Fact sheet **13**

MOSAICISM

This fact sheet talks about mosaicism, which refers to when people have a mixture of cells in their bodies containing different genetic information.

IN SUMMARY

- Mosaicism means that a person has a mixture of cells with different genetic information
- Mosaicism can occur in the cells in one part of the body (such as in the egg or sperm) or in a generalised way throughout all of a person's cells.

CHROMOSOMES, GENES AND DNA

Our bodies are made up of billions of cells. Each cell contains a complete copy of our genetic information or DNA. In all the cells of our body, our genes are found on chromosomes (long stretches of DNA containing genes). We have many thousands of genes that provide information for our body to grow, develop and stay healthy. The genes send messages to the cell to make important chemical products such as proteins.

There are typically 46 chromosomes in each cell that come in 23 pairs. One of each pair is passed on to us from our mother and the other from our father. 22 of these chromosome pairs are numbered. These numbered pairs are known as the autosomal chromosomes. The 23rd pair is made up of the sex chromosomes called X and Y. Males have an X and a Y chromosome and females have two copies of the X chromosome.

Since the chromosomes come in pairs, there are also two copies of each of the genes. The exception to this rule applies to the genes carried on the sex chromosomes called X and Y. The genes in our DNA provide the instructions for proteins, which are the building blocks of the cells that make up our body. Although we all have variation in our genes, sometimes this can affect how our bodies grow and develop.

Generally, DNA variations that have no impact on our health are called **benign variants** or polymorphisms. These variants tend to be more common in people. Less commonly, variations can change the gene so that it sends a different message. These changes may mean that the gene does not work properly or works in a different way that is harmful. A variation in a gene that causes a health or developmental condition is called a **pathogenic variant** or mutation.

A CLOSER LOOK AT MOSAICISM

Most people have the same amount of DNA with the same 'spelling' and structure in all the cells in their body, whether they are blood cells, skin cells or muscle cells. Mosaicism refers to when there is difference in the DNA, in different cells of the same person.

Some people with a genetic condition have some cells in the body with the right DNA 'spelling' and structure and other cells with a DNA change or variation.

Just as mosaic tiles on a floor have a mixture of patterns, someone who is mosaic for a DNA variation will have a mixture of cells in their body.

When there is mosaicism in the egg or sperm (reproductive) cells, it is referred to as **gonadal** or **germline mosaicism**.

WHAT DOES IT MEAN IF YOU HAVE MOSAICISM?

All of the genes are contained in every cell but only the genes that produce proteins necessary for the cell will be switched on. For a gene variant to cause a problem, how the gene product is made must have an impact on the cells of the tissue or organ in which it is present.

Content updated October 2021
OCT21/V1 NS12657
SHPN: (HETI) 240984

A person may have a variant detected in their blood cells but not have the condition associated with it.

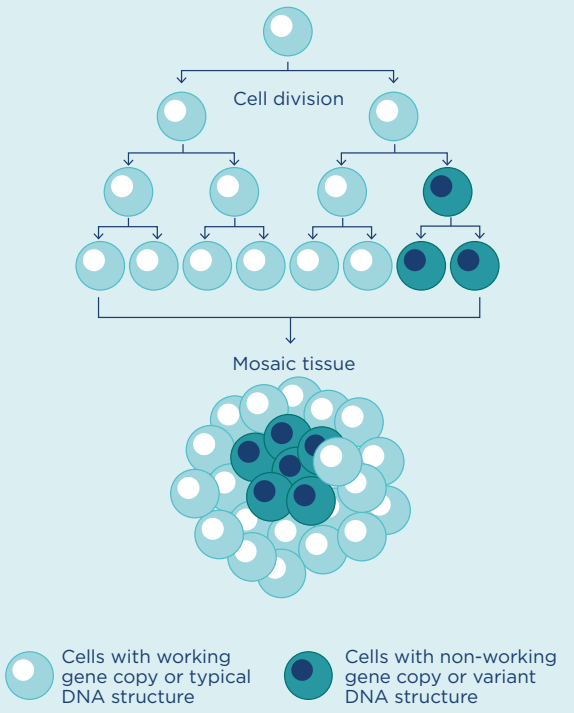
For example, a gene variant that would usually impact on brain development may be found in the blood of a person who does not show any signs of the condition. This may mean for example, that the blood cells contain the gene variant, but the brain cells contain only the working copy of the gene.

This person has a mixture of cells (**mosaic**) in their body. Some cells contain the variation in the gene so that it does not work (blood cells) and some have the working gene copy (brain cells).

Sometimes mosaicism may explain why the set of symptoms in people with the same genetic condition are different, or differ in severity.

It is, however, impossible to look at the spelling and structure of DNA in every cell in the body, and so we cannot always be certain if someone is mosaic for a variant or not.

Figure 13.1:
Mosaicism occurs when a cell gains a DNA variation during cell division. All cells that arise from the cell with the variation will also have this, while other cells will contain the working gene copy or, typical DNA structure.



GERMLINE MOSAICISM (MOSAICISM IN SPERM CELLS AND EGG CELLS)

A DNA variation may not be present in the body cells, but is in the germ cells (egg or sperm cells) and so the variation may be passed on in a pregnancy. For example, this is a possibility when a healthy couple have more than one child with a genetic condition that is usually passed down by an affected parent (autosomal dominant inheritance).

When parents have one child with a condition that is caused by an autosomal dominant gene variant, but neither parent has the gene variant on a blood test, it may be assumed that the condition in the child happened due to a new or spontaneous variant in the egg or sperm, or shortly after conception.

If they have a second child with the same condition, the chance of the condition happening again because of a spontaneous variant in the same gene for the second time is highly unlikely.

The more likely explanation is that a parent is mosaic for the variant in their germ cells that produce the egg or sperm, but they may have a working copy of the gene in their body cells including their blood cells.