Genetic Disorder

Genetic disorders are due to alterations or abnormalities in the genome of an organism. A genetic disorder may be caused by a mutation in a single gene or multiple genes. It can also be due to changes in the number or structure of chromosomes.

Genes are the basic unit of heredity. They hold the genetic information in the form of DNA which can be translated into useful proteins to carry out life processes. These genes undergo a mutation sometimes, which changes the instructions to formulate the protein, due to which the protein does not work properly. Such disorders are known as genetic disorders.

In certain situations e.g., due to environmental radiation, food intake or internal genetic conditions, chromosomes may suffer damage or may change in numbers. The change in structure is called structural chromosomal abnormality (or aberration) and the change in number is called numerical chromosomal abnormalities.

Type of Genetic Disorder:

Mendelian Disorder:

- These disorders occur due to mutations in a single gene and can be easily detected by pedigree analysis.
- These disorders can be autosomal dominant, autosomal recessive, sex-linked dominant, sex-linked recessive, and mitochondrial.

The most common Mendelian disorders include:

- Cystic fibrosis (autosomal recessive)
- Haemophilia (sex-linked recessive)
- Albinism (autosomal recessive)
- Sickle cell anaemia (autosomal recessive)

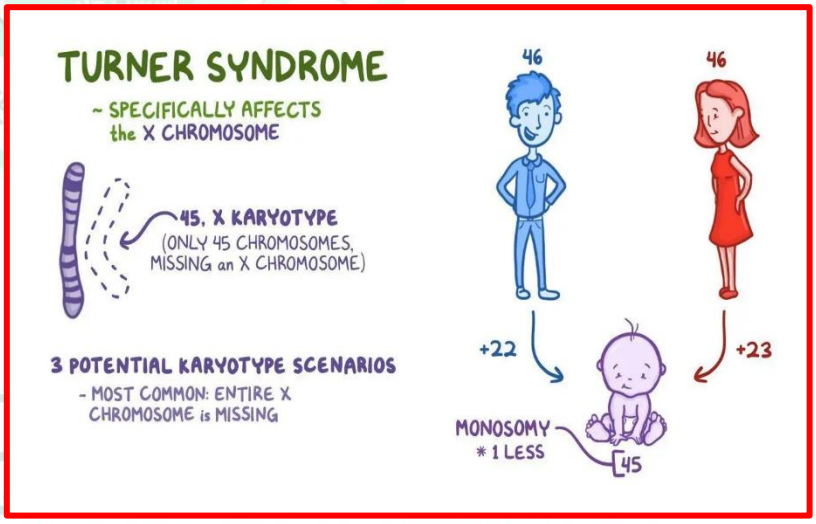
Chromosomal Disorder

- These disorders are caused by any alteration in the number or structure of the chromosomes.
- Sometimes the whole chromosome is gained or lost.
- This type of disorder is usually fatal and affects many genes.

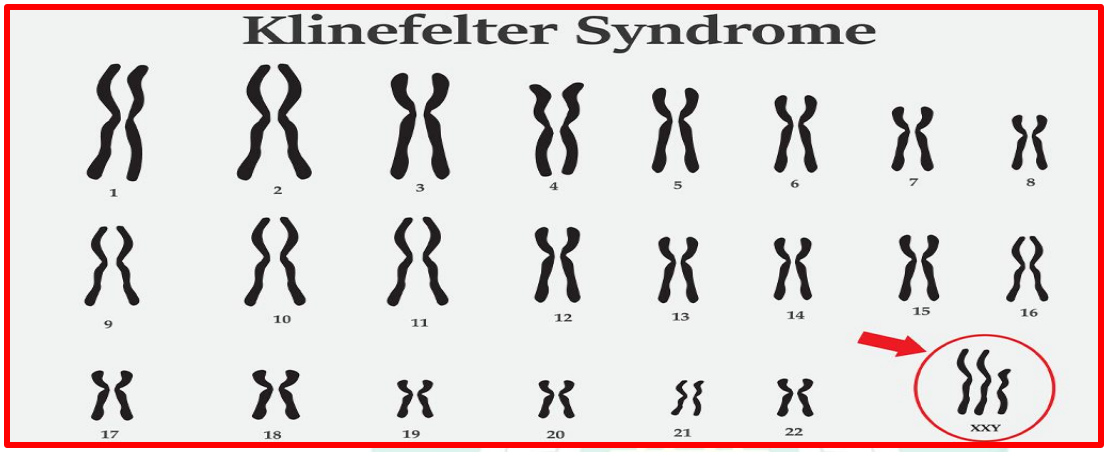
Some of the major chromosomal abnormalities are:

- Down's syndrome- the addition of a chromosome 21 (trisomy)
- Turner's syndrome-absence of an X chromosome (XO)
- Kleinfelter's syndrome-addition of an X chromosome (XXY)

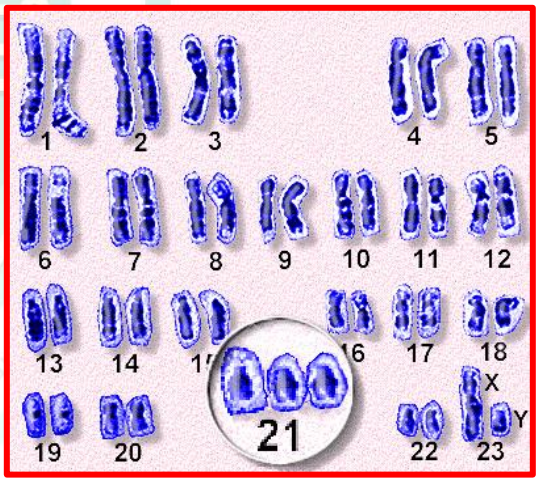
Most cases of Turner syndrome are not inherited. When this condition is caused by monosomy X , the chromosomal abnormality occurs as a random event during the formation of reproductive cells (eggs and sperm) in the affected person's parent.



There are 2 types of chromosome, called the sex chromosomes, that determine the genetic sex of a baby. These are named either X or Y. Usually, a female baby has 2 X chromosomes (XX) and a male has 1 X and 1 Y (XY). But in Klinefelter syndrome, **a boy is born with an extra copy of the X chromosome (XXY)**



Down's syndrome is when you're born with an extra chromosome. You usually get an extra chromosome by chance, because of a change in the sperm or egg before you're born.



Multifactorial Genetic Inheritance

This is also known as polygenic inheritance. These are caused as a result of environmental factors and gene mutations. Some of the examples of this kind of disorder are:

- Heart disease, High blood pressure, Alzheimer's disease, Obesity Diabetes , Cancer and Arthritis

Mitochondrial Inheritance

This type of genetic disorder is caused by mutations in the non-nuclear mitochondrial DNA. The mitochondrial DNA is inherited from the mother. Some of the diseases caused due to mitochondrial inheritance are:

- Leber's Hereditary Optic Atrophy (LHON)
- Myoclonic epilepsy with ragged red fibres
- Mitochondrial encephalopathy
- Lactic acidosis

Structural chromosomal abnormalities

Structural chromosomal abnormalities may be of following types:

1. **Deletion**: In deletion, a segment of a chromosome breaks away leading to shortening of the chromosome . For example, retinoblastoma is caused due to deletion of a portion of chromosome 13. Sometimes when two ends of a chromosome are deleted, they can reattach to form a ring chromosome.

2. Duplication: Duplication refers to when a segment of the chromosome gets repeated resulting in a longer chromosome This can lead to conditions e.g., Charcot-Marie-Tooth disease caused due to duplication of genes on chromosome 17.

3.Inversion: In inversion, a segment of the chromosome breaks away, completely reverses itself and reattaches with the chromosome. Here the overall length of the chromosome remains same but the orientation of gene is reversed by 180 degrees . For example, Renal cysts and diabetes syndrome(RCAD)syndrome caused by inversion of a segment of chromosome 17.

4.Translocation: In translocation, a segment of a chromosome breaks away and reattaches itself with another chromosome. If there is a mutual exchange of segments between two chromosomes, it is called

reciprocal translocation. Example: Burkitt's lymphoma, where exchange of materials happens between chromosomes 8 and 14. If a segment of a chromosome breaks away and attaches with another chromosome, without mutual exchange, it is called **Robertsonian translocation**. This may result in decrease of chromosome number of the cell

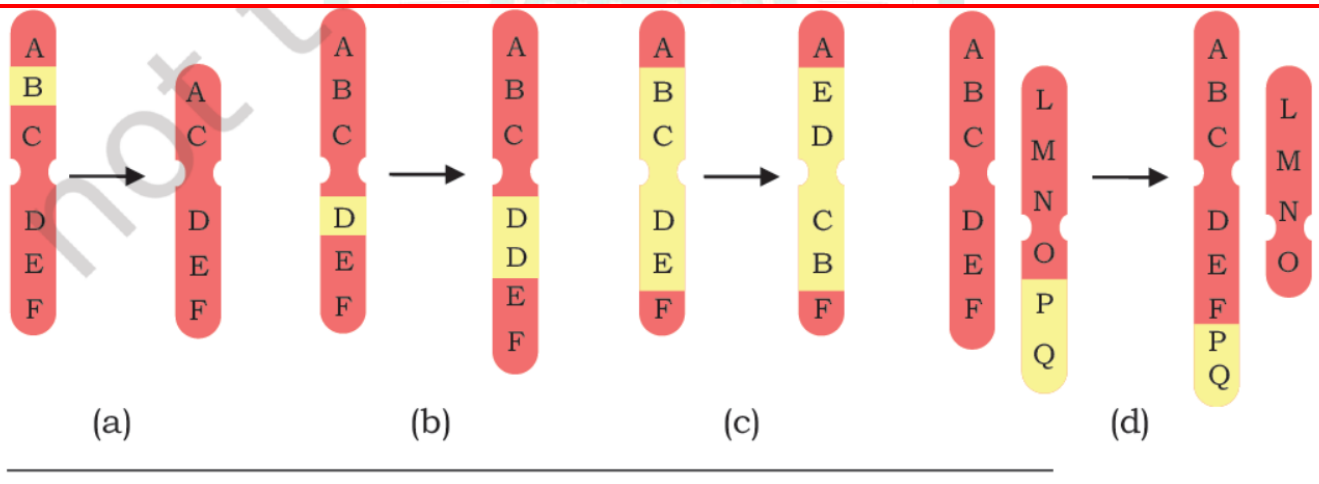


Fig. 8.1: (a) Deletion (b) Duplication (c) Inversion and (d) Translocation