Evolutionary Theories of Aging

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Introduction

Demographically, aging is defined as a decline in fitness with increasing chronological age, manifested by an elevated risk of death and a decrease in reproductive success. This demographic change is caused by functional deterioration at multiple levels, providing a mechanical explanation for the manifestation of aging. As to why organisms age, we are faced with an apparent paradox. As aptly articulated by G. C. Williams more than 60 years ago, "It is truly amazing that, after having completed the nearly miraculous feat of embryogenesis, a complex metazoon fails at the seemingly much easier task of simply preserving what was already created" (Williams, 1957). This paradox is best explained by evolutionary theories of aging.

 https://doi.org/10.1016/B978-0-12-801238-3.11327-3

Encyclopedia of Biomedical Gerontology, 2020, 57–67

Summary and Conclusions

The seeming paradox of why aging has not been eliminated by natural selection when it is apparently detrimental to individual fitness is well embraced by standard evolutionary theories of aging. The theoretical treatments of aging are underpinned by the fact that mortality itself is common in nature, irrespective of aging. This makes survival to a particular chronological age negatively associated with time since birth, enabling aging to evolve as a mere side effect of genetic drift ("**Mutation Accumulation**" section) or a consequence of the trade-off between early and late-life fitness income ("**Antagonistic Pleiotropy**" and "**Disposable Soma**" sections).

Not all organisms and not all cell lineages age. Germ cell lines, most prokaryotic organisms and many eukaryotes show no increase in mortality with chronological age. This is sometimes misleadingly interpreted as a failure of evolutionary theories of aging to incorporate their occurrence into their theoretical underpinning. However, evolutionary theories of aging specifically aim to explain situations where basic assumptions are met and are not relevant in other circumstances. Hence, while the current paradigm for the explanation why does aging sometimes evolve is solid, our understanding of how other taxa escape aging is far from settled. New discoveries, comparative analyses and experimental tests keep producing new insights into the evolutionary perspectives of aging, sometimes leading to clarifications and modifications of the prevailing opinions. In short, evolutionary understanding of aging is itself evolving.

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