Fact sheet **36**

TRISOMY 21 - **DOWN SYNDROME**

This fact sheet talks about the chromosome condition trisomy 21 and includes the symptoms, cause, treatment and available testing.

IN SUMMARY

- Trisomy 21 is also known as Down syndrome and is the most common chromosome condition that babies are born with
- People with Down syndrome usually have distinctive facial features, some learning disability and may have heart or digestive tract concerns
- Down syndrome is caused by having an extra copy of chromosome number 21.

WHAT IS DOWN SYNDROME?

Down syndrome is also known as trisomy 21. It is named after the doctor, John Langdon Down, who in 1866 noticed similar features in a number of his patients.

Down syndrome is well understood and although many different symptoms and features have been described, not everyone with Down syndrome will have all of them. The number of symptoms and the severity can vary between each person with Down syndrome.

At birth, many babies with Down syndrome will have one or more of the following features:

- Low muscle tone (a floppy baby)
- A face that appears flatter with eyes slanting upward
- Small ears and a wider neck than usual
- A single crease across the palm of the hand and a gap between the first and second toes ('sandal-gap' sign)
- Health concerns including those which affect the heart, digestive system and general development.

While learning disability is a feature of Down syndrome, most children are able to learn and develop at their own pace. Early intervention programs can help children with Down syndrome reach their learning potential.

In each cell of the body, except the egg and sperm cells, there are 46 chromosomes. Chromosomes come in pairs and each pair varies in size.

There are therefore 23 pairs of chromosomes, one of each pair being inherited from each parent.

- There are 22 numbered chromosomes from roughly the largest to the smallest: i.e. 1-22. These are called autosomes
- There are also two sex chromosomes, called X and Y.

In females, cells in the body typically have 46 chromosomes (44 autosomes plus two copies of the X chromosome). They are said to have a 46,XX karyotype. Eggs (female reproductive cells) are different as they only contain half of the chromosomes (23 made up of 22 numbered chromosomes and an X chromosome).

In males, cells in the body typically have 46 chromosomes (44 autosomes plus an X and a Y chromosome). They are said to have a 46,XY karyotype. Sperm (male reproductive cells) are different as they only contain half of the chromosomes (23 made up of 22 numbered chromosomes and an X chromosome or a Y chromosome). *Figure 36.1* shows a chromosome picture (karyotype) from a typical male (46,XY). The usual way a sperm and egg combine at conception is shown in *Figure 36.2*.

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Figure 36.1:
Chromosome picture (karyotype) from a male (46,XY).

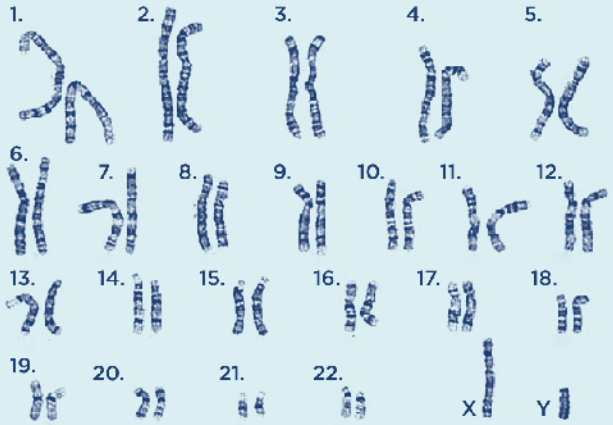
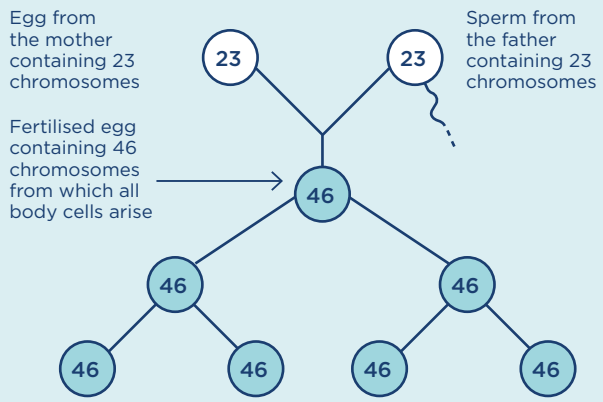


Figure 36.2:
At conception the sperm and egg combine



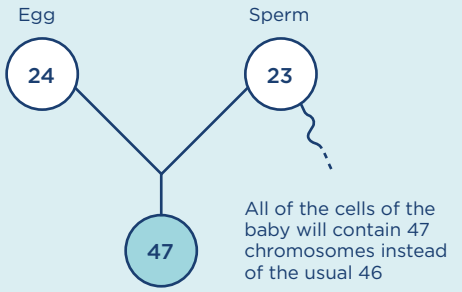
WHAT CAUSES DOWN SYNDROME?

About 1 in every 1000 babies in Australia is born with Down syndrome and it affects people of all ethnic and cultural backgrounds.

Sometimes, when the egg and sperm are forming, the chromosome pairs do not separate in the usual way. The result is an egg or sperm cell that has only 22 chromosomes while others have 24 chromosomes.

If an egg or sperm carrying 24 chromosomes combines with an egg or sperm carrying the usual 23 chromosomes, the result would be a person with 47 chromosomes in body cells instead of the usual 46 (See *Figure 36.3*).

Figure 36.3:
When the egg has 24 chromosomes, and the sperm has the usual 23, the baby's cells will contain 47 chromosomes instead of 46.



There would be three copies of a particular chromosome in the cells rather than two. This is called **trisomy**.

The chromosome pattern in people with Down syndrome includes an extra copy of chromosome number 21.

The presence of the extra copy of chromosome 21 causes the learning disability and physical features of Down syndrome. People with this condition usually have three *whole* copies of chromosome number 21, i.e. 47 chromosomes in their cells instead of 46. **Trisomy** means *three bodies*.

Figure 36.4 is a picture (karyotype) of the chromosomes from a female with trisomy 21 (47,XX+21).

Some people have Down syndrome as a result of a chromosome rearrangement.

Down syndrome due to an imbalance caused by a Robertsonian translocation happens when chromosome 21 material is *stuck onto* or *translocated* onto another chromosome. Please see *Figure 36.5* for a balanced version of a Robertsonian translocation involving chromosomes 21 and 14. Rarely, a chromosome translocation may happen when sections of chromosome 21 are rearranged with sections of another chromosome, so there is too much of only a part of chromosome 21 (partial trisomy). Signs and symptoms may be different from those found in full trisomy 21.

Figure 36.4:
Chromosome picture (karyotype) from a female with trisomy 21 (47,XX+21). In this cell, there are 47 chromosomes including three copies of chromosome 21 instead of the usual two.

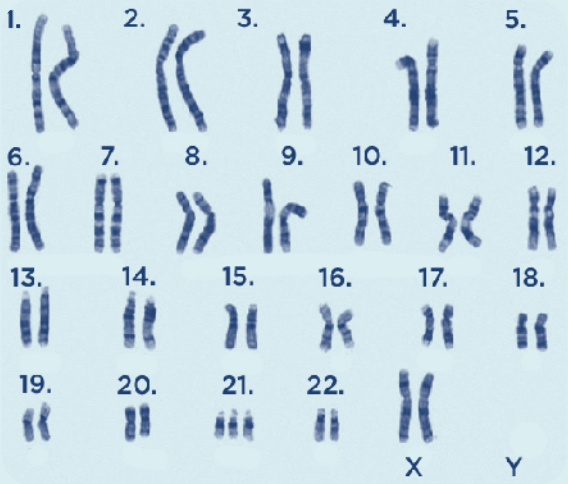
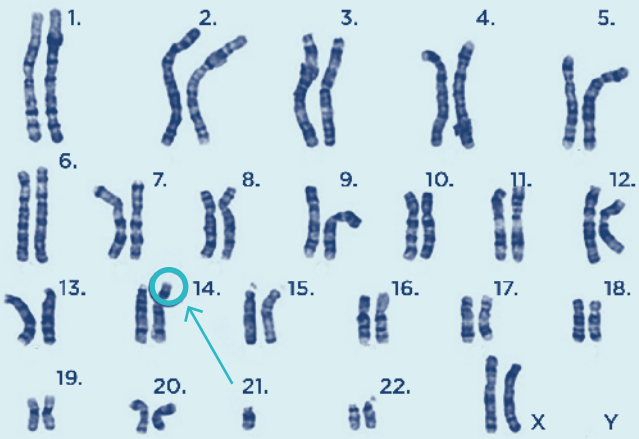


Figure 36.5:
A picture (karyotype) of the chromosomes from a female with a `balanced' Robertsonian translocation between chromosomes 21 and 14.



Some people have Down syndrome as a result of a mosaicism

Most individuals have the same chromosome makeup in all the cells in their body. People with Down syndrome as a result of **mosaicism** have some cells in the body with the usual two copies of chromosome 21, and other cells with three copies of chromosome 21. Someone who is mosaic for a chromosome change therefore has a mixture of cells in their body. Although, signs and symptoms tend to be milder in people with a lower proportion of cells with trisomy, it may be difficult to predict how signs and symptoms will show up just from a blood test.

HOW IS DOWN SYNDROME INHERITED?

In most cases where Down syndrome is caused by a complete extra copy of chromosome 21, that person will be the first and only person affected by the condition in that family. This is also the case where Down syndrome is the result of **mosaicism**.

It is usually assumed that if the parents of a person with Down syndrome have the usual two copies of chromosome 21, then the extra 21 in their child was a result of an egg or sperm with 24 instead of 23 chromosomes.

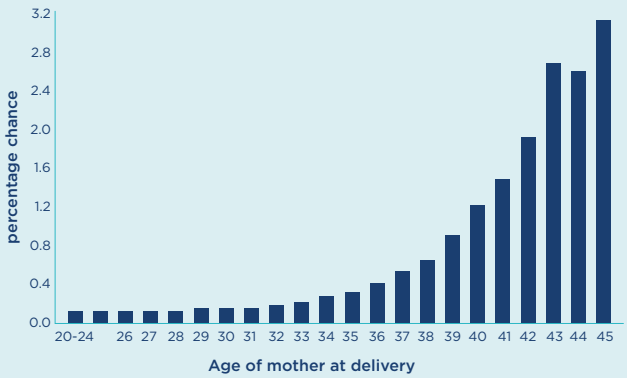
As mothers get older, errors in chromosome number are more likely to happen in their eggs. Figure 36.6 shows the chance of having a baby with Down syndrome depending on a mother's age.

For parents who have a child with a translocation form of Down syndrome, there may be more tests needed to check if the chromosome rearrangement in the child has happened as a new rearrangement or not. Depending on results of tests in the child and parents, the chance of another child having Down syndrome can vary.

IS THERE ANY TESTING AVAILABLE FOR DOWN SYNDROME?

Chromosome testing in a baby who is suspected of having Down syndrome can be done using a blood sample. A doctor may suspect a baby has the condition if there are facial features or other symptoms such as a concern with the heart or low muscle tone.

Figure 36.6:
Chance of having a live-born baby with Down syndrome (trisomy 21) according to the mother's age at the time of delivery of the baby. (Sources: Morris JK, Mutton DE and Alberman E (2002) Revised estimates of maternal age specific live birth prevalence of Down syndrome. Journal of Medical Screening. 9, 2-6).



Age of mother at delivery	Chance of having a live-born baby with Down Syndrome	Age of mother at delivery	Chance of having a live-born baby with Down Syndrome
20-24 years	1 in 1,411	35 years	1 in 338
25 years	1 in 1,383	36 years	1 in 259
26 years	1 in 1,187	37 years	1 in 201
27 years	1 in 1,235	38 years	1 in 162
28 years	1 in 1,147	39 years	1 in 113
29 years	1 in 1,002	40 years	1 in 84
30 years	1 in 959	41 years	1 in 69
31 years	1 in 837	42 years	1 in 52
32 years	1 in 695	43 years	1 in 37
33 years	1 in 589	44 years	1 in 38
34 years	1 in 430	45 years	1 in 32

Testing for pregnancy

Testing for Down syndrome may be offered during pregnancy.

Prenatal tests can happen in a number of different ways and at certain stages of the pregnancy. In general, there are two main types of prenatal test – a screening test and a diagnostic test.

Screening tests give a risk or estimate of the chance that a baby has a health condition. These tests do not generally look directly at a sample from the developing baby and are therefore very safe. Included in the group of screening tests are ultrasounds, non-invasive prenatal testing, first trimester screening and second trimester screening.

Diagnostic tests provide a more accurate result since they are generally directly testing the baby. Because of this, in a very small number of cases, a test may also cause a miscarriage. Included in the group of diagnostic tests are ultrasounds, chorionic villus sampling (CVS) and amniocentesis.

Testing during pregnancy is optional and should be talked about in full with your doctor, midwife or genetic counsellor. Making a decision to have a test or not is always up to you.

It may also be possible to have pre-implantation genetic diagnosis (PGD) to look for Down syndrome in an embryo made using in vitro fertilisation (IVF). When planning a family, options for testing are best talked about and considered before pregnancy.

More support and information is available for individuals and families through support organisations including Genetic Alliance Australia.