The Hardy-Weinberg Equilibrium

Allele Frequencies in a Population

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Hardy-Weinberg Equilibrium

"Allele and genotype frequencies in a population tend to remain constant in the absence of **disturbing influences**"

Disturbing influences:

- non-random mating
- mutations
- selection
- limited population size
- random genetic drift
- gene flow
- migration

In Reality…

The conditions for Hardy-Weinberg equilibrium are never met in nature.

- There are always some disturbing influences in nature
- Hardy-Weinberg equilibrium can be approximated in the lab
- It has usefulness as a model for studying real populations

The Equations

$$p + q = 1$$

$$p^2 + 2pq + q^2 = 1$$

- A gene has two alleles, *A* and *a*
- The frequency of allele *A* is represented by *p*
- The frequency of allele *a* is represented by *q*
- The frequency of genotype *AA* = p^2
- The frequency of genotype *aa* = q^2
- The frequency of genotype *Aa* = $2pq$

An Example…

Assume a population in which 36% of the population are homozygous for a certain recessive allele, a. Assume the population is at equilibrium.

Question #1: What is the frequency of the recessive allele, a in this population?

$$q^2 = 0.36$$

$$q = \sqrt{0.36}$$

$$q = 0.60$$

An Example…

Assume a population in which 36% of the population are homozygous for a certain recessive allele, a. Assume the population is at equilibrium.

Question #2: What is the frequency of the dominant allele, A in this population?

$$q = 0.60$$

$$p + 0.60 = 1$$

$$p = 0.40$$

An Example…

Assume a population in which 36% of the population are homozygous for a certain recessive allele, a. Assume the population is at equilibrium.

Question #3: What percentage of the population are homozygous for the dominant allele, A?

$$p = 0.40$$

$$p^2 = 0.40^2$$

$$p^2 = 0.16 = 16\%$$

An Example…

Assume a population in which 36% of the population are homozygous for a certain recessive allele, a. Assume the population is at equilibrium.

Question #4: What percentage of the population are heterozygous for this trait?

$$2pq = 2(0.40)(0.60)$$

$$2pq = 0.48 = 48\%$$

An Example…

Assume a population in which 36% of the population are homozygous for a certain recessive allele, a. Assume the population is at equilibrium.

Question #5: Why do we have to start the problem with the percentage of the homozygous recessive in the population?

Answer: It is not possible to tell the homozygous dominant (AA) from the heterozygous (Aa) by examining the phenotype!