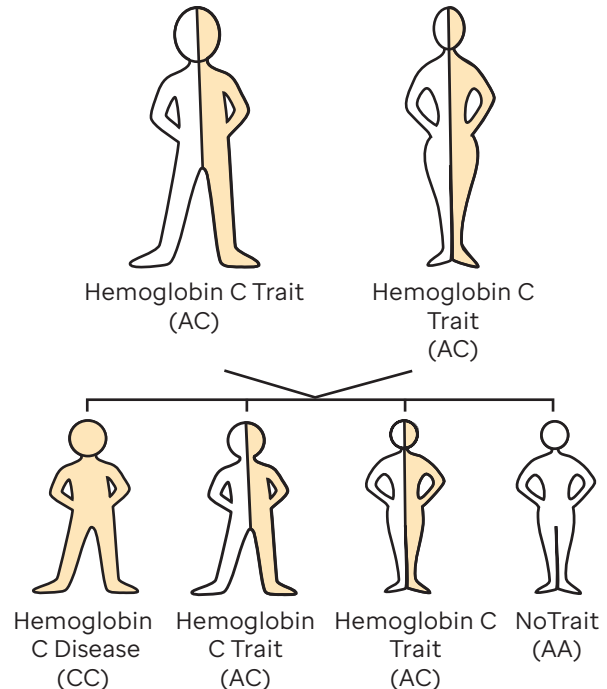
People who have hemoglobin C disease have red blood cells that contain mostly hemoglobin C. Too much hemoglobin C can reduce the number and size of red blood cells in your body, causing mild anemia. Hemoglobin C disease usually does not cause serious health problems.



Red blood Cell in People with Hemoglobin C Disease

If both parents have hemoglobin C trait, they can have a child with hemoglobin C disease. These are the possible outcomes with each pregnancy.

- 50 percent (1 in 2) chance of having a child with hemoglobin C trait
- 25 percent (1 in 4) chance of having a child with hemoglobin C disease
- 25 percent (1 in 4) chance of having a child without hemoglobin C trait and without hemoglobin C disease



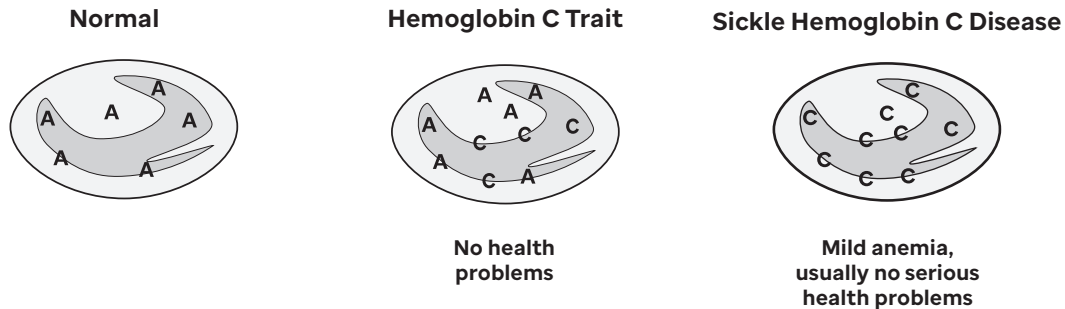
## Review - How Hemoglobin C Trait and Hemoglobin C Disease are Inherited

If one (1) parent has hemoglobin C trait and the other parent has normal hemoglobin, there is a 50 percent (1 in 2) chance with each pregnancy of having a child with hemoglobin C trait.

If both parents have hemoglobin C trait, there is a 25 percent (1 in 4) chance with each pregnancy of having a child with hemoglobin C disease. People with hemoglobin C disease usually do not have serious health problems.

The only way to know if you have hemoglobin C trait is to have a simple blood test.

## Review - Hemoglobin C Trait and Hemoglobin C Disease



To learn more about trait conditions, talk to your doctor or genetic counselor. This staff member can give you more details about your trait status and that of your child.

Also, for more information, you can visit our Web site at [www.stjude.org/sicklecell](http://www.stjude.org/sicklecell). Other Web sites of interest are published by the Sickle Cell Disease Association of America ([www.sicklecelldisease.org](http://www.sicklecelldisease.org)) and by the Georgia Comprehensive Sickle Cell Center at Grady Health System ([www.scinfo.org](http://www.scinfo.org)).

*St. Jude Children's Research Hospital does not endorse the content of any other Web sites provided in this manual.*





The Comprehensive Sickle Cell Center  
St. Jude Children's Research Hospital  
Department of Hematology  
262 Danny Thomas Place, Mail Stop 800  
Memphis, TN 38105-3678  
[www.stjude.org/sicklecell](http://www.stjude.org/sicklecell)