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Q7(a)

Critically discuss the Mendelian principles and their application to human populations.

UPSC Civil Services Mains 2016 · Anthropology GS 1 · 20 marks · Human Genetics

9.1 Human Genetics: Methods and Application: Methods for study of genetic principles in man-family study (pedigree analysis, twin study, foster child, co-twin method, cytogenetic method, chromosomal and karyo-type analysis), biochemical methods, immunological methods, D.N.A. technology and recombinant technologies.

Core demand of the question

- Critically discuss the Mendelian principles and their application to human populations
- Write about 250 words for 20 marks

Revision summary

Segregation and independent assortment are the core Mendelian laws.

Human pedigrees of recessives, dominants, and X-linked traits apply them.

Hardy-Weinberg is Mendelism at population scale.

Consanguinity and caste mating violate random-mating assumptions.

Polygenic traits and eugenic history are the critique.

Introduction

Mendel's principles explain how discrete traits move from parents to offspring. In human populations they work, and they need Hardy-Weinberg, linkage, and culture before they become demography.

Body

The principles

- **Segregation:** alleles of a locus separate in gametes. **Independent assortment:** unlinked loci mix independently.
- **Dominance** is a phenotypic relation, not a moral one. Recessive traits hide in heterozygotes.
- **Mendel** used peas. Humans added sex linkage, as in **haemophilia**, and mitochondrial exceptions.

Application to human populations

- Pedigrees for **albinism**, **PTC**, **achondroplasia**, and **thalassaemia** are Mendelian teaching files.
- **Hardy-Weinberg** turns **Mendel** into population frequencies if mating is random and selection is nil.
- **Consanguinity**, studied by **Sanghvi** in India, raises homozygosity for recessives.
- Blood groups applied Mendelism at scale. Forensic STRs still assume Mendelian transmission.

Critical limits

- Most stature and skin traits are **polygenic**, not one-pea genes.
- **Linkage, imprinting, penetrance, and phenocopies** break textbook ratios.
- Culture decides who mates. Caste and village endogamy are not bean-bag random mating.
- **Eugenic** misuse of Mendelism was political. Counselling today is voluntary and case-based.

Flow diagram

Mendel segregation assortment -> Human pedigrees

Human pedigrees -> Hardy Weinberg

Hardy Weinberg -> Polygenic consanguinity culture

Conclusion

Mendelian principles still govern single-locus human traits and forensic markers. Population application needs Hardy-Weinberg plus a map of marriage. Polygenic and cultural facts stop a pea-garden view of whole peoples.

Facts & figures

Mendel

1866 pea experiments; recovered in 1900 by Correns, de Vries, and Tschermak.

Hardy-Weinberg

$p^2 + 2pq + q^2$; the null model for allele frequencies.

Sanghvi

Indian consanguinity and genetic load.

Haemophilia

X-linked pedigree that taught sex linkage in humans.