

Ataxia  
UK



Genetics and  
Ataxia

# Introduction

Some types of cerebellar ataxia are inherited and some are not. This leaflet has been written to provide information on the **inherited ataxias**. If after reading this leaflet you have any questions or concerns, please contact us at the Ataxia UK office.

# How do people inherit ataxia?

Most of our individual characteristics, the way we look, the way we grow and develop, even the way we behave, are strongly influenced by inheritance from our parents. These characters are determined by the genes that we inherit from our parents. The majority of genes are located within the nucleus of the cell. Genes provide the instructions for making proteins, and proteins are the basic building blocks of life. For most genes, everyone inherits one copy of each gene from their mother and another copy from their father.

Genes are not constant. They can be changed by a process called mutation which is a source of human diversity. Unfortunately this process can sometimes lead to genes becoming faulty. The inherited cerebellar ataxias are caused by such faulty genes. The different types of ataxia are caused by defects in different genes. They are single-gene disorders, meaning only one gene is affected in each disorder. These faulty genes are passed from parents to children through the generations in a number of different ways.

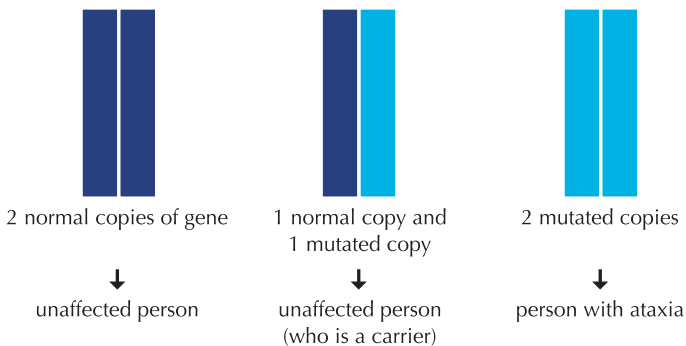
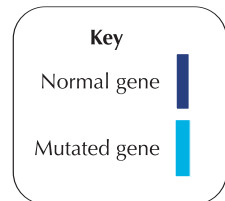
The inherited cerebellar ataxias can be divided into four groups, depending on how they are inherited. The disorder can either be inherited in an **autosomal recessive** way or an **autosomal dominant** way; it can be transmitted only from the maternal line (**mitochondrial ataxias**), or can be **X-linked** (only males are affected).

In most cases, it is not possible to say with absolute certainty whether an individual child will or will not inherit ataxia. It is only possible to say what the chances are, based on the type of ataxia and the way in which it is inherited. These chances are the same for each successive child in a family.

## Autosomal recessive inheritance

A person only gets ataxia if both copies of the gene are affected. If only one copy is affected, the person is a carrier and could pass on ataxia [see diagram 1]. **Friedreich's ataxia** is one disorder that is inherited in this way.

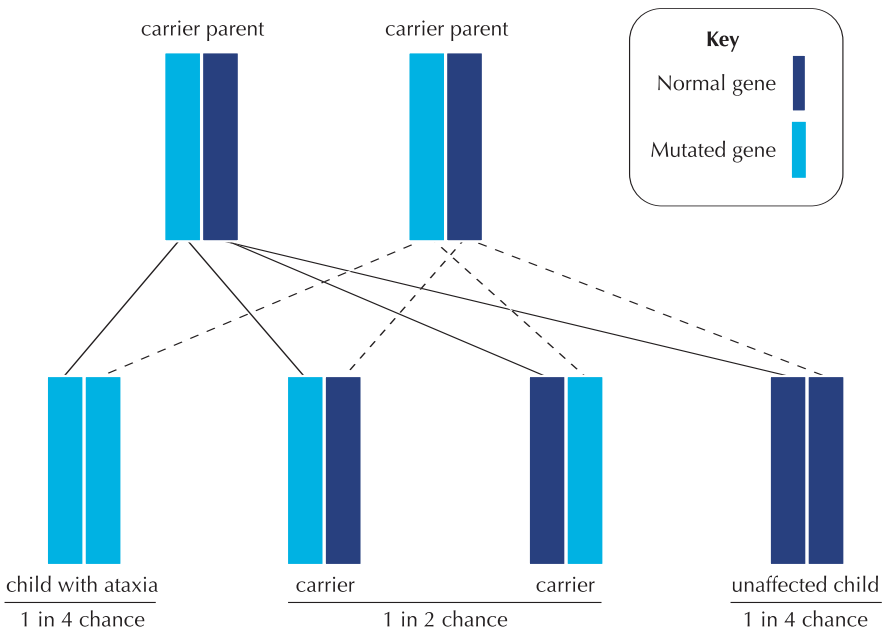
Diagram 1



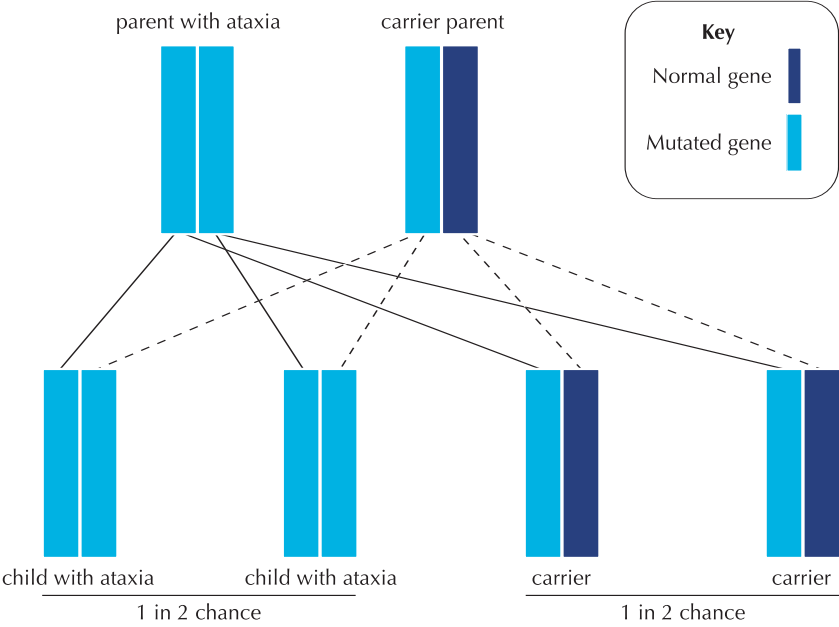
## What are the chances of inheriting ataxia?

If one parent has ataxia and the other parent is a carrier (i.e. has one mutated copy of the gene), then the chance of having a child with ataxia is one in two. If both parents are carriers then the chance of having a child with ataxia is one in four [see diagrams 2a-c]. If both parents have ataxia all their children will have ataxia.

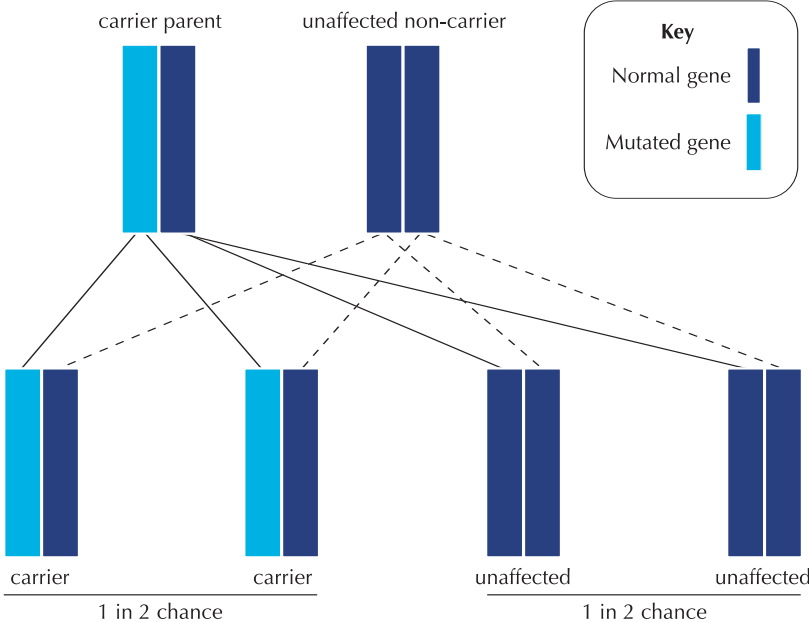
### Diagram 2 a) Both parents are carriers



**Diagram 2 b) One parent has ataxia and one parent is a carrier**



**Diagram 2 c) One parent is an unaffected carrier and the other is an unaffected non-carrier**



## Autosomal dominant inheritance

In this case the mutated copy is strong enough to override its normal partner and cause ataxia [see diagram 3]. Examples of this type of inheritance are the spinocerebellar ataxias (e.g. spinocerebellar ataxia type 1, spinocerebellar ataxia type 2).

**Diagram 3**



### What are the chances of inheriting ataxia?

If one parent has ataxia and the other parent is unaffected, they have a one in two chance of having a child with ataxia [see diagram 4]. If both parents have ataxia (with one normal copy and one mutated copy of the gene) they have a three in four chance of having a child with ataxia.



## Mitochondrial ataxias

These types of ataxia are caused by mutations in the genes that are found in the mitochondria (the energy-producing compartments of cells) rather than in the nucleus. As each person inherits their mitochondria from their mother, this means that these disorders can only be passed down the maternal line. If a woman has a mitochondrial ataxia she **will** pass it on to her children. If a man has a mitochondrial ataxia he will **not** pass it on to his children.

## X-linked ataxia

Very rarely the mutation that causes ataxia can be carried on the X chromosome. X chromosomes are the sex chromosomes. Females have two X chromosomes, whereas males have one X and one Y chromosome. Where ataxia is caused by a mutation on the X chromosome generally only males are affected. Females can be carriers but do not generally get affected. This is because for females to be affected their father must have this extremely rare condition, and their mother would also have to be a carrier.

## Genetic testing

It is possible to have a genetic test to try to find out if you have an inherited ataxia. This involves having a blood sample taken, which will be sent to a laboratory that will carry out the genetic test. Your doctor or neurologist can arrange a referral to a Regional Genetic Centre where genetic counsellors are also available to explain the tests and any implications of the test results. For a full list of Regional Genetic Centres in the UK contact the *Genetic Interest Group* ([www.gig.org.uk](http://www.gig.org.uk) Tel: 020 7704 3141). Genetic tests are only available for some of the inherited ataxias.

If your results are negative for all the genetic tests available, you could still have an inherited type of cerebellar ataxia. This is because you could have an inherited ataxia for which a genetic test is not yet available. If for example, there is more than one family member affected with ataxia, it is likely that it is an inherited ataxia.

## Presymptomatic genetic testing

If you are a close relative of someone with a known inherited ataxia and you do not show any signs of ataxia, it is possible to have a genetic test yourself. The chance of your developing the ataxia or being a carrier depends on how the ataxia is inherited (as described above). The decision to have a test or not is a very personal one and can be a difficult one to make. Some people prefer to have all possible information in advance, in order to plan for the future. Others may prefer not to know unless there is a cure. Support in making this decision is available from genetic counsellors, who are experienced and qualified in talking to people about these issues. Tests are only generally available for adults (i.e. people over 18 years old) without symptoms, but this may vary, depending on individual circumstances. For more specific advice talk to your doctor.

## Planning a family

Many people with inherited ataxias have children. Some develop ataxia after they have had children, others may do so knowing that they have ataxia. Every person with ataxia will have a different view on whether to have children. It is a deeply personal decision.

If you have a known recessively inherited ataxia (e.g. Friedreich's ataxia) and you wish to start a family, it is possible for your

partner to be tested to see if they are a carrier of the same type of ataxia. If he/she is not a carrier, then you will know that your child will not develop that ataxia.

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#### **A recessive ataxia**

Jan and her husband Ray discovered they were both carriers of the Friedreich's ataxia (FA) gene when two of their children were diagnosed with FA. Two older siblings, now adults, do not have ataxia symptoms and decided not to have a genetic test. If they want children themselves, their

partners could be tested. This would show whether their children could inherit ataxia. Jan has twin brothers. One found out he was a carrier following a test. The other has chosen not to have the genetic test for FA. Tests also showed that Ray's brother and two of his children are carriers of the gene.

# Prenatal diagnosis

It is also possible to test a baby before it is born to find out if he or she will develop a known inherited cerebellar ataxia. There are a number of situations where it may be helpful to do a genetic test before a baby is born to find out if he or she will develop ataxia.

- If you have a dominantly inherited ataxia that has been confirmed by a genetic test.
- If you have a recessively inherited ataxia confirmed by a genetic test and your partner is a carrier.
- If both parents are carriers of a recessively inherited disorder as confirmed by a genetic test (for example if they already have a child with ataxia).

It is also possible to do a prenatal diagnostic test for the mitochondrial ataxias or X-linked ataxias. Testing for mitochondrial ataxias may involve doing a genetic test or testing for specific chemicals that are 'markers' for the condition.

Prenatal diagnosis can be carried out by chorionic villus sampling or amniocentesis. Chorionic villus sampling involves testing a foetus at about 11 weeks of pregnancy by taking a small piece of placenta through the neck of the womb. Amniocentesis involves taking some of the fluid around the foetus and this test is done later in the pregnancy. These are complicated decisions to take and it is helpful to discuss them with your doctor and a genetic counsellor first.

# Research

Presently there are a number of people who have inherited cerebellar ataxias but do not know which type they have. This may be because they are negative for all genetic tests currently available. Research is continuing around the world to find new genes that cause inherited ataxias in order to develop new genetic tests. This is important, as it will help more people get a definite diagnosis of the type of ataxia they have, and will be helpful for research into finding treatments.

One important way in which you can help research is by letting Ataxia UK know which type of cerebellar ataxia you have. This will help us put together groups of people with the same type of ataxia for potential future research projects. We realise that this is personal information, which Ataxia UK will hold wholly confidentially and in accordance with the Data Protection Act 1998. Your details will not be disclosed to anyone without your permission.

## Glossary:

### **Autosomal**

affecting all the chromosomes except the sex chromosomes

### **Chromosomes**

Chromosomes are made up of long strands of DNA. Genes are segments of this DNA. Most human cells contain one pair of sex chromosomes and 22 pairs of non-sex chromosomes (autosomes).

### **Genes**

Genes are segments of DNA that provide the instructions for making proteins, and proteins are the basic building blocks of life. Genes are passed from one generation to the next. They are responsible for determining our inherited characteristics.

### **Mitochondria**

the energy-producing compartments of cells

**For more information or support, or if you would like a large print version of this leaflet, please contact us at the Ataxia UK Office.**

A list of medical and scientific references is available from the Office on request.

### **Disclaimer**

This leaflet is for information purposes only and, while every care is taken to ensure its accuracy, no guarantee of accuracy can be given. Individual medical advice should be sought before taking or refraining from taking any action based on the information contained in this leaflet and nothing should be construed as medical advice given by Ataxia UK or any of its officers, trustees or employees. No person shall have any claim of any nature whatsoever arising out of or in connection with the contents of this leaflet against Ataxia UK or any of its officers, trustees or employees.

This leaflet was written and produced by Ataxia UK. Dr Patrick Chinnery (Consultant Neurologist, Newcastle General Hospital) contributed to the production of this leaflet, and we also received input from a number of people affected by ataxia.

This leaflet is one of a series produced by Ataxia UK.

## **Data Protection**

Ataxia UK is committed to protecting your privacy and to processing your personal data in accordance with the Data Protection Act 1998 principles of good practice.

As soon as you contact us we create a record in your name. Information we collect, including information you give us during your first enquiry and any subsequent correspondence with us, is added to that record. Your personal data are used to provide you with the services, products or information you have requested and to further our aims as a charity.

The type of information we collect might include name, address, telephone number, email address and bank details. We may also collect “sensitive” data such as ethnic origin, physical or mental health. All your personal data are held securely and transfers of data within Ataxia UK are on a “need to know” basis only.

If you provide us with personal data, including sensitive data, you consent to us using that data for the purposes for which it is intended.

If you have any questions regarding data protection, or would like to receive a copy of our Privacy Statement, please contact Ataxia UK.



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This leaflet has been awarded a Triangle mark by the Centre for Health Information Quality, based on accuracy, clarity and relevance.

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Fighting Friedreich's and other cerebellar ataxias

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