Data Analysis

Pedigrees

Long before DNA testing made it possible to determine genotypes analytically, scientists constructed pedigrees to study inheritance patterns. A pedigree is a family tree that tracks a trait through multiple generations.

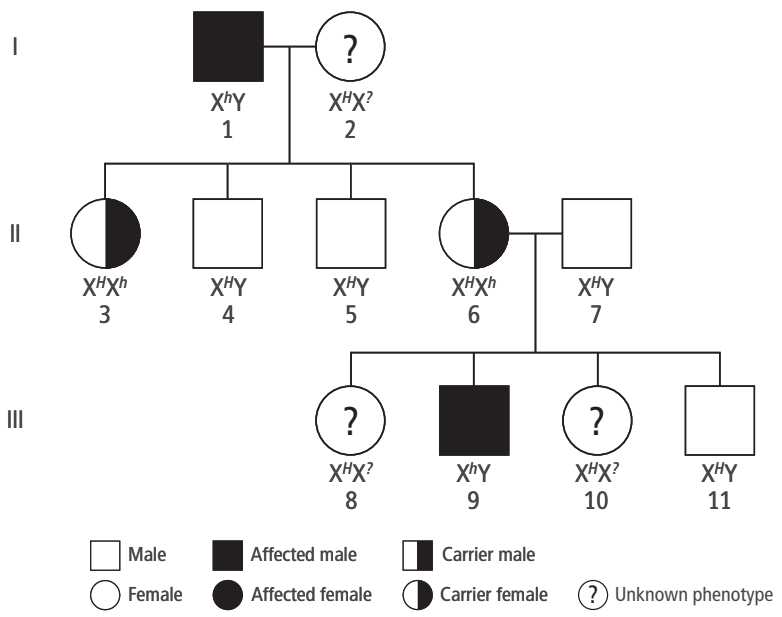
The inheritance pattern of hemophilia can be determined by analyzing a pedigree. Hemophilia is a sex-linked disorder that causes uncontrolled bleeding because the body fails to make one or more clotting factors. It can be fatal if untreated.

Pedigrees are built using symbols to represent relationships between individuals. Figure 15 is a pedigree following hemophilia through three generations. Males are represented by squares and females are represented by circles. A direct line between two individuals indicates a relationship. Siblings are listed from left to right in order from oldest to youngest, connected by a sibling relationship line. Parents and offspring are connected by a line of descent.

Fully shaded shapes represent individuals who are affected by the trait of interest—hemophilia. Affected males must have the hemophilia allele on the X chromosome, represented by X^h. Unaffected males must have a normal allele at this location, represented by X^H.

Half-shaded shapes represent carriers. No females in the second generation have hemophilia. Therefore, they all must have at least one normal allele for this gene. Also, their father can only pass along the hemophilia allele to his daughters. Therefore, all daughters in the second generation are heterozygous for this condition, X^HX^h. These females are carriers of the hemophilia gene.

FIGURE 15: A pedigree tracing hemophilia through three generations.



It is impossible to determine the genotype of Female 2. She may be a carrier for hemophilia who passed along a normal allele to all of her children. Or she could be homozygous dominant for this gene. This unknown allele on the X chromosome is represented by $X^?$.

It is also impossible to determine the genotypes of Females 8 and 10. The father can donate only a dominant allele. The mother can donate either a dominant or a recessive allele. Therefore, the daughters are either homozygous dominant or heterozygous at this location. Again, the unknown allele on the X chromosome is represented by $X^?$.

Data Analysis Use the pedigree to answer the following questions.

1. Is hemophilia a dominant or recessive trait? Use evidence to support your claim.
2. In the second generation, how many females are carriers of the gene? What is their genotype?
3. Imagine Male 9 married a female carrier. What is the probability that they will produce a female child with hemophilia? A child who does not have hemophilia? A child who has the parental phenotypes? Use evidence to support your answers.

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