The VI scientific and practical conference with international participation «Mechanisms of pathological processes development and diseases, their pharmacological correction»

Pathogenetic mechanisms of ageing

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CONTENT OF THE PRESENTATION

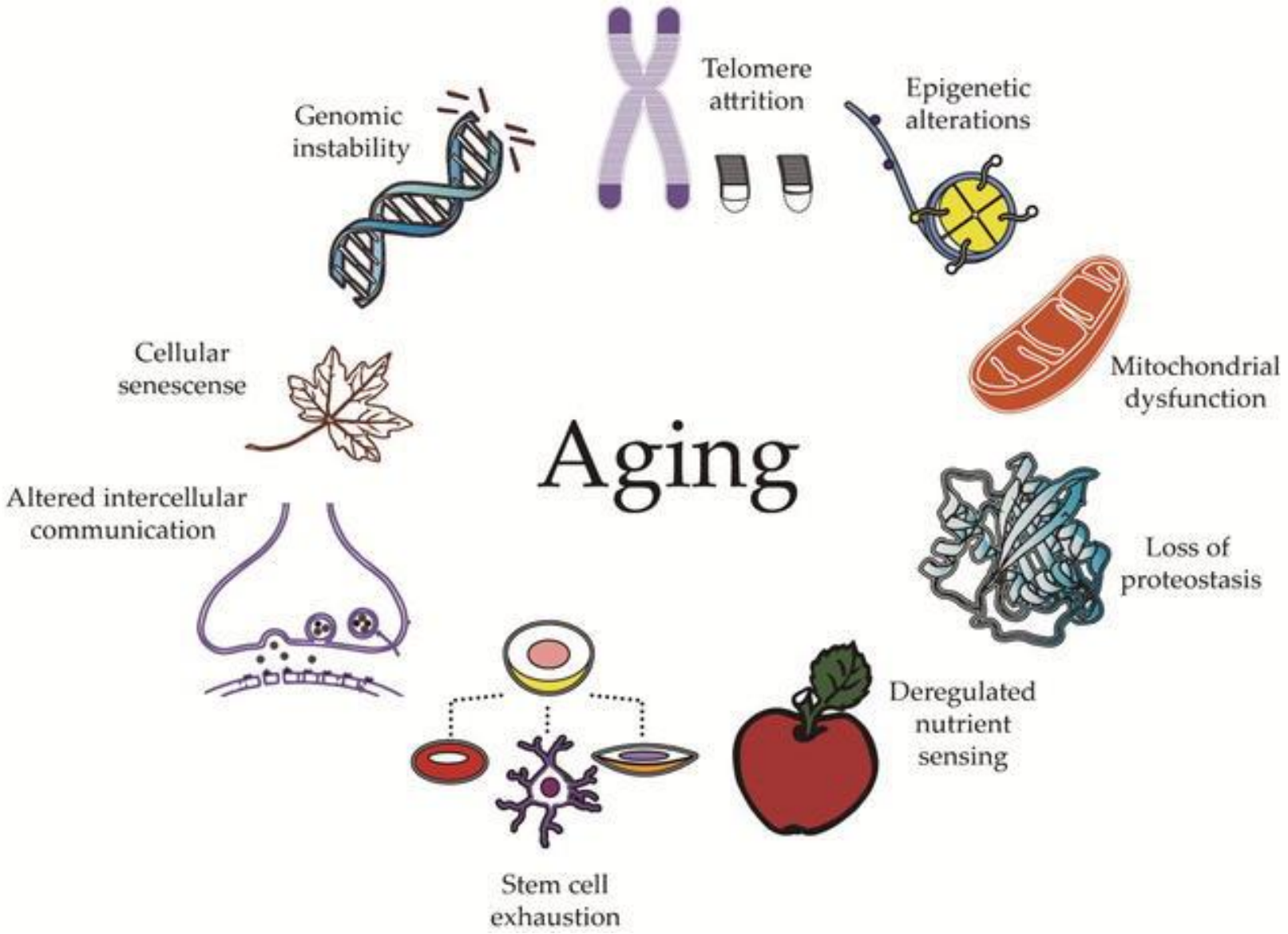
1.Cellular ageing: DNA damage, Mitochondrial dysfunction.
2.Loss of proteostasis: protein misfolding and aggregation
3.Stem cell exhaustion: muscle stem cell, neuronal stem cell,
4.Telomere shortnening.
5.Inflammation: cardiovascular disease, neurodegenerative diseases, chronic respiratory diseases, weak immune response in cancer, Bones, muscles, joints diseases.
6.Oxidative stress: DNA mutations, protein aggregation, tissue and organ damage.
7.Hormonal changes: Thyroid hormone changes, growth hormone decline, adrenal changes and pituitary hormones.
8.Immune system decline: Thymus atrophy, Reduced of T-cell function.
9.Metabolic changes: B-cell dysfunction,Altered cytokine production, immune memory decline, diabetes type2.

AIM

- The aim of study was to explore the pathogenetic mechanisms of age related processes that will enable improving health-related quality of life, education, and awareness.

ACTUALITY OF THE THEME

- The study of the pathophysiology of age-related problems is a contemporary and significant field of research. With advancing age, individuals become increasingly vulnerable to a range of illnesses and disorders, making it essential to comprehend the fundamental mechanisms behind these age-related transformations to devise effective treatments and interventions.


Genomic instability
Telomere attrition
Epigenetic alterations
Cellular senescense
Mitochondrial dysfunction
Aging
Altered intercellular communication
Loss of proteostasis
Deregulated nutrient sensing
Stem cell exhaustion

Cellular aging is a slow and irreversible physiological progression marked by a decrease in the functional capacity of organs. This decline limits the capability to sustain homeostasis when faced with stressful conditions.

- **DNA Damage**: The gradual accumulation of DNA damage, induced by factors such as radiation, chemicals, and oxidative stress, can result in cellular aging. Cells make efforts to mend this damage, but with the passage of time, the repair mechanisms may become less efficient.
- **Mitochondrial Dysfunction:** Mitochondria, the energy producers of the cell, can amass damage as time goes on. This can lead to reduced energy generation, heightened oxidative stress, and cellular malfunction.

LOSS OF PROTEOSTASIS

- **Protein Misfolding and Aggregation:** Disruption of proteostasis can cause proteins to misfold, resulting in the creation of protein aggregates or amyloids. These aggregates can disrupt cellular operations and might be linked to neurodegenerative conditions like Alzheimer's and Parkinson's.
- **Ageing and Loss of Proteostasis:** The decline in proteostasis is recognized as a key feature of the aging process. With increasing age, cells may become less proficient in preserving the correct protein balance, resulting in cellular malfunction and a heightened susceptibility to age-related illnesses.

STEM CELL EXHAUSTION

- Stem cell exhaustion is a biological occurrence in which the body's supply of stem cells diminishes or loses its ability to regenerate as time passes. Stem cells are undifferentiated cells capable of maturing into diverse specialized cell types. Stem cell exhaustion is connected to multiple age-related concerns and the aging progression.

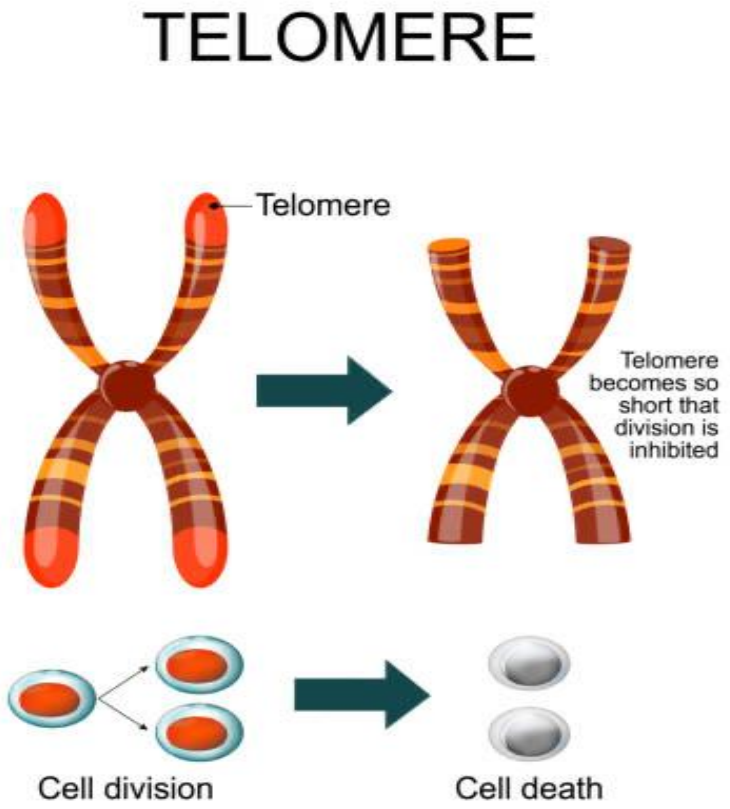
- **Muscle Stem Cells:** In skeletal muscle, satellite cells are responsible for repair and regeneration. Aging can reduce the regenerative capacity of these cells, leading to muscle atrophy and impaired muscle function.

- **Neural Stem Cells:** The decline in the number and function of neural stem cells in the brain is associated with age-related neurodegenerative diseases and cognitive decline.

- **Skin and Hair Regeneration:** Stem cell exhaustion can also impact the regenerative capacity of skin and hair follicles, contributing to skin aging and hair loss.

TELOMERE SHORTENING

Telomeres, which serve as protective caps at the tips of chromosomes, naturally shrink with each cell division. Once they reach a critically short length, cells can no longer undergo replication, contributing to the process of aging and the development of age-related illnesses.

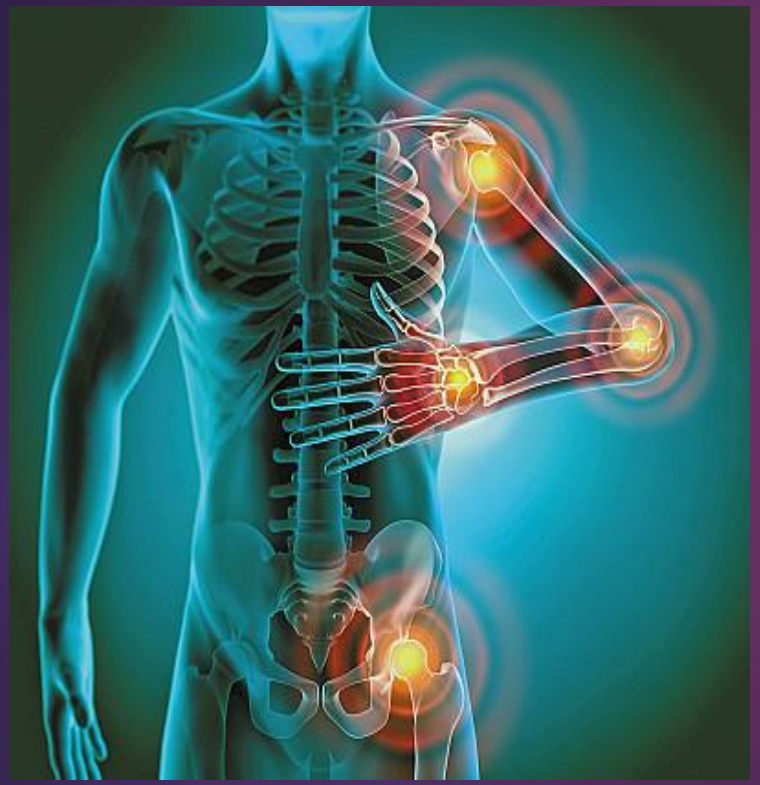


INFLAMMATION

Inflammation is an inherent component of the body's immune reaction to injury, infection, or tissue damage. Nevertheless, long-term or chronic inflammation, particularly when it lingers at a low level, is linked to a range of age-related illnesses and health conditions.

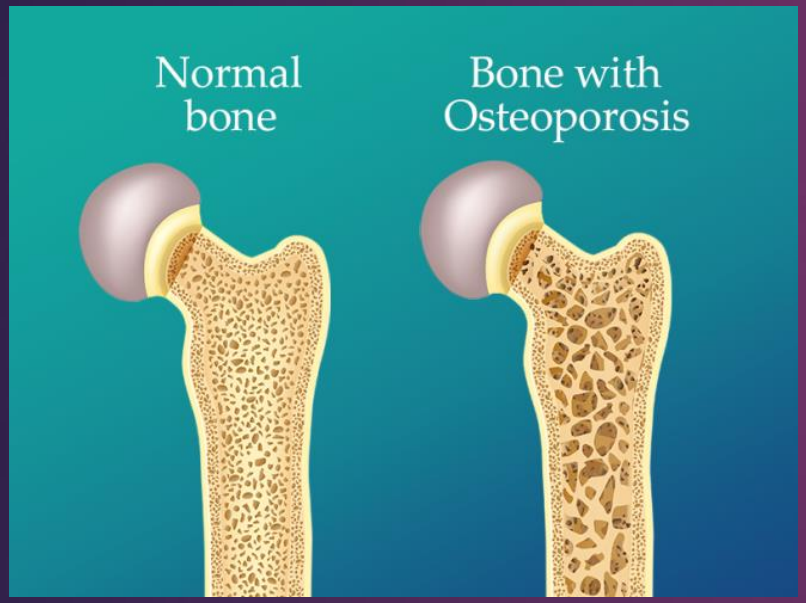
- **Inflammatory mechanisms of age-related processes:**
- **Cardiovascular Diseases:** Persistent inflammation has the potential to harm blood vessels, promoting atherosclerosis, which is the narrowing and hardening of arteries. This, in turn, elevates the likelihood of heart attacks and strokes.
- **Neurodegenerative Diseases:** Inflammatory activity within the brain is associated with neurodegenerative conditions such as Alzheimer's and Parkinson's diseases. Inflammation can play a role in the demise of nerve cells and the advancement of these disorders.

Inflammation



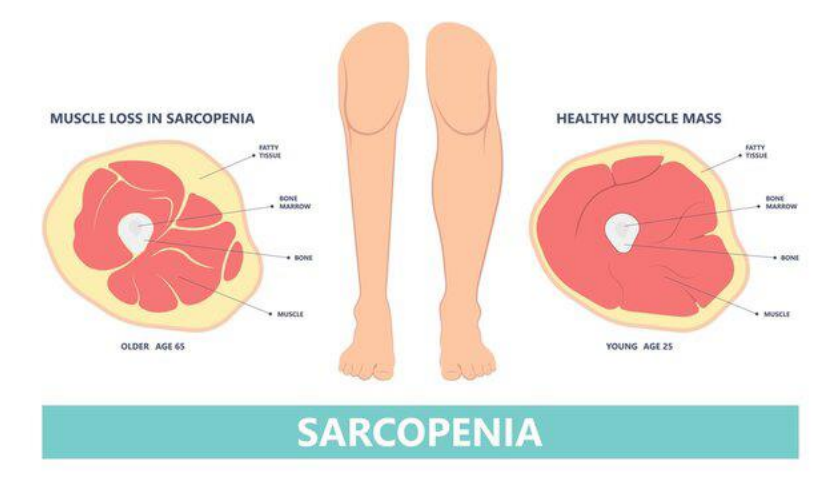
- **Weakened Immune Response:** Chronic inflammation can impair the immune system's ability to fight infections, making older adults more susceptible to illnesses.
- **Cancer:** Chronic inflammation can create a microenvironment that promotes cancer development. Inflammatory cells and signaling molecules can support the survival, growth, and spread of cancer cells.

BONES



- **Osteoporosis**: This is a condition where bones become weak and brittle, making them more likely to break.It is especially common in older women Treatment includes medication, lifestyle changes, and fall .
- **Loss of bone density:** From about age 30, the density of bones begins to diminish in both men and women this loss of bone density accelerates in women after menopause As a result, bones become more fragile and are more likely to break.

MUSCLES



- **Sarcopenia**: This is a gradual loss of muscle mass and muscle strength that starts around age 30 Muscles progresses throughout the life . It can lead to weakness, falls, and difficulty performing daily activities Treatment includes exercise, nutrition, and medicatio
- **Lipofuscin and fat deposition:** Lipofuscin, an age-related pigment, and fat are deposited in muscle tissue as people age The muscle fibers shrink, and muscle tissue is replaced more slowly

JOINTS

- **Osteoarthritis**: This is a degenerative condition affecting the joints, wherein the cartilage within a joint gradually diminishes in thickness and elasticity. It can result in pain, stiffness, and challenges in joint mobility. Treatment methods encompass medications, physical exercise, and, in some cases, joint replacement surgery.
- **Loss of cartilage**: As individuals age, hip and knee joints might experience cartilage loss, resulting in degenerative alterations. Additionally, finger joints undergo cartilage reduction, and the bones exhibit slight thickening. Modifications in posture and walking patterns are prevalent as people age. The stiffening of joints is attributed to variations in the connective tissue within ligaments.

OXIDATIVE STRESS:

As we age, our bodies may encounter difficulties in maintaining a equilibrium between the generation of reactive oxygen species (ROS) and the presence of antioxidant defenses, which can result in oxidative stress. This condition can contribute to cellular harm and the development of a variety of diseases.

- DNA Mutations: Oxidative stress has the potential to cause DNA mutations, which can disturb regular cellular functions and heighten the risk of cancer and various age-related ailments.
- Protein Aggregation: Oxidative stress can induce the misfolding and accumulation of proteins, playing a role in the development of diseases like Alzheimer's and Parkinson's.
- Tissue and Organ Damage: The gradual impact of oxidative stress may result in harm to tissues and organs, impacting overall well-being and operation. This is evident in age-related conditions such as atherosclerosis, osteoarthritis, and age-related macular degeneration.

HORMONAL CHANGES

Alterations in hormone levels associated with aging, such as reduced secretion of growth hormone and sex hormones, can influence a range of bodily functions, potentially giving rise to conditions such as osteoporosis and symptoms related to menopause.

- Thyroid Hormone Changes: The thyroid gland's performance may diminish as one ages, causing a decrease in the synthesis of thyroid hormones. This can manifest as symptoms like fatigue, weight increase, and alterations in metabolism.
- Decline in Growth Hormone: With aging, the pituitary gland's output of growth hormone decreases. This can lead to a reduction in muscle mass, an augmentation in body fat, and a decline in bone density.

AGE RELATED SEXUAL FUNCTION IN WOMEN

Menopause: Menopause is an inherent biological occurrence that transpires when a woman's ovaries cease to release eggs, resulting in a range of symptoms such as hot flashes, vaginal dryness, and shifts in sexual desire.
Treatment: Management approaches encompass hormonal therapy, medication, and adjustments in lifestyle.

Vaginal Changes: With advancing age, the vaginal canal may experience a reduction in length and width, accompanied by thinning and stiffening of its walls, potentially leading to discomfort or pain during sexual activity.
Treatment: Approaches to address this issue include the use of vaginal moisturizers, lubricants, and hormone therapy.

AGE RELATED SEXUAL FUNCTION IN MEN

Erectile Dysfunction: It is a prevalent issue among men and refers to the incapacity to attain or sustain an erection suitable for sexual activity.
Treatment: Strategies to address this concern encompass the use of medication, therapy, and lifestyle modifications.

Reduced Testosterone: As men grow older, their testosterone levels naturally decline, resulting in symptoms such as decreased sexual desire, fatigue, and a reduction in muscle mass.
Treatment: Management options include hormone therapy, medication, and adjustments to one's lifestyle.

IMMUNE SYSTEM DECLINE

Immunosenescence, the progressive deterioration of the immune system, can render older individuals more vulnerable to infections and less receptive to vaccinations.

The age-related deterioration of the immune system, known as immunosenescence, is a multifaceted process involving several alterations in the body's immune function.

Thymus Atrophy: Over time, the thymus, a central organ for the development of T cells, gradually diminishes in size. This results in a decreased production of naïve T cells, which play a crucial role in a robust immune response.

Diminished T Cell Function: The efficacy of T cells, especially CD8+ cytotoxic T cells, may decrease as individuals age. These cells are essential for targeting infected or abnormal cells, so a reduction in their activity can weaken the immune response.

METABOLIC CHANGES:

- Age-related changes in metabolism, such as insulin resistance and altered fat distribution, can lead to conditions like type 2 diabetes and obesity.

B-Cell Dysfunction: B cells, which play a role in generating antibodies, may also experience age-related dysfunction. This can result in a diminished capacity to produce particular antibodies in response to infections.

Altered Cytokine Production: Alterations in the synthesis of pro-inflammatory and anti-inflammatory cytokines can disturb the equilibrium of the immune system, potentially resulting in chronic inflammation and an elevated susceptibility to infections.

Immune Memory Decline: The immune system's ability to remember and respond to pathogens it has encountered in the past may diminish. This can lead to less efficient immune responses when facing subsequent infections.

Vascular changes

- Ageing can result in the stiffening of arteries, the development of atherosclerosis, and a decline in blood vessel function. These factors increase the risk of heart disease and hypertension.

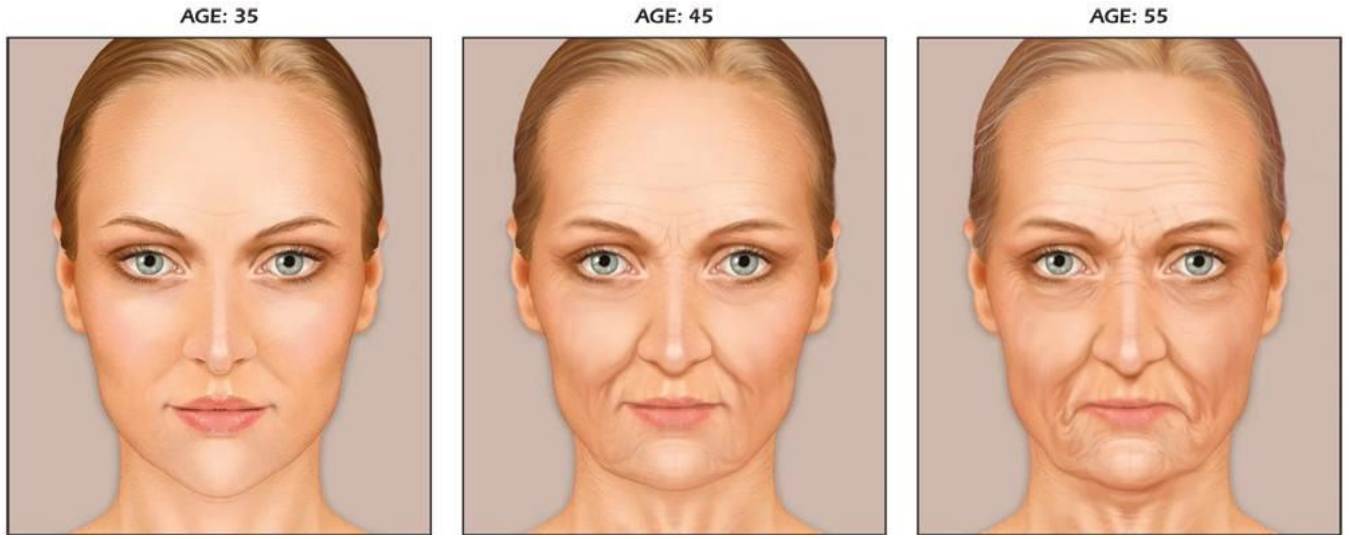
GENETIC FACTORS

- Genetic factors can also impact the onset of age-related conditions. Certain individuals might have a greater vulnerability to specific diseases because of their genetic composition.

AGE RELATED SKIN ISSUES

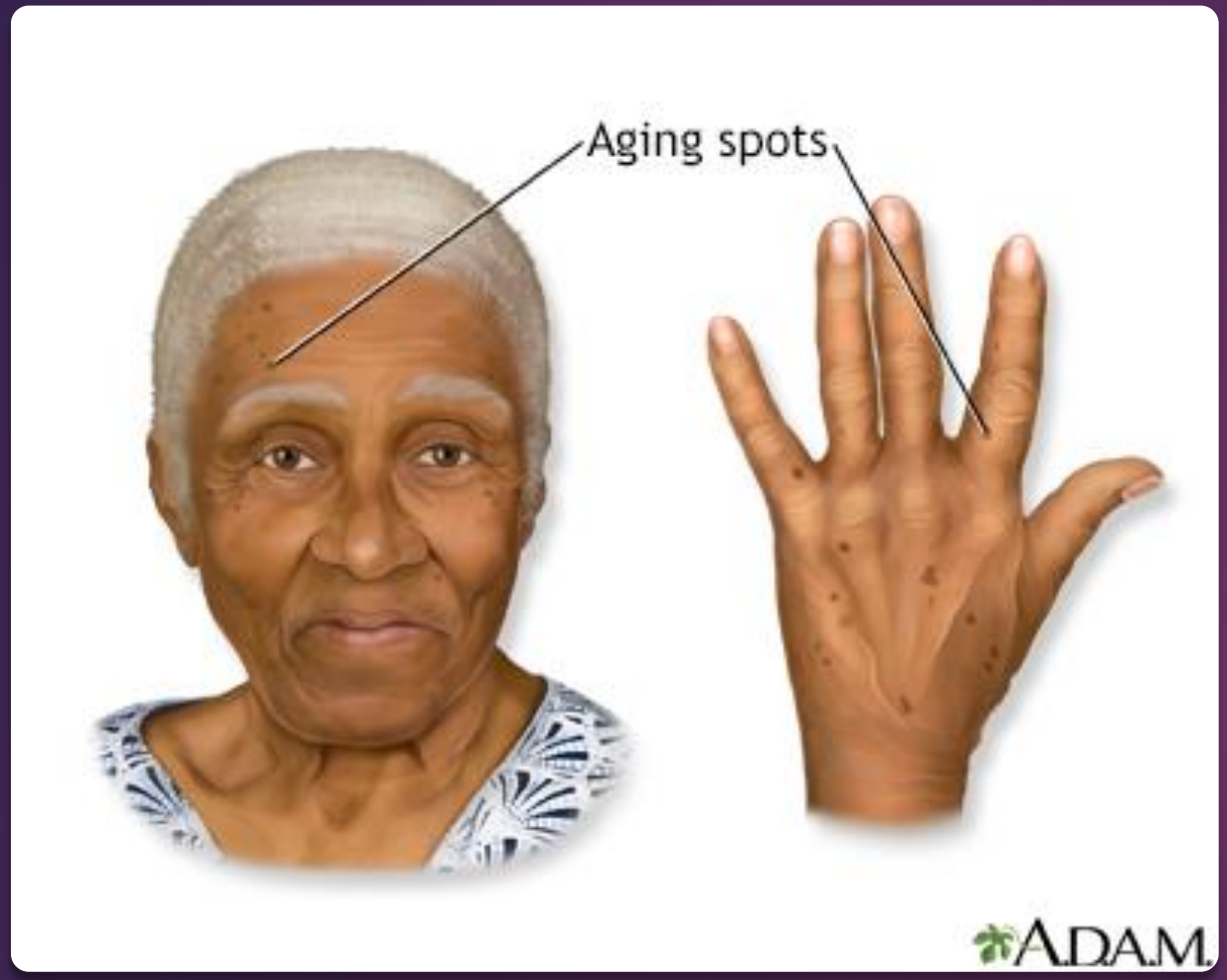
- Skin Thinning: The epidermis, the skin's outermost layer, becomes thinner with aging. This can render the skin more delicate and susceptible to injury.
- Reduced Natural Oil Production: Aging results in a decrease in the skin's natural oil production, which can lead to dry and itchy skin.

- Reduced Skin Cell Renewal: The pace at which skin cells are replenished diminishes with aging, leading to a dull and coarse appearance of the skin.



Decreased production of collagen and elastin: Collagen and elastin are proteins that give the skin its structure and elasticity. As people age, the production of these proteins decreases, which can cause the skin to sag and wrinkles.

Loss of elasticity: The skin loses its elasticity as people age, which can cause sagging and wrinkles



Appearance of age spots: Age spots, also known as liver spots, are flat, brown spots that appear on the skin as people age. They are caused by exposure to the sun

AGE RELATED HEARING LOSS

- Age-related hearing loss, also known as presbycusis, is a common problem linked to aging. It is a gradual loss of hearing in both ears, and it often affects the ability to hear high-pitched noises such as a phone ringing or beeping of a microwave.

CONCLUSION

In summary, age-related concerns are an intrinsic and intricate aspect of the human life journey. As people advance in age, they encounter a variety of physical, physiological, and psychological transformations. These alterations are shaped by a blend of genetic, environmental, and lifestyle elements.

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