

What happens as a body ages?

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Outline

1) Body changes with aging

2) Why do we age? Theories of Aging

What shall we do to delay the process of aging?

Aging

- It is a progressive loss of tissue and function of various body organs
- There is significant individual variation in it's onset and progression

Body changes with aging

- After age 30 years, we tend to lose lean tissue and some of the cells of the muscles, liver, kidney and other organs gradually lose their functioning
- Tissue loss reduces the amount of water and increases the amount of fat in the body
- Overall metabolism slows down
- **Hence, as we grow old, we need lower dose and less frequent medications**

Changes in Skin with aging

- **Thinning:** of both superficial and deep layers of skin
- **Sagging:** Older skin produces less elastin and collagen, which means it is more likely to sag and droop.
- **Wrinkles:** Combination of both thinning of skin along with reduced elastin and collagen lead to formation of wrinkles, predominantly around eyes and mouth

Changes in face with aging

- *Missing teeth and receding gums* changes appearance of face
- **Hairs:** People tend to develop gray hairs, due to hair follicles make less melanin with as age progresses
 - rate of hair growth slows → loss of hairs, baldness may appear
- **Eyes** may look sunken and people may develop refractive errors
 - lens of eye may develop **cataract**
- **Age-related gradual hearing loss (presbycusis):** which can make it hard for person to tolerate loud sounds or to understand what others are saying

Changes in Bones with aging

- Shrink in size and in density
- **Loss of bone tissue**
- Low bone mass makes bone weak
- Increase risk of **osteoporosis**
- **Increase in susceptibility to develop fractures**

Changes in Joints with aging

- Joint movement becomes **stiffer and less flexible**, mainly due to...
 - ligaments tend to shorten and lose their flexibility
 - the amount of lubricating fluid inside the joint decreases &
 - cartilage becomes thinner

Changes in Muscles with aging

- **Loses size and strength**
- Changes in nervous system cause muscles to have reduced tone and reduction in their ability to contract
- Contribute to..
 - **fatigue, weakness and reduced tolerance to exercise**
 - **can affect coordination, stability and balance**
 - **increase risk of falls**

Changes in Cardiovascular system with aging

- **Blood vessels:**

Baroreceptors within walls of arteries...

- monitor blood pressure &
 - make changes to help maintain blood pressure, whenever person changes posture.
-
- **The baroreceptors becomes less sensitive with aging.**
 - This leads to increase risk of **postural hypotension and falls**

Changes in Cardiovascular system with aging

- **Blood vessels becomes stiff with aging:**
- **Heart:**
 - These stiff blood vessels make heart to work harder to pump blood through them
 - lead to **increase in size of the Heart muscles (hypertrophy)** to adjust the workload
 - Increase the risk of **hypertension & ischemia**

Changes in nervous system with aging

- Neurons may **begin to pass messages more slowly**



- Leading to **slowing** of thoughts, memory and thinking

- **Reduction or loss of reflexes or sensations**



- Affects balance, coordination, driving skills and increase risk of falls

Changes in nervous system with aging

Neurons break down with aging



As a result, products of neuronal damage or other chemicals such as beta amyloid can collect in the brain tissue

- increase risk of **neurodegenerative diseases**
e.g. Alzheimer's dementia

Changes in kidneys and bladder with aging

Kidneys:

- **Amount of kidney tissue and kidney function diminishes**
- Hence, we need to reduce the dose of medications that get metabolized in the kidneys

Bladder:

- Weakness and reduced tone in the bladder muscles and pelvic floor muscles
- **Difficulty in emptying bladder completely**



- Increase risk of Urinary Tract Infection (**UTI**)

Changes in female reproductive system with aging

- Menstrual periods stop completely – **menopause**
- Ovaries stop making hormones – estrogen and progesterone
- Vaginal walls become thinner, dryer and less elastic
- Having a sex can be painful due to these changes

Changes in male reproductive system with aging

- Testicular mass decreases. Hence, **production of testosterone reduces**
- Affect sperm production & erectile function
- About 50% men experiences Benign Prostate Hyperplasia (BPH)

Changes in Gastrointestinal system with aging

- Slowness of gut motility, lack of exercise, not drinking enough fluids, and low-fibre diet



- **Increase risk of constipation in older people**
- Thinning of walls of the large intestine results in out pockets from the wall, which is a condition known as '**diverticulosis**'

Psychological effects of aging

- **Health and Death anxiety:**

- e.g. anxiety related to falls, serious medical conditions and death
- At times, it can be very difficult to treat

- **Grief and loss:** e.g. loss of spouse, siblings, friends etc.

- Impact of recent COVID-19 pandemic

- Some people may have **difficulty in accepting the changes in life as we age:**

- especially with respect to decline in their functioning, changes in their appearance etc.

Social effects of aging

- **Decreased social contacts / loneliness**

- Friends, family members die
- Person may withdraw from social activities, as they may experience difficulty in attending it due to physical health issues
- Recently due to COVID-19 pandemic

- **Changes in roles / tasks:**

- **Retirement**
- Changes purpose in people's lives
- It may affect lack of a routine
- Cope with spouse, who is also aging: e.g. Carer distress with aging in spouse
- Financial challenges

Why do we age?

Various theories of aging

- 1) Deteriorative processes
- 2) Aging program or biological clock

Deteriorative processes: Theory of aging

Oxidation



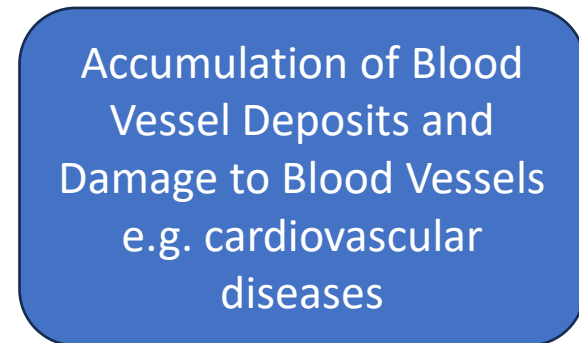
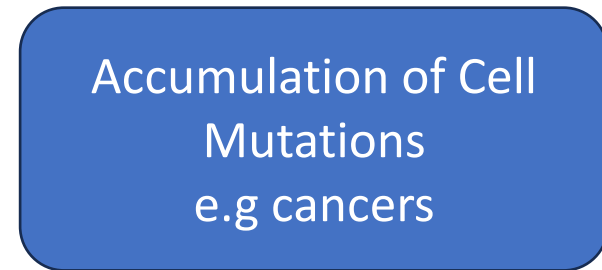
Deteriorative
processes

Telomere
shortening

Disease
Specific
Processes

Accumulation of Cell
Mutations
e.g. cancers

Accumulation of Blood
Vessel Deposits and
Damage to Blood Vessels
e.g. cardiovascular
diseases



Oxidative stress enhance aging

Free radicals form reactive oxygen and nitrogen species (**RONs**)



Oxidative Stress



Significant damage to cells, proteins and DNA



Impacts **functioning** of various body cells

(e.g. Cardiovascular diseases [CVDs], Diabetes, COPD, chronic kidney disease,
Various cancers and Neurodegenerative diseases e.g. Alzheimer's disease,
Parkinson's disease etc.)

What increase the risk of oxidative stress?

- **Smoking**
- **Illicit substances e.g. stimulants, hallucinogens etc.**
- **Unhealthy diet (e.g. Processed food, Smoked meat, oily and fatty food)**
- **Physical inactivity**
- **Air & water pollution**
- **Radiation exposure**
- **Heavy metals exposure**

What can we do to reduce oxidative stress?

- **Reduce exposure to various factors which increase oxidative stress**
 - Dietary modifications: Reduce oily and fatty food, processed food etc
 - Reduce and STOP SMOKING, ILLICIT SUBSTANCES
- **Improve antioxidant defenses**
 - Physical exercise:
 - Dietary modifications: Food rich in polyphenols
 - Antioxidant therapy: Vit A, C and E, Coenzyme Q10 supplements

Physical Exercise

Physical inactivity



increase levels of free radicals and RONS production



sarcopenia (loss of strength of skeletal muscle mass)



frailty

What kind and how much of Physical Exercise helpful to improve oxidative defense?

Instead of acute exercises, focus to be on **moderate intensity endurance training and resistance exercises**

Endurance training exercises (at least 20 minutes, 5 days a week):

- Walking briskly,
- Running / jogging, Dancing,
- Biking,
- Climbing stairs at work or at home (if available)

Resistance exercises (8-10 min each set, 3-5 sets, 5 days a week):

- Squats, Lunges, Pull ups,
- Push ups, Bench press,
- Barbell curls, Triceps pushdown, Bent over Row etc.

Improve Antioxidant defences: Foods rich in polyphenols

- **Fruits:** Blueberries, blackberries, strawberries, cherries, oranges, apples etc
- **Vegetables:** spinach, red onion, artichoke, broccoli, olives, asparagus, tomato
- **Nuts, legumes:** Walnuts, almonds, hazelnuts, black beans, white beans
- **Beverages:** Coffee, tea, red wine
- **Fats:** dark chocolate, virgin olive oil
- **Spices:** cloves, star anise, ginger, cinnamon, cumin, dried oregano etc

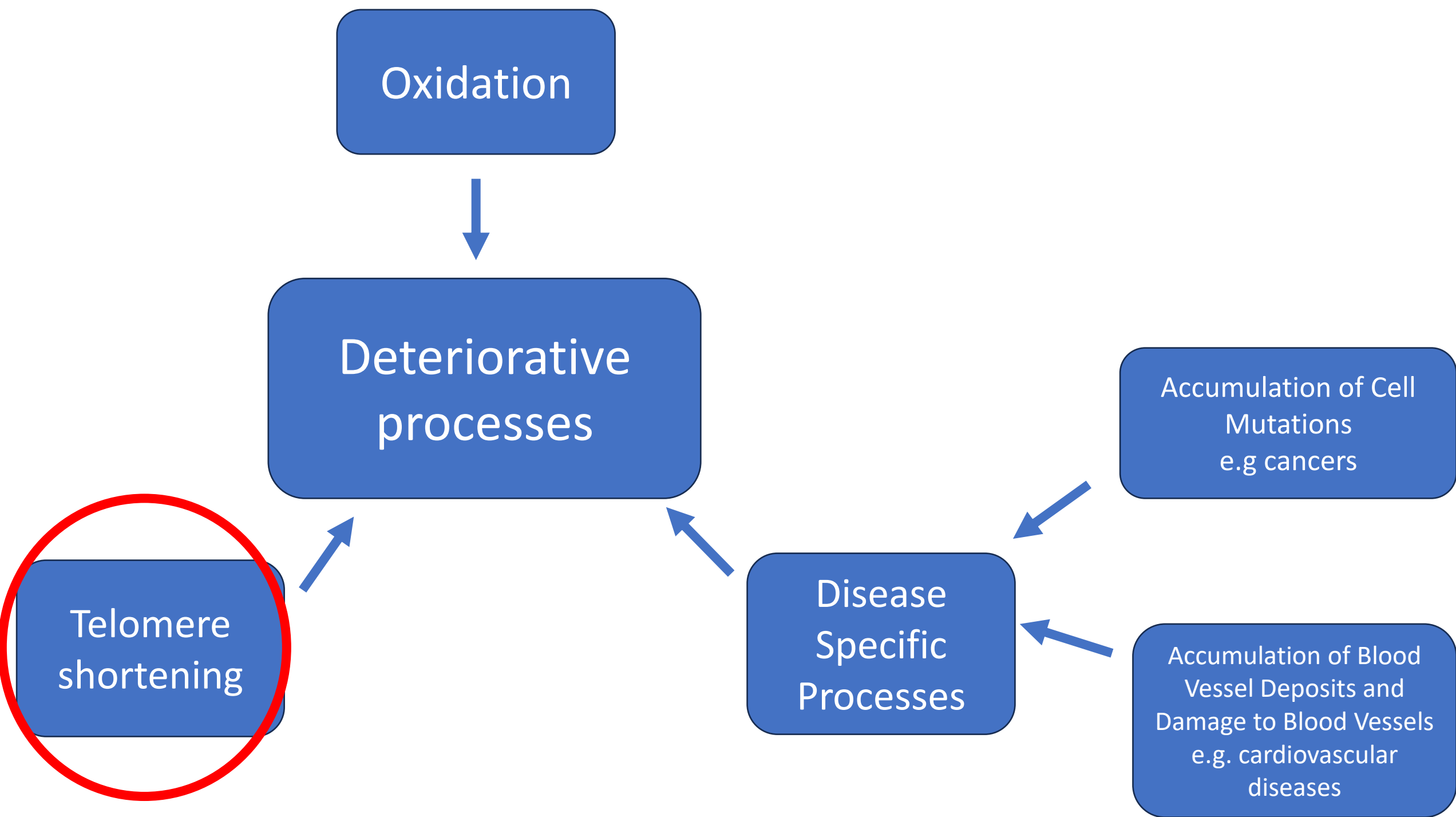
Antioxidant therapy

- **Vitamin A, C and E**

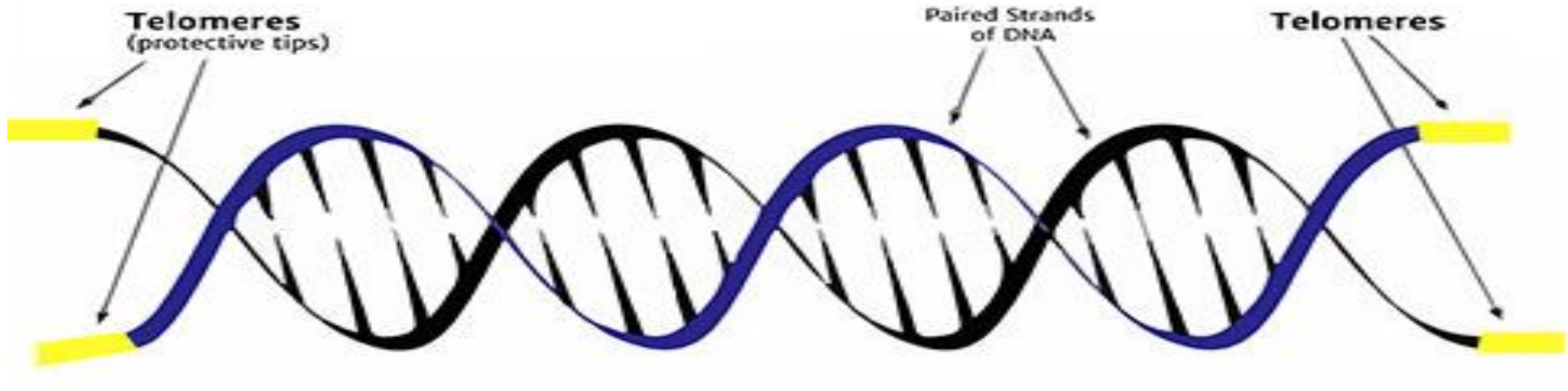
- conflicting results about their benefits as an antioxidant role

- **Coenzyme Q10 supplements**

- Natural antioxidant in cells
- It's level declines with age
- Usual dose is 150-300 mg per day, depending on CVDs
- Research shows variable mild to significant benefits in delay aging and it also has cardio-protective benefits

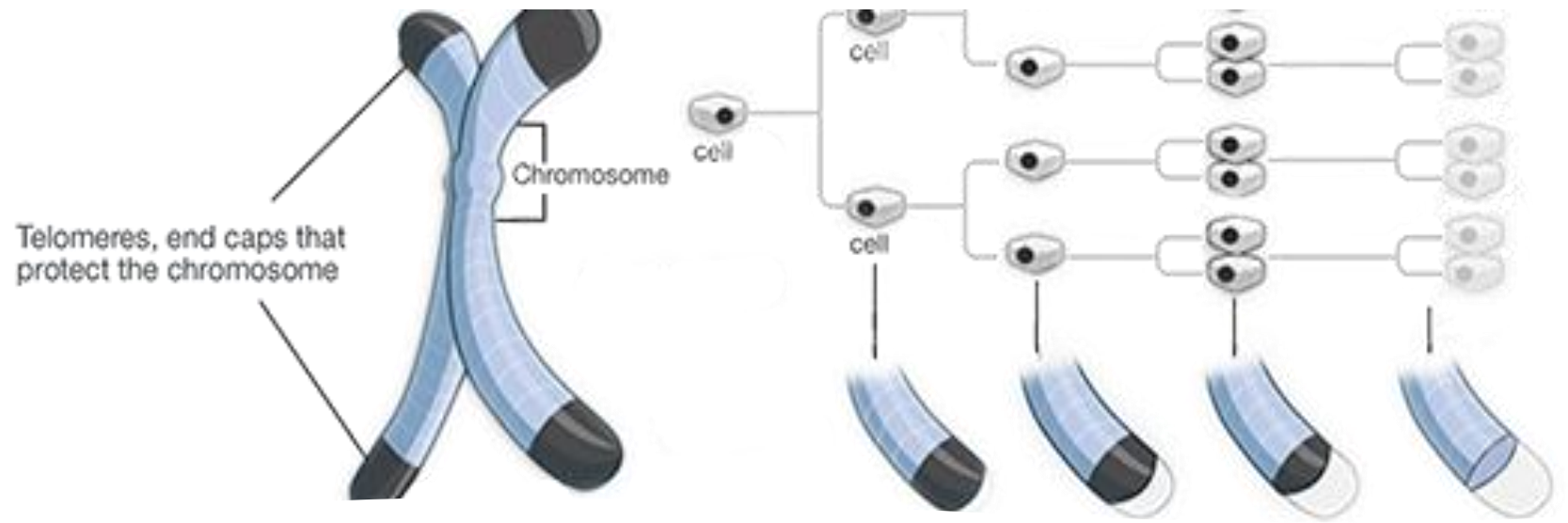


Telomere shortening predicts aging



- **Telomeres:** caps at the end of the each strand of DNA that protect our chromosome
- Like the plastic tips at the end of shoelaces

Telomeres shorten with each cell division



- Our body cells replenish by copying themselves. This happens constantly throughout our lives
- Telomeres get shorter each time a cell copies itself, but the important DNA stays intact
- Eventually, telomeres get too short to do their job, causing our cells to age and eventually cells stop functioning properly

Telomeres shortening and aging

- **Telomeres are shortened as we age**
- Telomeres shortening accelerated by...
 - stress
 - smoking
 - physical inactivity
 - unhealthy diet



Effect of a lifestyle intervention on telomere length: A systematic review and meta-analysis

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ABSTRACT

Background: We conducted a systematic review and meta-analysis to assess the effects of lifestyle intervention on telomere length (TL).

Method: Four databases were searched for studies reporting TL in leukocytes, before and after a lifestyle intervention. We computed random-effects meta-analysis on TL within intervention and control group after versus before intervention, and on changes in TL between groups. Sensitivity analyses and Meta-regression were conducted.

Results: We included 20 studies in the systematic review (2995 participants, mean 50.3 years old, 77% women, 2045 following an intervention and 950 controls) and 19 in the meta-analysis. TL were similar at baseline between intervention and control groups. The physical activity \pm diet group had an increase in TL (Effect size 0.17, 95%CI 0.03–0.31, $p = 0.020$) using changes within the intervention group, whereas TL shortened in the control group (-0.32 , -0.61 to -0.02 , $p = 0.037$). TL was longer in the physical activity \pm diet intervention group (0.24 , 0.08 – 0.40 , $p = 0.004$) compared to controls after the intervention. Sensitivity analysis gave similar results. Meta-regressions demonstrated that combining strength and endurance exercise increased TL more than endurance alone or strength alone.

Conclusion: A lifestyle intervention with physical activity \pm diet can increase telomere length, independently of population characteristics or baseline TL.

Conclusion from 20 studies of 2995 participants

A lifestyle intervention with physical activity \pm diet



Can significantly increase telomere length

(independently of population characteristics or baseline telomere length)

Oxidation



Deteriorative
processes

Telomere
shortening



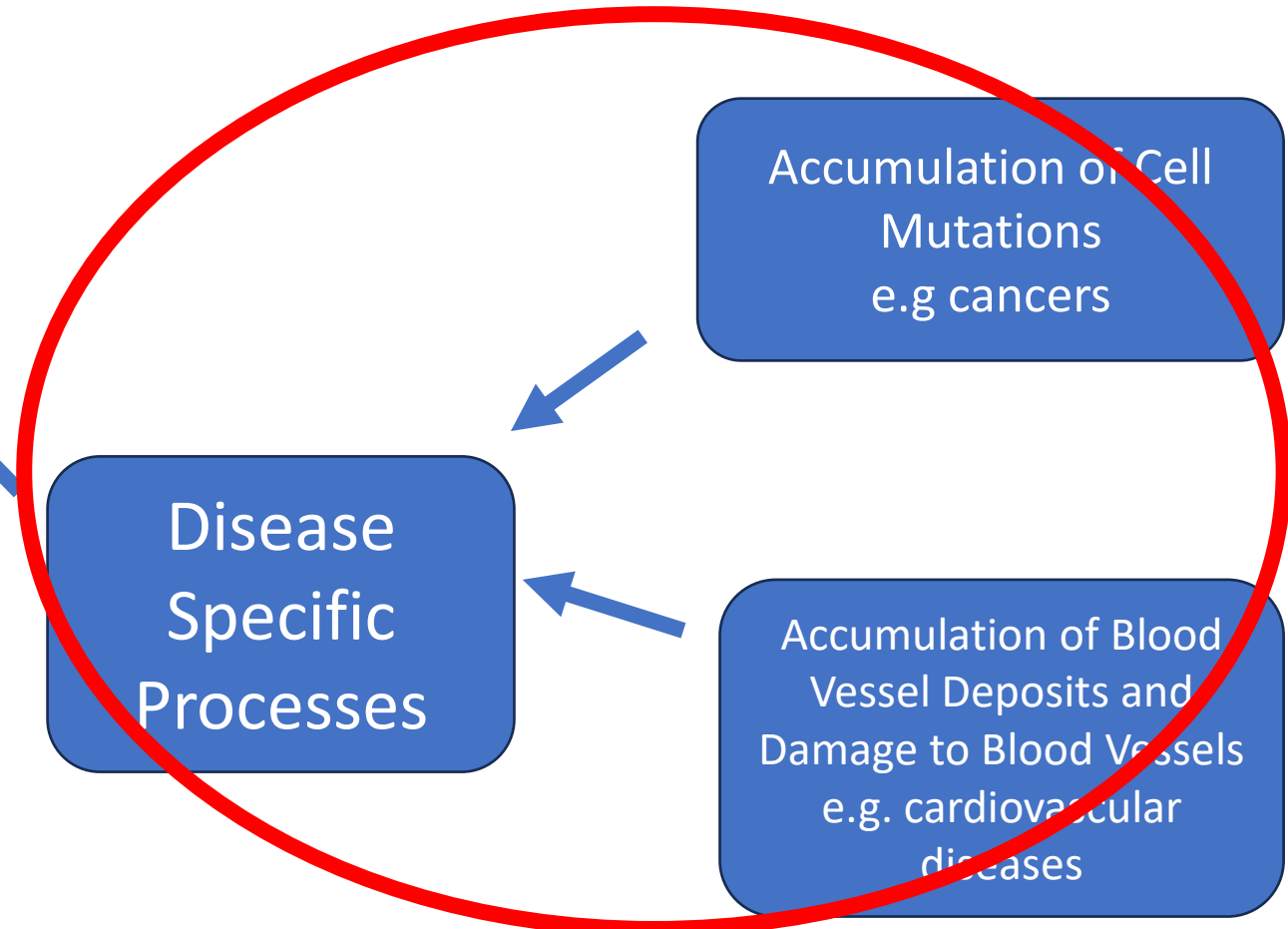
Disease
Specific
Processes



Accumulation of Cell
Mutations
e.g cancers



Accumulation of Blood
Vessel Deposits and
Damage to Blood Vessels
e.g. cardiovascular
diseases



Disease Specific Processes impacts the process of aging

- Accumulation of cell mutations e.g. **cancers**
- Accumulation of blood vessel deposits or damage e.g. **cardiovascular diseases**

Early detection and proper management of these diseases and their risk factors



May possibly delay aging process

Aging program or biological clock: Theory of aging

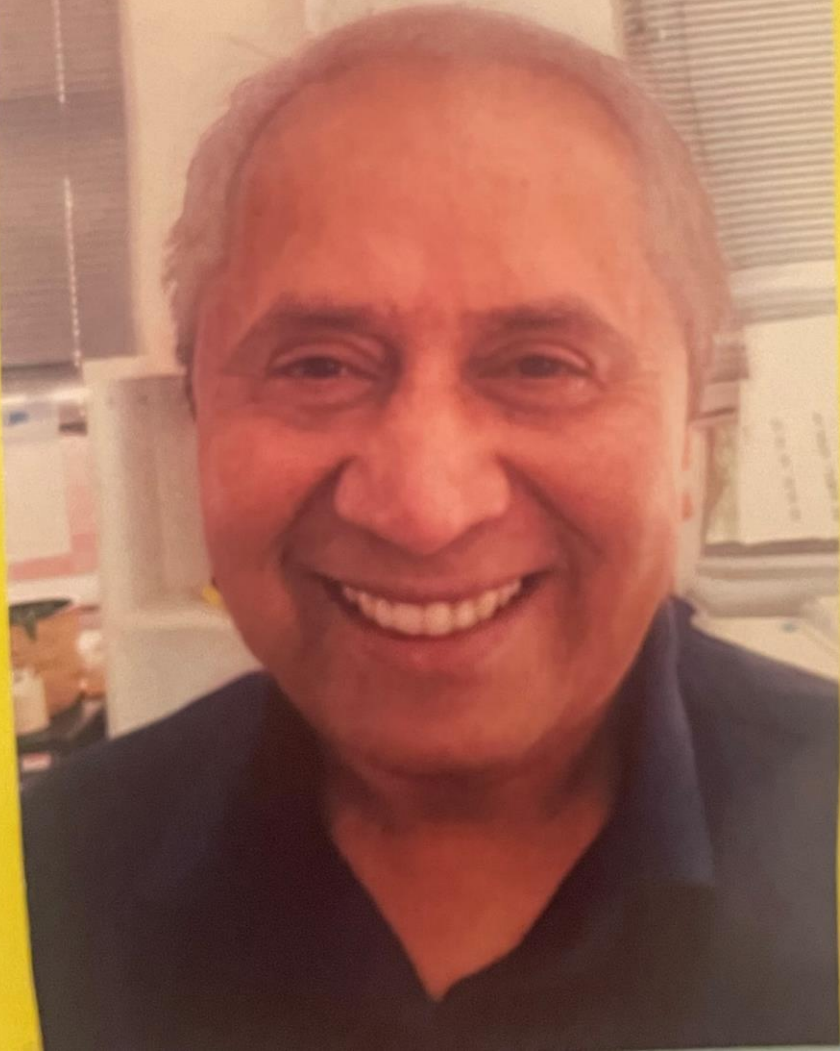
Based on genetic make up of each individual



Specific biological clock or aging program that get fixed at the time of the birth of each individual

- Which decides at what age the aging process will start
- Fits observation of some human genetic diseases that cause acceleration of many (**progeria in children**) or most (**Werner's syndrome in adults**) symptoms of aging

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Thank you!

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