



Psychological Changes in the form of Aging

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ABSTRACT: Aging is a normal biological process that entails permanent modifications in the physiological structures and functions of almost all physiological systems. The changes lead to reduced physical and cognitive performance and predisposition to chronic diseases. Cardiovascular aging, with stiffening of the arteries, loss of blood vessel compliance, and a decline in maximal cardiac output, is one of the most obvious changes and it may cause hypertension and cardiac workload increase.

The respiratory system is affected by aging causing a loss in the alveolar surface area, decreased elasticity of lung tissues and decreased strength of respiratory muscles hence loss in the efficiency of oxygen exchange. Renal functioning is also impaired and a decreased glomerular filtration rate (GFR) alters the body so that it cannot maintain a normal balance of fluid and electrolytes.

The signs of musculoskeletal aging include muscle loss (sarcopenia), reduced bone density (osteopenia or osteoporosis), and loss of joint mobility, which lead to reduced mobility and the risk of fractures. Neurological alterations involve slowing the nerve conduction and lower neurotransmitter levels and mild impairments of the mind, but these are strongly different in different human beings.

Endocrine changes include dropped levels of hormone production and sensitivity, e.g., decreased insulin sensitivity (likely to develop diabetes type 2), changes in thyroid activity, and reduced levels of sex hormones (e.g. estrogen and testosterone), affecting metabolism, mood and energy.

Immunosenescence of the immune system occurs, which is reduced naïve T-cell production, dysfunction in the response to new antigens, and chronic low-grade inflammation (inflammaging), predisposing to infections and autoimmune diseases.

Such physiological changes are regulated by genetics, lifestyles, diet, physical exercises, and exposure to the environment. The mechanisms and the course of such changes are important to understand to provide interventions to improve the quality of life, delay frailty and healthy longevity.

KEY WORDS: aging, biological, Psychological

INTRODUCTION TO AGING

Aging is a dynamic and multifaceted biological process which takes place at several levels: molecular, cellular, tissue and systemic. Although aging is a normal occurrence in the life cycle, physiological integrity starts to diminish with aging (1), which adds to functional breakdown and predisposition to illness and mortality. It is a multifactorial behavior that is affected by the interactions of the genetics programmed and on the environmental interactions (2).

On the molecular scale, age-related changes are linked to oxidative stress, DNA damage accumulation, telomere shortening, changes in the epigenome, and protein homeostasis disruptions(3). With time, these molecular insults damage the functionality of the cells causing the cellular senescence which is a condition whereby cells are no longer able to divide and help in the maintenance of tissues. Senescent cells express clustering of pro-inflammatory factors that cause chronic inflammation, a characteristic of aging called inflammaging.(4).

At the organismal level, there are almost no physiological systems that are not impacted by aging. There is a decrease in the efficiency of the cardiovascular system, slowing of the processing speed and memory of the nervous system, and decreased musculoskeletal system strength and mobility. In the meantime, the immune system is dysregulated and has a lower capacity to combat infections, as well as, the risk of autoimmune diseases and cancer is increased(5).

Besides physiological deterioration, aging is also defined by loss of resilience, or the ability of the body to react to physical and environmental stressor. This reduced adaptive response is important in the occurrence of age-related illness and functional deficiency like frailty (6) .

These declines notwithstanding, aging is not a decay process. It is also influenced by the factors which can be changed like diet, exercise, sleep, stress management and social interactions. Biomedical research and especially in the domain of gerontology,

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genetics and regenerative medicine present us with novel perspectives into the pathways of aging and the approaches that can be implemented to delay its course (7) .

Sensory System Changes in Aging:

The body experiences slow changes as it ages and all five senses, namely, vision, hearing, taste, smell and touch, experience such changes because of structural and functional changes in the sensory organs and the neural pathways that support them(8) .

Vision:

Aging is usually characterized by the development of presbyopia (inability to focus on near objects), shrinking of the pupil, loss of lens elasticity, and clouding of the lens (cataracts)(9). It may also result in the reduced contrast sensitivity, reduced adaptation to light changes, and the predisposition to such conditions as glaucoma, macular degeneration, and diabetic retinopathy(10)).

Hearing:

Presbycusis or age-related hearing loss is defined as progressive and bilateral deafening in high frequency. This is because of degenerations of hair cells in cochlea, diminished functioning of auditory nerve fibers, and alterations of central auditory paths. It influences the hearing capacity to comprehend speech, particularly where there is noisiness (11) .

Taste and Smell:

Taste buds become less sensitive and fewer in number, and the olfactory receptors could be fewer or less sensitive. These changes combine to cause a loss of taste and smell sensation which may influence appetite, nutrition and the enjoyment of food(12). Certain elders will also suffer anosmia (loss of smell) and this puts them at risk of food poisoning or gas leakages that goes unnoticed(13) .

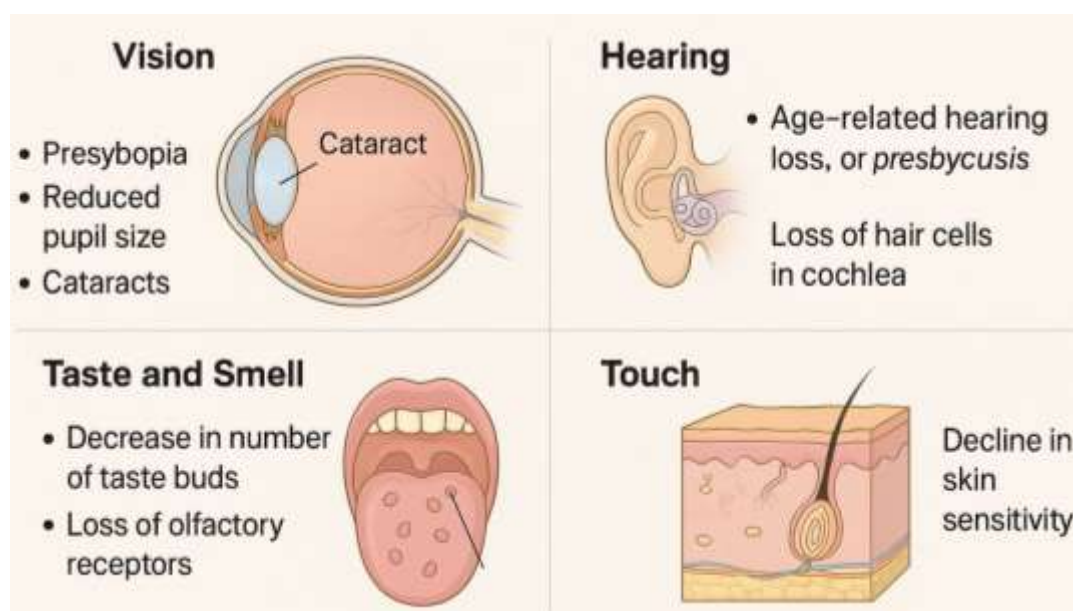


Figure (1) Age-Related Changes in the Sensory Systems

Touch and Vibration:

Aging causes depletion of the skin sensory receptors particularly in the fingertips and decreases the speed of the conduction of the nerves. As a result, this causes reduced sensitivity to touch, heat, vibration and pain. It may impair the coordination, risk injury, and slow the response time (14) .

Such sensory changes cannot be uniform and may depend on health condition, genetics, and life style. Although a bit of aging is expected, some conditions such as assistive tools (e.g. glasses, hearing aids), rehabilitative treatments and physically healthy living can be used to preserve the sense sensations and improve the overall health(15).

Musculoskeletal System Changes in Aging:

The musculoskeletal system also experiences progressive structural and functional changes with age that influence bones, muscles, joints, and connective tissues (16). Such alterations are associated with decreased mobility, strength, flexibility, and are more likely to fall, fracture, and be disabled in older people (17).

Bone Changes:

The musculoskeletal system also experiences progressive structural and functional changes with age that influence bones, muscles, joints, and connective tissues (16). Such alterations are associated with decreased mobility, strength, flexibility, and are more likely to fall, fracture, and be disabled in older people (17).

Muscle Changes (Sarcopenia):

It is of the essence to maintain musculoskeletal fitness by engaging in routine weight-bearing and resistance training, proper nutrition (including calcium and vitamin D), and good lifestyle practices to maintain independence and quality of life among the aging population. Rehabilitation and early intervention may assist in controlling or preventing the development of musculoskeletal disorders(20).

Muscle mass and strength naturally diminish as a result of age, a condition known as sarcopenia. This is due to a loss of muscle fibers (both number and size), motor neurons, reduced anabolic hormone concentrations (such as growth hormone and testosterone), and a reduction in protein synthesis(21). Sarcopenia also causes a reduction in endurance, balance and coordination, which affects day to day activities and predisposes to falls(22).

Joint and Cartilage Changes:

Age-related changes in articular cartilage make it thin and less resilient, which is a factor in increasing the rigidity of the joint and the decrease in range of motion. The synovial fluid can also reduce so that joints have less lubrication and cushioning. Such changes, along with the mechanical wear, may lead to the osteoarthritis, which leads to pain, inflammation, and poor mobility (23).

Connective Tissue Changes:

Tendons and ligaments lose their elasticity and become readily injured. Collagen fibers become hard which makes them less flexible and hinders recovery of physical stress or trauma. This helps in general loss of flexibility and agility(24).

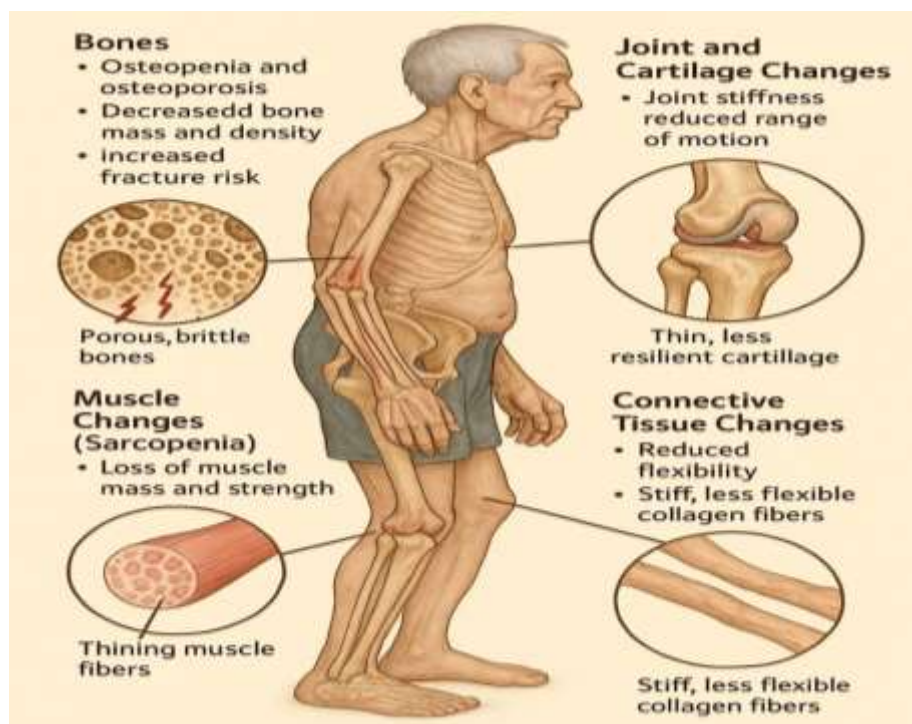


Figure (2) Aging and the Musculoskeletal System Changes

Neurological System Changes in Aging:

The elderly experience numerous changes to their nervous system structure and functionality, such as the brain, the spinal cord, and peripheral nerves. These alterations lead to reduced reflexes, memory impairment and loss of coordination and in certain instances, neurodegenerative diseases(25).

Brain Structure and Function:

As one gets older, the brain slowly atrophies (decreases in volume and weight), specifically in the frontal cortex and hippocampus- regions that perform executive functions and memory (26). Neurons become smaller, and the number of synapses and neurotransmitter levels (dopamine, acetylcholine, and serotonin) decline and results in reduced signal transmission (27).

Cognitive Function:

Normal aging is characterised by mild memory impairment, delays in information processing and a decrease in attention span. They do not however have a major effect of impairing daily functioning(28). More profound cognitive impairment can be an indicator of

diseases such as Alzheimer's or other dementia. The multitasking capacity, learning rate and solving problems is also influenced by aging although vocabulary and general knowledge tends to stay constant or even improve (29).

Peripheral Nervous System:

The conduction velocity of the nerves reduces with age and this results in slow reflexes and reaction time. The response of the sensory nerves can be reduced, which can interfere with balance, proprioception and detecting pain, temperature, and touch. This adds to increased chances of injury and falls (30).

Sleep and Circadian Rhythms:

Neurological aging affects quality of sleep. Seniors tend to have problems with sleeping, reduced sleep duration, increased waking, and circadian variations, which give rise to fatigue or sleep disorders (31).

Motor Function:

Aging has an impact on the motor neuron and muscle innervation result in a lack of coordination, slowing movement, more muscle tremors or rigidity. Fine motor skills can be lost so activities such as writing or buttoning clothes become harder (32)

Neuroplasticity:

The aging brain is not completely plastic, that is, it is able to make new connections even though these connections are reduced. Cognitive impairment can be maintained through mental stimulation, physical activity, social life, and healthy lifestyle, which also encourages neurogenesis in later life(33).

IMMUNE SYSTEM CHANGES

The effect of aging on the body is a serious change in the immune system a phenomenon called immunosenescence. The changes include effects on both natural and adaptive immune systems, resulting into a diminished capacity to respond to infections, reduced vaccine responses, augmented swell and heightened danger of autoimmune diseases and and neoplasms (34).

Innate Immunity:

The first line of the defense organ of the body is the innate immune system. In aging individuals:

The phagocytic ability of neutrophils and macrophages also decreases, and they are unable to destroy the pathogen by engulfing it.

An increase in the number of Natural Killer (NK) cells with a decrease in cytotoxic activity is possible.

Dendritic cells have poor antigen presentation that covers the initiation of the immune responses.

-There is reduced and ineffective initial immune response caused by these changes (35).

Adaptive Immunity:

Adaptive immune system also getting less efficient with age:

T lymphocytes: T cells are produced in reduced amounts because of the shrinkiness of the thymus(involution). The T cells in the memory form are predominant, yet their efficacy might be weakened(36) otherwise.

B lymphocytes: B cells? The new B cells are produced less, and the antibody is less specific. This causes the reduction of the effectiveness of vaccines and predisposes to new infections (37).

Inflammaging:

With aging comes chronic, low-grade inflammation- which we call inflammaging. It is characterized by a high degree of pro-inflammatory cytokines (including IL-6, TNF-a, and CRP), which lead to tissue damage and are associated with age-related ailments such as atherosclerosis, Alzheimer, and type 2 diabetes (38).

Clinical Implications:

Because of immunosenescence, elderly patients:

More serious or longer-lasting infection (e.g. pneumonia, influenza, COVID-19).

Does not react well to vaccines.

Become more susceptible to autoimmune disorders.

Risk of cancers because the immune system has been weakened (39).

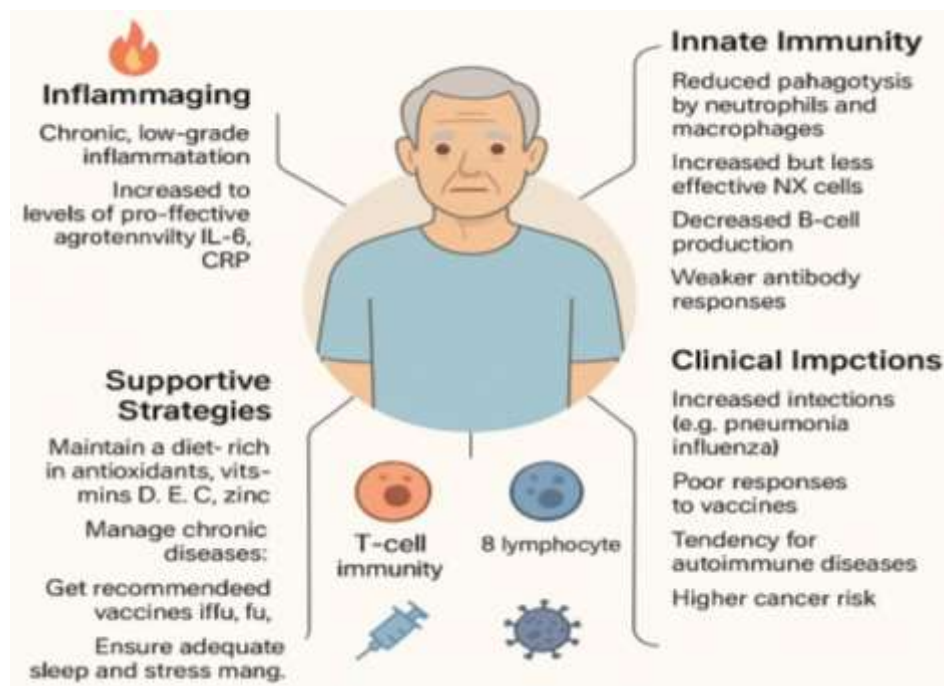


Figure (3) Changes in Immune System with Aging

Hormonal Changes in Aging:

Adulthood causes extensive alterations of the endocrine system and is characterized by compromised hormone production, release, metabolism and responsiveness. The hormonal changes influence almost all the physiologic systems, metabolism, growth, reproduction, mood, and general homeostasis (40).

1. Hypothalamic-Pituitary Axis:

Partiality of the regulatory center of the endocrine system is less sensitive and responsive to changes with age. This may reduce efficiency in the mechanisms of feedback between the hypothalamus, pituitary and peripheral glands (41).

2. Growth Hormone (GH) and IGF-1:

GH and insulin-like growth factor-1 (IGF-1) levels decrease with age and this helps to decrease muscle mass (sarcopenia), resulting in deterioration in bone density, accumulation of fat tissues, and a fall in skin elasticity. It is a progression that is known as the somatopause(42).

3. Thyroid Hormones:

The thyroid activity can be on hold, however the change of T4 to T3 can be lowered. There is also slowed basal metabolic rate to add to the energy shortage, cold intolerance, and even mild cognitive impairment. The subclinical case of hypothyroidism is more prevalent among the elderly (43).

4. Reproductive Hormones:

Hormonal modification is a natural process, which concerning changes may cause clearly visible physiological and psychological alterations. Checking endocrine health in older adults- and lifestyle assistance like well-regulated diet, physical activities and rest may aid in monitoring the consequences of aging hormonally and confirmed longevity and well-being(44).

Reduction in estrogen and progesterone in women is intense during menopause, and it results in cessation of the reproductive capability. This can impact bone health, cardiovascular risk threshold, the skin and mood(45).

Testosterone in men decreases slowly (andropause), causing drop in libido, muscle strength, energy and mood changes (46).

5. Cortisol:

The basal cortisol can be normal or slightly elevated though the diurnal rhythm is not so significant. It is capable of influencing sleep patterns, stress response response and even natural immunity (47).

6. Insulin and Glucose Metabolism:

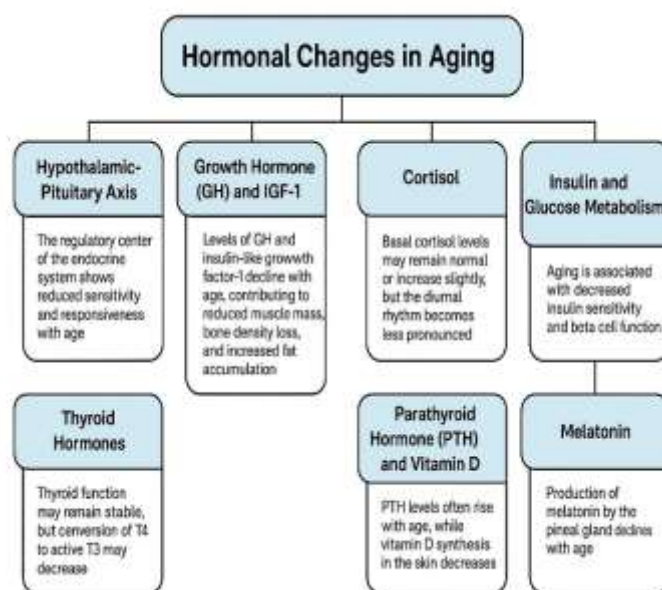
Aging is linked to the reduction of insulin sensitivity and insulin beta- cell responses, making it more dangerous to glucose intolerance, and type 2 diabetes is prone to occur. This is complicated by the fact that body composition changes and physical activities decrease (48).

7. Parathyroid Hormone (PTH) and Vitamin D:

The PTH concentration tends to increase with age whereas the vitamin D output in the skin becomes reduced. This is contributing to calcium imbalance, bone loss and risk of osteoporosis and fractures (49).

8. Melatonin:

The pineal gland produces decreasing levels of melatonin as someone ages, interfering with circadian rhythms and leading to the predilection to insomnia or inadequate sleep quality (50).



Figure(4) Hormonal Changes Associated with Aging

Age-Related Changes in the Cardiovascular System:

Aging is a normal process that changes occur in the cardiovascular system including factors like structure, functional changes and their effects may affect blood flow within the heart and heart functioning. It can be gradual, but these alterations can cause a heightened risk of cardiovascular diseases in terms of high blood pressure, heart failure, and atherosclerosis(51).

1. Structural Changes in the Heart:

Left ventricular wall thickening: The heart muscle particularly the left ventricle tends to thicken and harden as they age. This inhibits the normal function of filling of the heart during its relaxation phase (diastole) (52).

Fibrosis: The presence of more connective tissue in the myocardium decreases myocardial elasticity, which consequently causes affected contraction and relaxation (53)

Calcification of valves: Valves in the heart can get stiffer and thicker, specifically on the valves of the aorta and mitral valves, and develop stenosis or regurgitation (54).

Change of electrical conductivity:

The SA node (natural pacemaker) also becomes dysplastic, and this can account to a decreased resting heart rate, and predisposition to arrhythmias including atrial fibrillation.

The conduction system can also develop fibrosis, which helps to result in conduction delays or blocks (55).

3. Vascular Changes:

Arterial stiffening: Sizable arteries, including the aorta, lose their elasticity, which is caused by the accumulation of collagen and degradation of elastin elevates systolic blood pressure and pulse pressure.

Endothelial dysfunction: The inner lining of the blood vessels becomes inefficient in the control of vascular tone, clotting and immunity.

Risk of atherosclerosis: Aging in vessels walls leads to lipid deposition and inflammation that favor the formation of plaque and allow arteries narrowing(56).

4. Blood Pressure Changes:

Another trend regarding aging is isolated systolic hypertension (elevated systolic BP and normal or low diastolic BP) caused by an arterial stiffness.

It can cause dysregulation of blood pressure, which can result in orthostatic hypotension (lowing of blood pressure when standing up) (57).

5. Reduced Cardiac Reserve:

As people age, the maximum heart rate reduces and the heart becomes less effective in terms of responding to physical or emotional stress.

At rest, the cardiac output can still be normal but during exercise, the increased output obtained through the heart is impaired(58).

Changes in Body Composition with Aging:

During ageing, there are gross changes in the composition of the body whether in the presence or absence of disease. These changes impact physical performance, metabolic wellness, movement and general wellness. Most significant modifications take place with muscle mass, body fats, bone density, and body water content(59).

1. Loss of Muscle Mass (Sarcopenia):

Skeletal muscle mass and strength progressively decrease after the age of 60, and from the 30s onwards.

Sarcopenia plays a role into the decreased mobility, balance problems, and fall-prone complications and decline in functions.

This is partly caused by decreased physical activity, hormones (e.g., decrease in growth hormone and testosterone), and less synthesis of proteins(60).

2. Increase in Fat Mass:

Fat abundant is more likely to grow with age, and especially the visceral fat (around abdominal organs) was more metabolically active and associated with greater risks of cardiovascular disease, insulin resistance and inflammation.

Under fat (under skin) can be reduced particularly in arms making everything frail and body shape being changed(61).

3. Redistribution of Fat:

Knowledge about alterations in body composition during aging is essential to the development of strategies to enhance health aging, disability prevention, and better the quality of life among older adults.

As people age, the redistribution of fat tends to move outwards (arms, legs) to the trunk and abdomen.

Ectopic fat can also be stored in non-adipose tissues such as liver (fatty liver), heart and muscles, which can disrupt their performance(62).

4. Bone Density Reduction (Osteopenia/Osteoporosis):

Bone bulk is highest at an early adulthood and tends to decrease with age particularly in postmenopausal women whom low levels of estrogen predisposes.

This causes the bones to be more porous, fragile and prone to fractures, especially the hips, spine and wrists (63).

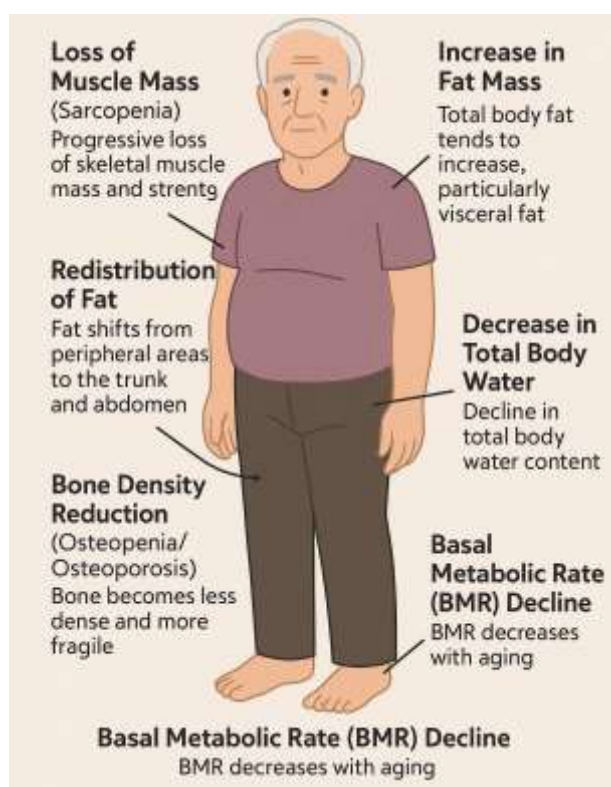
5. Decrease in Total Body Water:

Aging is also linked to decreasing the body water content content thus depleting fluid reserves hence increasing the tendency to become dehydrated.

This also interferes with thermoregulation and kidney action(64).

6. Basal Metabolic Rate (BMR) Decline:

As the lean body mass is reduced, the BMR decreases derived: on which weight can be lost due to non-adaptation of dietary intake and activity levels(65).



Figure(6) Changes in Body Composition with Aging

Impact on Daily Life Due to Aging-Related Physiological Changes:

With natural aging processes, the accumulating effect of physiological changes might greatly influence how one is able to live daily, its independence, and quality of life. Although slow, these changes frequently demand changes in their way of life, surroundings and care demands(66) .

Mobility and Physical Activity:

The loss of musculoskeletal strength, flexibility of joints, and balance heightens the risk of falls and complicates the processes of daily activities such as walking, steps up stairs, and lifting a heavy item. A weariness can commence faster, as well, restricting stamina and involvement in physical exercises(67).

Cognitive and Emotional Function:

It may impair communication, decision making and ability to complete tasks due to mild memory impairments and slow processing speed. Transitions in the neurotransmitters, loneliness, or inability to feel independent can alter emotional well being and result in greater vulnerability to depression or anxiety (68).

Sensory Changes:

The deficiencies in sight, hearing, taste and smell could include impacts on their safety, nutrition and communication. As an illustration, hearing impairments can result in social isolation and lack of visual power puts people at risk of accidents(69).

Sleep and Rest:

Disturbed circadian mental activity and the inability to go to sleep safely, may lead to somniphobia and as Somniphobia is known to affect efficiency and mood(70).

Nutrition and Digestion:

Appetite and digestive performance, as well as dental conditions, alterations may contribute to a nutritious diet, an unwanted loss of weight, and gastrointestinal disturbances, consequently undermining immunity and body fitness (71).

Immunity and Health Maintenance:

Older people have an immunologically compromised system and are more susceptible to infectious disease, slow in healing, and can use more medical services than usual. Treatment of the chronic conditions will take a center stage in the daily routine (72).

Medication Management:

Polypathy (multiple medicines) occurs often in elderly patients. Its administration must be done carefully to prevent undesirable effects, drug-drug, or dose omissions, and in many cases aids or assistive devices (73).

Independence and Safety:

Assistive equipment (e.g., walkers, hearing aids, glasses) or home modifications (e.g., grab bars, non -slip floors) are necessary to ensure that aging persons remain independent and do not fall and suffer harm(74).

Social and Recreational Life:

Aging can also reduce engagement in social or recreational activity, as a result of being physically constrained or cognitively/emotive altered, which can affect a sense of mental health and life satisfaction(75).

CONCLUSION

Aging occurs as a normal biological process, which leads to the progression of physiological changes in all body systems such as the musculoskeletal, neurological, sensory, endocrine, immune and cardiovascular system. Such transformations have the capability to affect the everyday functioning, cognitive, and emotional well-being and quality of life. Although some deterioration is normal, the types of deterioration and rate are greatly different among different people and this may depend on the genetic makeup, complication of lifestyle, surroundings and access to health treatment.

It is necessary to understand the nature of these changes to develop a healthy aging. Early intervention, periodic medical care, the use of a balanced diet, exercise, stimulating the brain and social interactions are all significant factors that help maintain the functions and independence of the elderly. Instead of perceiving aging only as a time of risk, it could be taken as a time in life full of experience, flexibility and further learning through informed care and active living.

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