Q8(b)

Discuss the physiological and evolutionary theories of aging

UPSC Civil Services Mains 2021 · Anthropology GS 1 · 15 marks · Ageing and senescence. Theories and observations

Ageing and senescence. Theories and observations-biological and chronological longevity. Human physique and somatotypes. Methodologies for growth studies.

Core demand of the question

- Discuss the physiological and evolutionary theories of aging
- Write about 200 words for 15 marks

Revision summary

Physiological theories include oxidative damage, telomeres, and endocrine decline.

Hayflick limits and repair failure describe cells, not purpose.

- **Medawar:** late harmful mutations accumulate.
- **Williams:** genes good early can be bad late.
- **Kirkwood:** the soma is disposable once reproduction is served.

Introduction

Aging is the rise of mortality and the loss of function after maturity. Physiological theories name what breaks. Evolutionary theories name why selection allowed the break.

Body

Physiological theories

- **Wear and tear** and rate-of-living ideas treat the body as a machine that rusts. They are intuitive and too simple.
- **Free radical** and oxidative stress theories, after **Harman**, blame mitochondrial leaks. Antioxidant evidence in humans is mixed.
- **Telomere shortening** and cellular senescence limit division. **Hayflick** showed cells do not divide forever.
- **Endocrine and immunological** aging: less growth hormone and sex steroid, more inflammation, weaker vaccine response.
- Protein cross-links, DNA repair failure, and stem-cell exhaustion are further cellular accounts. They describe mechanism, not why the clock exists.

Evolutionary theories

- **Medawar**'s mutation accumulation: late-acting harmful alleles hide from selection because most ancestors had already reproduced.
- **Williams**' antagonistic pleiotropy: a gene that helps youth can harm age. Selection prefers the youth effect.

- **Kirkwood**'s disposable soma: energy goes to reproduction over perfect repair, a life-history bargain.
- Grandmother hypotheses argue that post-menopausal life can still be selected if it raises kin fertility, as in some forager demography.
- Humans live long beside a large brain and late adolescent spurt. Aging is not a failure of **erect** living alone; it is scheduled by life history.

Together

- Evolution explains the schedule. Physiology names the rust. Neither is a complete gerontology without nutrition and class.

Flow diagram

Aging -> Damage telomere endocrine

Aging -> Medawar Williams Kirkwood

Medawar Williams Kirkwood -> Life history reproduction vs repair

Conclusion

Physiological theories track damage, telomeres, and hormones. Evolutionary theories-Medawar, Williams, Kirkwood-explain why selection did not delete old age. Human longevity still sits in a social environment.

Facts & figures

Hayflick
Showed finite division of cultured human cells, later linked to telomeres.

Medawar
Mutation accumulation theory of senescence.

Williams
Antagonistic pleiotropy as an evolutionary cause of aging.

Kirkwood
Disposable soma theory: trade-off between repair and reproduction.