Sex-linked inheritance

Inheritance related to sex chromosomes exists in three types – X-linked dominant, X-linked recessive and Dutch, i.e. Y-linked.

This is fundamentally a deviation from Mendel's laws - the monitored gene is not located on the autosome, but on the gonosome.

Inheritance gonosomally dominant

🔎 *For more information see Gonosomal Dominant Inheritance.*

- women are affected twice as often as men (they can inherit the disease from both parents)
- affected person has at least one affected parent = vertical type of inheritance
- typical diseases:
  - *vitamin D resistant rickets*
  - *incontinentia pigmenti*
- gametes combination XY and mutated = incapable of further development → one part of males does not develop → arise:
  - *2 parts female: 1 part male*
  - ← shift in the sex ratio
- For clarity:

- a heterozygous woman has affected sons and daughters with a 50% risk

- the affected man has all his daughters affected and his sons are healthy (they have Y from him)

Sick mother		
	X A	**X**
X	X and X	XX
Y	X AND Y	XY

- ½ daughter sick
- ½ daughters healthy
- ½ sons sick
- ½ sons health

Sick father		
	X	**X**
X A	X and X	X and X
Y	XY	XY

- all daughters ill
- all sons healthy

Inheritance gonosomally recessive

🔎 *For more information see Gonosomal recessive inheritance.*

- trait linked to a chromosome = practically only men are affected − women are only carriers (healthy – mostly)
  - a man is hemizygous for the gene, so he only needs one chromosome for the disease, while a woman would have to inherit the diseased allele from both parents
- typical diseases:
  - *hemophilia A, B*
  - *Daltonism (color blindness)*
  - *Duchenne muscular dystrophy* - fatal under 20 years of age (*dystrophin* production defect)
- For clarity:

- women (heterozygotes) are carriers of the disease

- a typical GR family tree shows the characteristic skipping of one generation, i.e. that the affected male has all carrier daughters (healthy heterozygotes) and all healthy sons (they get Y from the father)

- sons of carrier women have a 50% risk of disability

Carrier mother		
	X a	**X**
X	X and X	XX
Y	X and Y	XY

- ½ daughter of carrier
- ½ daughters healthy
- ½ sons sick
- ½ sons health

Sick mother		
	X a	**X a**
X	X and X	X and X
Y	X and Y	X and Y

- all daughters are carriers
- all sons sick

Sick father		
	X	**X**
X a	X and X	X and X
Y	XY	XY

- all daughters are carriers
- all sons healthy

In the case of a combination of a carrier mother and a sick father, half of the daughters and sons are sick, half of the daughters are carriers and half of the sons are healthy.

- a typical family tree with generation-skipping – a sick father has only healthy sons and carrier daughters, who in turn can have sick sons

Deviations from the normal pedigree

Lyonization

🔎 *For more information see Lyonization.*

- changes on the X chromosomes, one of which is inactive = genes will not manifest in the phenotype
- inactivation during embryonic development − it is random which of the X chromosomes will be inactive
- the resulting phenotype of the heterozygote, therefore, depends to some extent on how the lyonization took place (partial manifestation of the disease in carriers)

Gonosomal inheritance Y = Holland type

More detailed information can be found on the Dutch Inheritance page .

- the Y chromosome is acrocentric = the centromere is near the end = the smallest chromosome in the human karyotype
- no hereditary disease transmitted through the Y chromosome has yet been found
- area *for male sex determination* (on short arms) − near it lies *the SRY* area ← is responsible for spermatogenesis

Links

related articles

- Allelic interactions