# Sex Chromosome Aneuploidies

Sex chromosome aneuploidies (SCA) occur when there are changes in the expected number of the chromosomes associated with sex determination, the X and Y chromosome. The most common SCA are Klinefelter syndrome, Triple X syndrome, 47,XYY syndrome and Turner syndrome and they collectively occur in approximately 1 in 500 live births. People with SCA are sometimes mosaic, meaning that they have some cells that have the SCA and some cells that have the expected number of chromosomes. Mosaicism can affect the severity of the phenotype and can also make accurate testing more difficult. People with SCA generally have relatively few physical or intellectual changes and many people with SCA are never diagnosed because they do not have any clinical symptoms.

Non-invasive Prenatal Testing (NIPT) for SCA testing also has a lower positive predictive value (PPV) than testing for the common trisomies (Down syndrome, Edwards syndrome and Patau syndrome). This means that there is a lower chance a woman who receives a high risk result is actually carrying a baby with a SCA. This can result in unnecessary anxiety for the pregnant woman and her family. For these reasons consideration should be given before selecting this additional testing option and appropriate pre- and post-test genetic counselling should be provided.

## Turner syndrome (45,X)

Turner syndrome occurs in females when there is only one copy of the X chromosome instead of the usual two (figure 1). Unfortunately, many pregnancies with Turner syndrome will miscarry in the first or second trimester. Babies that are born with Turner syndrome could have a number of the features and symptoms, however, not everyone will have them all and severity will vary significantly. Some features and symptoms that may be present include short stature, infertility, heart defects and a number of various health conditions. The average intellectual ability of people with Turner syndrome is within the normal range; however, difficulties with learning (particularly math and spatial reasoning) has been noted.

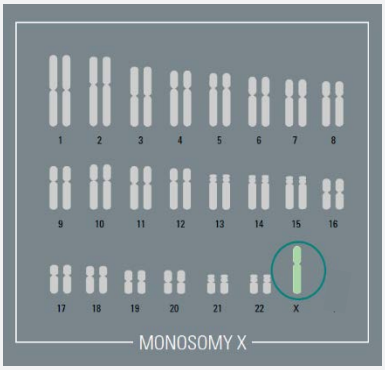


**Figure 1** Karyotype showing a female with one copy of the X chromosome. This person would have Turner syndrome.

## XYY syndrome (47,XYY)

XYY syndrome (sometimes known as Jacobs syndrome) occurs in males when there are two copies of the Y chromosome instead of the usual one. Many males with XYY syndrome do not have any clinical features and symptoms and will never come to clinical attention. There are no fertility issues associated with XYY syndrome. The average intellectual ability of males with XYY syndrome is within the normal range; however, their IQ may be slightly lower than their siblings. Learning difficulties have been associated in some people with XYY syndrome, usually involving speech and language. There are many misconceptions about males with XYY syndrome, previously, it was sometimes called the super-male disease and was associated with being overly-aggressive and lacking in empathy. Recent studies have disproven this and they are no longer associated with the condition.

This information sheet provides general information about the test result and recommendations. It is not intended to replace genetic counselling by a medical professional.

Non-invasive prenatal testing (NIPT) based on cell-free analysis is not diagnostic: results should be confirmed by diagnostic testing. Before making any treatment decisions, all women should discuss their results with their healthcare provider, who can recommend confirmatory, diagnostic testing where appropriate

Reference Material:

- Triple X syndrome. Mayo Clinic. December, 2015.
- Visootsak J, Graham JM. Orphanet Journal of Rare Diseases. 2006;1:42.
- National Organization for Rare Disorders. XYY syndrome [internet]. 2012.
- National Institute of Health (US). Genetic and Rare Diseases [Internet]. Gaithersburg (MD). 47, XYY syndrome; Oct 16 2017.
- A.D.A.M. Medical Encyclopedia. Atlanta (GA): A.D.A.M., Inc.; ©2005. Turner syndrome;2015 Oct 27.
- Centre for Genetics Education (AU). Fact sheet 40 - Turner syndrome [internet]. 2015 Nov.
- Mayo Clinic for Medical Education and Research. Turner Syndrome. August 20, 2011.

# Sex Chromosome Aneuploidies

### Triple X syndrome (47,XXX)

Triple X syndrome occurs in females when there is an extra copy of the X chromosome so there are three copies instead of the usual two. It is estimated that only 10% of females with Triple X syndrome ever come to clinical attention. Babies that are born with Triple X syndrome could have a number of the features and symptoms, however, not everyone will have them all and severity will vary significantly. Some females with Triple X syndrome will not have any features. Some features and symptoms could include learning difficulties, psychological conditions and tall stature. The average intellectual ability of people with Triple X syndrome is within the normal range; however, their IQ may be slightly lower than their siblings. Females with Triple X syndrome do not have issues with fertility.

### Klinefelter syndrome (47,XXY)

Klinefelter syndrome occurs in males when there are two copies of the X chromosome instead of the usual one. Babies that are born with Klinefelter syndrome could have a number of the features and symptoms, however, not everyone will have them all and severity will vary significantly. Some features and symptoms include learning difficulties (language-related), developmental delay, hypogonadism (small testes), tall stature and infertility. The average intellectual ability of people with Klinefelter syndrome is within the normal range; however, their IQ may be slightly lower than their siblings.

### Inconclusive SCA

In a very small number of cases, NIPT cannot give an answer about the probability of a SCA being present. In these cases, an inconclusive SCA result will be issued. This result does not indicate an increased probability of a condition being present but rather no change from the probability of when the woman presented for screening. There are many possible reasons for this to occur. Repeat screening with NIPT is not recommended for this result. A healthcare provider may recommend other types of prenatal screening or diagnostic tests if concern remains.

**NIPT is considered a prenatal screening test, not a diagnostic test. Before making any treatment decisions, all women should discuss their results with their healthcare provider, who can recommend confirmatory, diagnostic testing and genetic counselling where appropriate.**

This information sheet provides general information about the test result and recommendations. It is not intended to replace genetic counselling by a medical professional.


Reference Material:

- Triple X syndrome. Mayo Clinic. December, 2015.
- Visootsak J, Graham JM. Orphanet Journal of Rare Diseases. 2006;1:42.
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