Twins - Type

Monozygotic

Arise from a single egg fertilized by a single sperm.

Twins are identical genetically.

Dizygotic

Arise from the fertilization of two different eggs by two different sperm.

Twins share, on average, one half of their genes in common.

Polar Body

Arise from the fertilization of an egg and a polar body by two different sperm.

Twins share, on average, one half of their genes in common.

Twins can also arise as a result of:

- **Superfetation –**

Twins arise as the result of the fertilization of an egg during an ongoing pregnancy. This results in a set of twins where the pair members are of different gestational age.

- **Superfecundation –**

Twins arise as the result of the fertilization of two different eggs by sperm from two different fathers. Twins arising in this way are only related to each other as half-siblings.

Approximate Twinning Rates in Different Populations Ranked by DZ Rate

Population	Twin Pairs Per 1000 Pregnancies*	
	MZ	DZ
AFRICAN		
Nigerians	5	40
South African Blacks	5	22
United States Blacks	4	12
CAUCASIAN		
Italians	4	9
Swedes	3	9
United States Whites	4	7
ORIENTAL		
Koreans	5	6
Chinese	5	3
Japanese	5	3

*Data are average values primarily from tables in Bulmer (1970).

Factors influencing the Frequency of Twin Birth

Maternal Age- Exclusive to DZ twinning- probably related to increase in gonadotropin level (FSH)

Birth order - DZ twinning rate increases with birth order.

Fertility Drugs- Have resulted in an increase in the frequency of DZ twins as well as a smaller increase in the frequency of MZ twins.

Genetic Factors - DZ twinning runs in families- this has not generally been the case for MZ twinning.

-Twins-

Methods Used in Assigning Twin Zygosity

- Genetic Markers
- Number of Fetal Membranes
- Questionnaires
- Physical Similarities
- Weinberg's Differential Rule

Genetic Markers

The efficiency of a given genetic marker is dependent upon the number of alleles and their frequency in the population. The accuracy of zygosity assignment increases with the number of informative markers evaluated.

Twin zygosity was determined using 6 DNA markers that included:

D1S495	(0.87)
D2D1363	(0.72)
D3S1261	(0.85)
D4S1625	(0.76)
D51473	(0.83)
D6S477	(0.90)

Using these markers the probability of correct zygosity assignment was 0.999

-Twins-

Number of Fetal Membranes

Since only MZ twins can be monochorionic, the presence of a single chorion (placenta) is proof of monozygosity. This can only be determined by examining a cross-section of placental membranes.

Questionnaires

Cost effective for large studies, however is not as accurate as use of genetic markers.

1) Alike as two peas in a pod
2) Often confused with each other

-Twins-

Physical Similarities

Misclassification rate is relatively high (13-23%)

1) Finger ridge counts and patterns
2) Height
3) Weight
4) Hair and eye color

Weinberg's Differential Rule

Used when it is only possible to obtain the sex of the twin pair. Assuming that males account for 50% of DZ twins and the sex of both members of a DZ pair is independently determined, then the number of MZ twins is estimated as the number of unlike-sexed twin pairs minus the number of same-sexed twin pairs and the number of DZ twin pairs is twice the number of unlike-sexed twin pairs.

Twins in Research

Advantages

Matched for age, race
Extremely efficient for determining if genetic factors are important

Disadvantages

May not be the same as singletons
More difficult to find than singletons

Ascertainment Methods

- Advertisements
- Clinic Population
- Population-based Twin Registries

Ascertainment Methods

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The rationale for the use of twin studies to detect the existence of genetic influences is that monozygotic twins are identical genetically and dizygotic twins share only half their genes in common, MZ co-twins should be more similar for traits that are genetically determined than are DZ co-twins.

-Twins-

Twin Study Design

1. Classical twin study
2. Twins separated at birth and reared apart
3. Placentation type twin analyses
4. Partitioned twin analyses
5. Extended twin kindred study

-Twins-

Analytical Methods Used in Twin Studies to Detect the Existence of Genetic Effects

Quantitative Traits

- Correlation Analyses
- Paired Analyses of Variance

Qualitative Traits

- Tetrachoric Correlation Analyses
- Concordance Rate Analyses

Pairwise Concordance Rate:

$$[1/2(c+w)/[(1/2(c+w))+d)]$$

c = The number of concordant twin pairs

w = The number of concordant twin pairs where both affected pair members were independently ascertained.

d = The number of discordant pairs.

Probandwise Concordance Rate:

$$[\ 2c_2 + c_1\ ] / [\ 2c_2 + c_1 + d\ ]$$

c_1 = The number of singly ascertained concordant pairs.

c_2 = The number of doubly ascertained concordant twin pairs.

d = The number of discordant pairs