

How old are you?

Ashwini M. Bhat¹, Dr. B. E. Rangaswamy² Dr. Ir. Sreenivas Reddy Bathula³
Department of Biotechnology, Bapuji Institute of Engineering and Technology,
Davanagere - 577004, Karnataka, India
E-mail ID: jaishwa@hotmail.com; Mobile number- +91-9591240234

ABSTRACT

Gerontology is the study of social, psychological and biological aspects of aging. It encompasses scientific research on various aspects of aging which provides us a way to gain knowledge and to know how many more years one can expect to live actively. Factors that contribute aging include behavioural traits, environment and genes. Due to over exposure of humans to unhealthy condition leads to premature aging. There are numerous syndromes associated with premature aging. Even though current advances provides way to control premature aging, further more research studies are still under progress. Research in gerontology offers us the opportunity to enjoy more life experiences and to obtain healthy aging.

Key words – Gerontology, Premature aging, Telomere shortening, Stress, Hormonal secretion, DNA damage, Mutations, Free radicals.

1. INTRODUCTION

Gerontology (from Greek: *geron*, "old man" and *-logy*, "study of") is the study of the social, psychological and biological aspect of aging. This term was coined by Ilya Ilyich Mechnikov in 1903. Scientists who study aging are called Gerontologists. Gerontology is concerned primarily with the changes that occur between the attainment of maturity and the death of the individual. Gerontologists view aging in terms of four distinct processes: chronological aging, biological aging, psychological aging, and social aging. Chronological aging is the definition of aging based on a person's years lived from birth. Biological aging refers to the physical changes that reduce the efficiency of organ systems. Psychological aging includes the changes that occur in sensory and perceptual processes, cognitive abilities, adaptive capacity, and personality. Social aging refers to an individual's changing roles and relationships with family, friends, and other informal supports, productive roles and within organizations [1].

Aging can be defined as the time related deterioration of the physiological functions necessary for survival and fertility. Aging begins as soon as adult hood is reached and is as much a part of human life as are infancy, childhood, and adolescence. Aging is known to be a major risk factor for several most diseases. It is also an important part in every human.

The maximum lifespan is a characteristic of a species. It is the maximum number of years a member of species has been known to survive. The maximum longevity of humans is 122 years, recorded by the late Jeanne Calment [2]. Life expectancy is not a characteristic of species, but of populations. It is the age at which half the population still survives. Life expectancy of Indians: Men - 65.77 years; Women- 67.95 years.

2. AGING THEORY

Theories of aging are numerous and no one theory has been accepted to full extent. Regardless of the theory, a commonality is that as human beings age, functions of the body decline. Some of those theories are listed below:

- **Programmed Aging Theory: Hay flick Phenomenon & Telomere shortening**

The Hay flick limit has been found to correlate with the length of the telomere region at the end of a strand of DNA. During the process of DNA replication, small segments of DNA at each end of the DNA strand (telomeres) are unable to be copied and are lost after each time DNA is duplicated. The telomere region of DNA does not code for any protein; it is simply a repeated code on the end region of DNA that is lost. After many divisions, the telomeres become depleted and the cell begins apoptosis. This is a mechanism that prevents replication error that would cause mutations in DNA. Once the telomeres are depleted, due to the cell dividing many times, it will no longer divide. This is when the cell has reached its Hay flick limit [3].

- **Wear & Tear Theory**

Dr. August Weismann, a German biologist, first introduced this theory in 1882. He believed that the body and its cells were damaged by overuse and abuse. The organs, liver, stomach, kidneys, skin and so on are worn down by toxins in our diet and in the environment; by the excessive consumption of fat, sugar, caffeine, alcohol and nicotine; by the ultra-violet rays of the sun and by the many other physical and emotional stresses to which we subject our bodies. Wear and tear is not confined to our organs, however; it also takes place on the cellular level. Of course even if you've never touched a cigarette or had a glass of wine, stayed out of the sun and eaten only natural foods, simply using the organs that nature endowed you is going to wear them out. Abuse will only wear them out more quickly. Likewise as the body ages our very cells feel the effect; no matter how healthy is our life style [4].

• **Free Radical Theory/Accumulation**

The free-radical theory of aging was formally proposed by Denham Harman in 1956 and postulates that the inborn process of aging is caused by cumulative oxidative damage to cells by free radicals produced during aerobic respiration. Free radicals are atoms or molecules with single unpaired electrons. They are unstable and highly reactive, as they attack nearby molecules in order to steal their electrons and gain stability, causing radical chain reactions to occur. Free radicals are generated in vivo primarily within mitochondria during mitochondrial electron transport as well as by other physiological processes. Harman later extended the free-radical theory of aging to incorporate the role of mitochondria in the generation of free radicals and other reactive oxygen species. The theory proposes that the rate of oxidative damage to mitochondrial DNA primarily determines life span [5].

3. FACTORS THAT CONTRIBUTE AGING

3.1. Physical basis of aging

Physical factors play vital role in aging faster or slower, some of the conditions that drives aging are seems to be lifestyle choices, exercise, nutrition, stress management, genetics, and environment. The seven most common physical factors contribute in premature aging are attitude, smoking, drinking, drug use, stress, diet, climatic conditions [6].

The mind plays a significant role in whether we are aging faster or slower, and we can use the mind to help us accelerate or decelerate the process. Happier people are quite simply younger looking people. The more you hold hope, optimism, and joy at the top of your list of priorities the younger your face will appear. Moreover, happier people live longer often with fewer health problems like heart disease, high blood pressure, and even aching joints and bones. A happier face is devoid of wrinkled eyebrows and scowl marks because the muscles have spent more time in a relaxed state.

3.2 Chemical basis of aging

Chemical factors also contribute equally for premature aging. Chemicals that are involved in our day to day lifestyles cause aging. Some of the chemicals that are present in day today lifestyle are listed which causes premature aging:

i) Sulfates: These are harsh, corrosive, and drying ingredients you'll find in your cleansers, body washes, shampoos, and even in your toothpastes. They cause skin irritation and corrosion, and over time, leads to increased dryness and more visible fine lines and wrinkles. In fact, studies have indicated that sulfates can age the skin.

ii) Certain alcohols: In most of the anti-aging skin products we may find ingredients like specially denatured alcohols, methanol, ethanol, propanol and benzyl alcohol. These are all drying ingredients that strip away skin's natural oils and lead to premature aging and irritation.

iii) Mineral oil: It comes from petroleum, and it forms a sort of film over the skin, clogging pores and hindering the skin's natural ability to get rid of toxins. With extended use, it can encourage acne and actually irritate and inflame skin. The result is an aging effect that can make fine lines and wrinkles much more visible.

iv) Chemical sunscreens: Many so called sunscreens includes chemicals like oxybenzone, benzophenone-3, and octyl methoxycinnamate can actually encourage free radical damage when exposed to sunrays. Free radicals and UV exposure are the primary causes of wrinkles and fine lines.

3.3 Biological basis of aging

(i) Cellular

All cells change as they age, generally becoming larger. Their capacity to divide and reproduce tends to decrease. Normal cells have built in mechanisms to repair minor damage, but the ability to repair declines in aged cells. DNA is damaged through the aging process and changes occur in cellular membranes, enzymes, transport of ions and nutrients. Due to this the nucleus of chromosomes undergoes changes such as clumping, shrinkage, and fragmentation.

The changes like reduction in the number of mitochondria and lysosomes occur, causing cells to function less efficiently. When the mitochondria decrease in function, metabolism is decreased to about 95% of capacity by age 50, and to 85% by age 70. This effect also ties in with a decrease in hormonal secretions. A decrease in metabolism has several effects: toleration of cold is less, a tendency to gain weight increases, there is a decreased efficiency in the body's use of glucose.

Cellular aging alters the tissues formed by these cells which, in turn, affect organ function. For instance, by the age of 85, lung capacity has decreased by 50%; muscle strength by 45%; and kidney function by 30%. Collagen and elastin decrease in connective tissue formation, resulting in joint tissues becoming stiffer, less elastic, and less efficient in their function. In men, there is a gradual increase in tissue lipids and fat until age 60; then there is a gradual decrease. In women, lipids and fats accumulate in the tissues continuously, but there is no decline as happens in men. Then the total amount of water in the body gradually decreases. These changes in body fat and water reduction are the main reasons why the elderly respond differently to drugs than the younger population [7].

(ii) Extracellular

When our brain ages some brain regions shrink, while others remain stable as we age. Aging of the brain also impairs the ability of the brain to encode or decode new memory and processing speed. In case of skin and hair aging is visible very prominently. Our skin begins to develop wrinkles and dark spots. The ability of skin to produce oils reduces resulting in dry and lusterless skin. Hair becomes thinner than normal and the change in hair color from gray initially to turning white eventually marks aging. With bones the friction between the joints increases causing pain while moving. The bones also become porous and there is a gradual yet constant loss of density and strength. Bones are reservoirs of minerals like calcium and phosphorus, but during the process of aging there is a typical depletion of these minerals making bones fragile and weak [8].

As we age the retinas become thinner than usual, the sharpness that should be achieved in viewing objects at a distance is impaired and objects placed at a distance appear blurred. The irises get stiffened; hence, the pupils become less responsive and more sensitive to glare. Eye problems like cataracts and glaucoma are common as you age. Aging also leads to hearing loss. The eardrums thicken, making hearing more difficult than usual. Due to aging the blood vessels lose their elasticity and the fatty deposition on the artery walls makes the arteries smaller or rather narrow the space for the blood flowing through it. All these factors make the heart work harder than usual to pump the blood to other parts of the body. The result is hypertension, cardiac arrest, arteriosclerosis and other serious disorders.

4. PREMATURE AGING SYNDROMES

Premature aging syndromes are also known as progeria. It includes two very rare inherited conditions, Hutchinson-Gilford syndrome and Werner syndrome. Both are autosomal recessive disorders, which mean an individual has inherited a mutated gene from both parents. 1 in 4 offspring would be expected to have the disorder and others may be carriers of the gene.

(i) HUTCHINSON-GILFORDSYNDROME



Figure1. A boy with Hutchinson-Gilford syndrome

Hutchinson-Gilford syndrome [9][10] is characterized by normal development in the first year of life followed by rapid aging. It is caused by a genetic defect. It has been found that there is a mutation in the gene LMNA (Lamin A/C) that produces the protein Lamin,

which is the structural scaffolding that holds the nucleus of a cell together. The cellular instability lead to premature aging. Symptoms include dry and wrinkled skin, total baldness, prominent scalp, veins and eyes, small jaw, delayed tooth formation, short stature, joint stiffness, hip dislocations, thin limbs with prominent joints and birdlike facial features. Average life expectancy is 13 years, with approximately 75% dying from heart disease. The signs of progeria begin to show around 6-12 months when the baby fails to gain weight and skin changes occur in about 1 in 8 million children [11].

(ii) WERNER SYNDROME

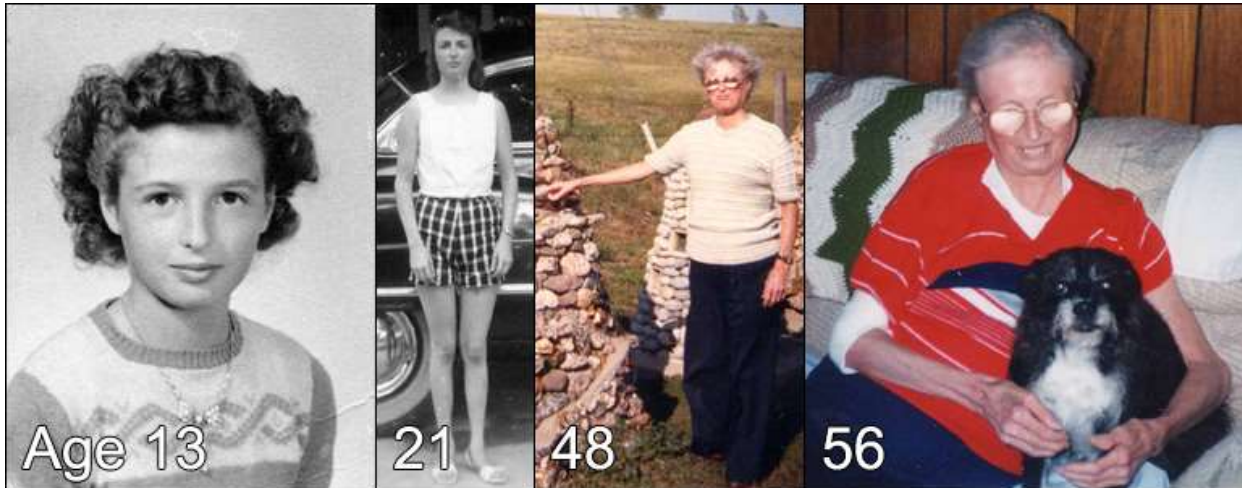


Figure2. Werner syndrome patient at various ages

Werner syndrome is a rare, inherited disease that causes a rapid acceleration of aging. While the person is only in his or her twenties, first sign of syndrome appears. Other than that the child fails to have a normal growth spurt, or may be delayed until an individual is as old as 30 years. It is caused by a defect at the Werner syndrome gene [12] (WRN) locus, which provides instructions to a protein called helicase. Werner syndrome is caused by a helicase defect, which affects the way DNA and RNA are replicated and repaired in the body. Characteristic features include: Greying hair and/or balding, wrinkling and aging of the face, sunken cheeks, small jaw, small stature (usually less than 1.6m tall), muscle weakness, thickened, tight and shiny skin over joints, leading to ulcers and high-pitched voice [13]. Werner syndrome occurs in about 1 in 1 million individuals [14]. There is tendency to develop diabetes mellitus, cancer, and cardiovascular disease. Most afflicted individuals die before age 60. Death usually occurs in patients between 30-60 years, with most dying from heart disease or cancer.

5. CONCLUSION

Aging is the natural process of the growing older. Yet there are many factors that play a role in aging. Out of two in one are aging faster than their biological age. This is because either we engage in behaviours that increase our aging, or we do not actively support a more youthful body through our action. Knowledge is the power and the more you know about fighting the aging process the more control you can gain over it. Although aging comes in with its own discomforts like aches, pains, diseases, sags and forgetfulness; regular exercise, practicing relaxation techniques, keeping stress under control and taking good care of your body and brain can ensure more active and pain free old age. Research in gerontology offers us the means to a healthier, longer life. Advancement in gerontology gives us an opportunity to spend more time with our loved ones, meet our great-great-grandchildren, to enjoy more life experiences and to obtain healthy aging.

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