A Changing Life: Why we Age

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Dan Reynolds
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All life goes through the inevitable process of aging from youth to adulthood and ultimately ends. While the aging process is essential to a species' maturation and reproduction, the process continues past the point of optimal age to a decline in physical and mental capacities. By understanding how and why life ages, scientists are able to make recommendations on how people can try to extend their lives, and potentially address the topic of preventing aging all together.

There are many factors that contribute to human aging. Cells in the human body are constantly dying and being replaced by newly created ones. Inside of these cells are chromosomes, strands of DNA that contain genetic information. When a cell divides to create new cells, another nucleic acid called RNA is used as a primer to begin the division. After the RNA attaches to the DNA strand, the genetic information is copied. While the primer is necessary for the cell division, by attaching to the DNA it obscurs part of the strand's genetic material, causing the copy to be missing a small part of the original information [1]. In order to minimize the loss of information, DNA strands have repeated sequences of genetic information, called telomeres, at each end. When the primer attaches to a telomere, the cell is able to divide without losing any essential genetic information, however, the length of the telomere in the copied cell is reduced. A single cell is able to divide approximately 50-70 times before the cell ages to the point that the length of its telomeres become too short to prevent the loss of important genetic information. Researchers at the University of Utah found that people over the age of 60 with naturally shorter telomeres were "three times more likely to die from heart disease and eight times more likely to die from infectious disease" [1]. By possessing naturally shorter telomeres, cells will have a shorter lifespan, and this is an important discovery that scientists continue to investigate in order to better understand the human aging process.

Another factor that contributes to aging is the negative effect of one of human life's greatest necessities, oxygen. Oxygen molecules frequently combine in the body with the four electrons of

hydrogen atoms to create water molecules. If the oxygen molecule only bonds with fewer than three hydrogen electrons, then the resulting "reactive oxygen species" is capable of removing electrons from biological structures in the body, which can cause cellular damage and mutation [2]. Studies indicated that fruit flies supplemented with enzymes that decrease the number of reactive oxygen species in their bodies doubled their lifespan, suggesting a link to the effect of these oxidants on aging [2]. Scientists continue to examine the effect of these oxidants on the human aging process to determine if there is a similar correlation.

A third explanation for the cause aging is the theory of Antagonistic Pleiotropy, proposed by George Williams in the late 1950s, which suggests that many genes that promote reproduction early in an organism's life may have a negative impact on their overall lifespan [3]. Since the negative effects of aging generally occur after a species' age of reproduction, they are not filtered by natural selection, causing them to persist through generations of evolution. A gene called P53 in humans directs damaged cells to stop reproducing and reduces the chance of cancer in young adults, however, in old age it may prevent needed tissue regeneration [3]. Additional studies on fruit flies found that when the flies were prevented from mating at a young age, their offspring lived longer but were less fertile in their youth [3]. Species with many predators and environmental dangers like fruit flies evolve to favor early reproduction and short lifespans, while species with fewer predators such as humans can reproduce for a much longer period of time, promoting genes that support longer lives through natural selection,.

The final example of aging examined is glycation, the process by which glucose, a natural sugar processed by our bodies, dangeorusly combines with DNA, lipids and proteins, disabling their normal function [1]. As evidence for the negative effects of high-sugar diets on the aging process, one 2014 study at Cardiff University found that type-2 diabetics taking the drug metformin, which interferes with glycation, lived 15 percent longer than similarly healthy participants [4]. This findings contradicts

existing evidence that diabetics typically have shorter lifespans than non-diabetic adults, suggesting that impeding the glycation process has a positive effect on slowing the aging process.

Science has shown that there is no single cause for aging and current evidence suggests that it is instead the result of a number of different processes at work within the body. It is frequently the goal of this research to find ways to help people live longer, but this is a complex problem that has no simple solution. In the case of the shortening telomeres in cells, scientists have tried using the enzyme telomerase to lengthen strands of DNA, however this can lead to rapid cell division similar to a cancer [1]. Studies continue to examine the benefits of anti-oxidants in reducing reactive oxidants and whether reducing these oxidants in humans actually promotes long life. Aging is a natural and complex process that effects all life and which remains a challenging problem for science to explore.

References

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