



Multifactorial Inheritance and Quantitative traits

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Outline



- What is Multifactorial inheritance
- Difference Between Single-Gene and Multifactorial Inheritance.
- Characteristics of Multifactorial Traits
- Genetic and Environmental Interactions
- What is Quantitative Traits
- Clinical and Practical Implications

■ Objectives

- ❖ To understand and explain the fundamental principles of Multifactorial Inheritance and Quantitative traits.

❑ What is Multifactorial inheritance



- Refers to the inheritance of traits that are influenced by **multiple genes** (polygenic) and **environmental factors**.
- Multifactorial traits result from complex interactions between genes and external influences.
- Examples: height, weight, blood pressure, intelligence, and skin color.

❑ Difference Between Single-Gene and Multifactorial Inheritance



Feature	Single-Gene Inheritance	Multifactorial Inheritance
Number of genes involved	One	Multiple
Environmental influence	Minimal or absent	Significant
Phenotype distribution	Distinct categories (discrete)	Continuous (quantitative)
Example traits	Cystic fibrosis, Huntington's disease	Height, diabetes, blood pressure

❑ Characteristics of Multifactorial Traits



- **Additive Effects of Genes:**

- ✓ Multiple genes contribute small additive effects to the overall phenotype.

- **Environmental Modulation:**

- ✓ Factors like diet, lifestyle, and climate can influence trait expression.

- **Threshold Model:**

- ✓ For some traits (e.g., diseases like diabetes), a threshold must be crossed for the phenotype to manifest.

❑ Genetic and Environmental Interactions



1. **Additive Effects:** Genes and environment contribute independently to the phenotype.
2. **Epistasis:** Interaction between genes where one gene modifies the effect of another.
3. **Gene-Environment Correlation:** Individuals may be exposed to environments that correlate with their genetic predispositions.

❑ What is Quantitative Traits:



- Are characteristics or phenotypes that vary continuously across a population and are influenced by multiple genes (polygenic inheritance) as well as environmental factors.

1. Polygenic inheritance:

- ✓ Many genes contribute to the phenotype.

2. Environmental factors:

- ✓ Influence the extent of expression.

❑ Examples:



- **Height:**

- ❖ Affected by multiple genes and nutrition.

- **Skin color:**

- ❖ Determined by the cumulative effect of multiple pigment genes and sun exposure.

- **Blood pressure:**

- ❖ Influenced by genetics and lifestyle factors like diet and stress.

❑ Polygenic Inheritance:

Definition: Inheritance of traits determined by the combined effect of multiple genes.

Basic Features:

- . Each gene has a small, additive effect.
- . No single gene has a dominant influence
- . Example: Height

❖ Statistical Tools for Studying Quantitative Traits:



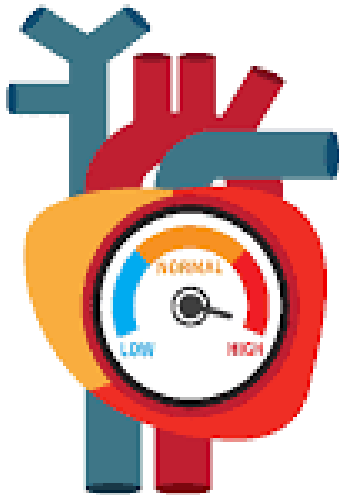
1. Regression Analysis.
2. Quantitative Trait Loci (QTL) Mapping.
3. Genome-Wide Association Studies (GWAS)

❖ Examples of Multifactorial Traits and Disorders:



1. Hypertension:

- Genetic factors: Variants in genes regulating salt metabolism.
- Environmental factors: High salt intake, obesity, stress.



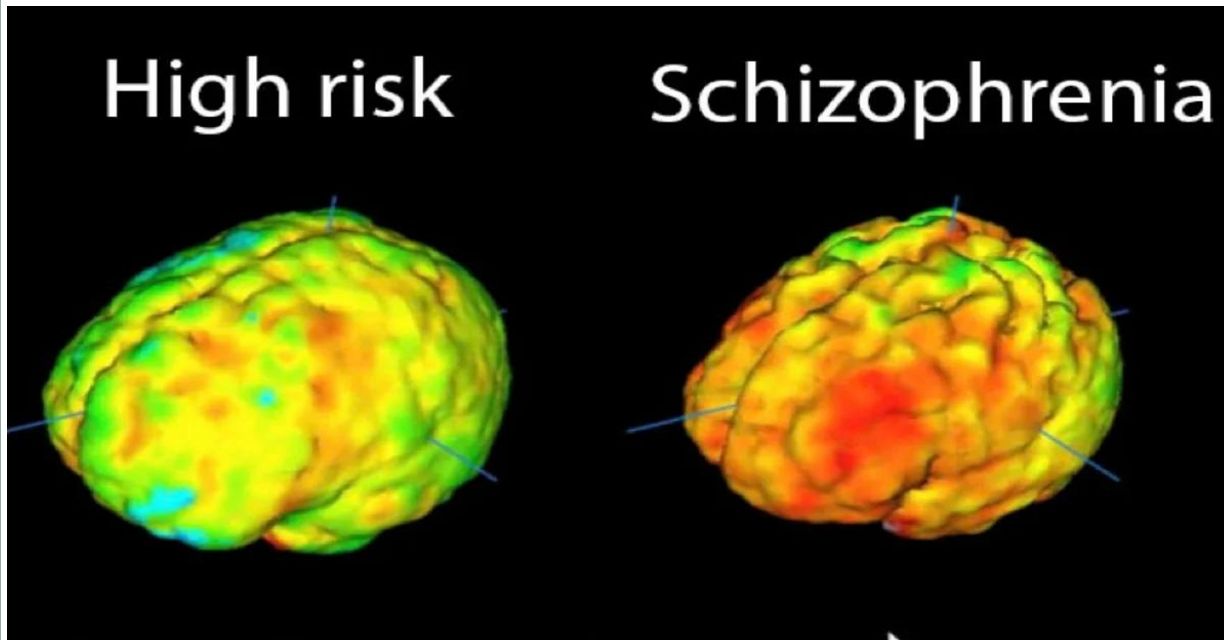
2. Type 2 Diabetes:

- Genetic predisposition in insulin regulation genes.
- Environmental factors: Diet, sedentary lifestyle.



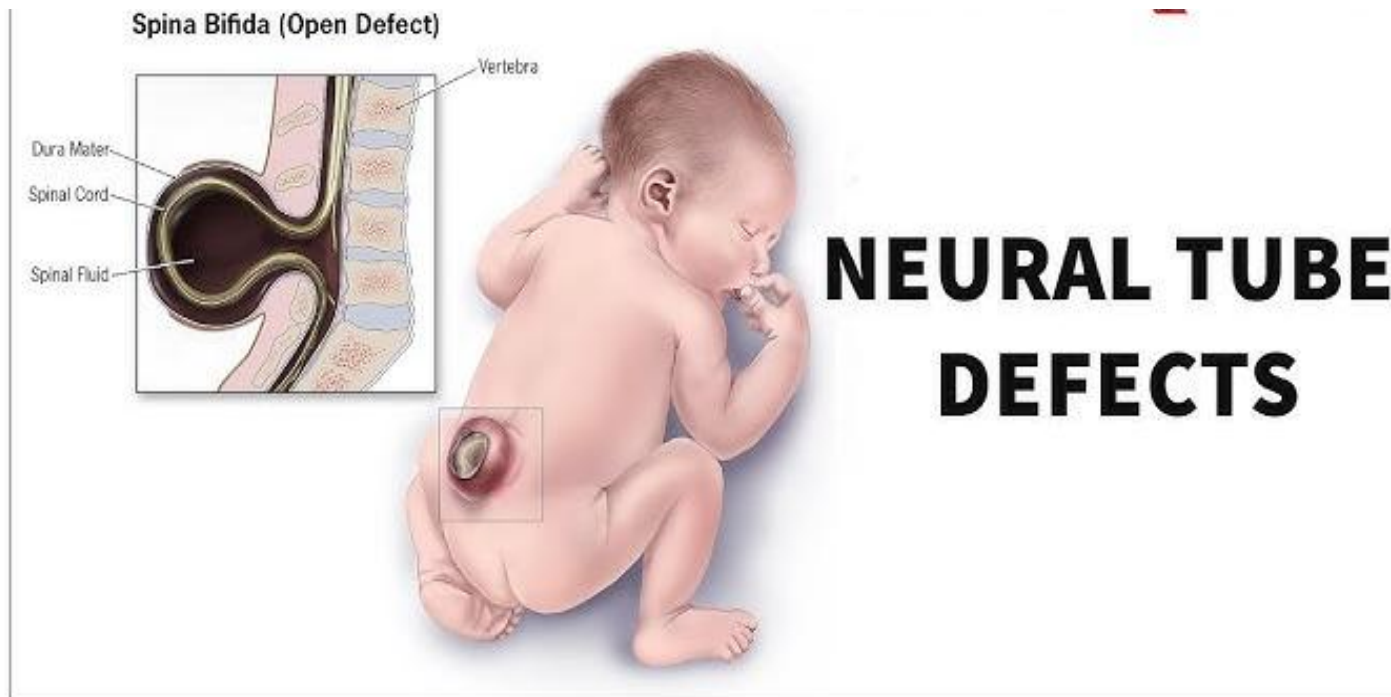
3. Schizophrenia:

- Polygenic inheritance with contributions from brain development genes.
- Environmental factors: Prenatal stress, infections



4. Neural Tube Defects:

- Genetic susceptibility (e.g., MTHFR gene variants).
- Environmental factors: Folic acid deficiency during pregnancy



✓ Clinical and Practical Implications:



1. Personalized Medicine: Tailoring treatments based on genetic predisposition (e.g., pharmacogenomics).
2. Genetic Counseling: Providing risk assessments for multifactorial disorders.
3. Preventive Strategies: Mitigating environmental risks to reduce the likelihood of disease.

References



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Thanks