





Primary Aging: Oxidative Damage

Free radicals: by-products of normal metabolism and response to environment

- Random damage on cellular level
- Resistance to and repair of potentially damaging chemical reactions decline with age

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Do you C what I C?

Do vitamins and minerals identified as antioxidants protect against oxidative damage?

What does the evidence suggest?

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Primary Aging: Genetic Limits

- Every species has characteristic maximum life span set by genetic program
- Number of cell divisions species undergo before reaching replicative senescence = Hayflick limit
- Primary aging occurs when species limit is approached

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Do tell about telomeres

- Timekeepers for cells
- With age and chronic stress, cells stop dividing and shorten

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Telomere Length and Exercise

- Figure 2.1: Telomere length is related to the amount of time adults spend in leisure time activity

Physical Activity Level	Telomere Length (kb)
Inactive (16 min. per week)	~6.98
Light (36 min. per week)	~7.05
Moderate (102 min. per week)	~7.12
Heavy (199 min. per week)	~7.20

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Think about it!

What would your meal plan be on a diet of 1400 calories per day?

What challenges might you face on such a diet?

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Primary Aging: Caloric Restriction

- Can calorie restriction increase human longevity?
- How does calorie restriction affect longevity and freedom from disease and quality of life?
- Is the use of a CR mimetic plausible?

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Considerations and Cautions

- No single theory of primary aging explains everything.
- Theories cross and complement each other and show signs of merging.

Can you think of an example?

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Physical Changes During Adulthood

- Outward appearances
- Senses
- Bones and muscles
- Cardiovascular and respiratory systems
- Brain and nervous systems
- Immune system
- Hormonal system

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Outward Appearances: Changing Weights

Figure 2.2: Both men and women gain weight in young adulthood and middle adulthood, losing late in the 50s, but in slightly different patterns.

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The Facts on Fat in the US

- Over two-thirds of US adults are over normal BMI range
- Proportion of people in overweight range remains fairly constant; those in obese range shows steady increase

Let's take a look!

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Proportion of Obese in the US

- Figure 2.3: The proportion of obese and extremely obese adults in the United States has increased over the past 40 years, whereas those who are overweight has remained relatively unchanged.

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Why?

What are the major risk factors for obesity?

What are the solutions?

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A Wrinkle in Time: Skin and Hair

Skin

- Wrinkles due to redistribution of body fat and loss of elasticity
- Treatment with tretinoin and medical procedures somewhat effective
- Looking younger may be related to feeling younger

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Mirror, mirror, on the wall!

- How are youthful looks obtained?
 - Plastic surgery (See Table 2.3)
 - Botox
 - Injection of hyaluronic acid

Would you be willing to pay for these?

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Hair today...gone tomorrow!

Hair loss

- Common aging characteristic for men and women

Solutions

- Hair coloring, wigs, hair replacement, drugs

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Body Changes: The Senses

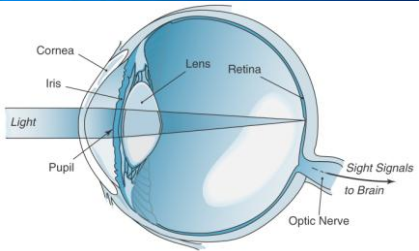
Vision

- Loss of pupil effectiveness and decline in ability to accommodate = reduction in visual acuity
- Gradual loss of dark adaptation

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- Figure 2.4: Cross-section view of the human eye



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Additional Age-Related Vision Problems

Cataracts: clouding of lens that reduces sharp transmission to retina

Cataract surgery: most common surgery procedure in US

Glaucoma: pressure buildup inside eye that destroys optic nerve

Glaucoma treatment: surgery, eye drops, and laser treatment

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Additional Age-Related Vision Problems

Age-Related Macular Degeneration: retina disorder causing central vision loss

Age-Related Macular Degeneration Treatment: vitamin therapy, laser treatment, rehabilitative interventions

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What are the potential consequences associated with these age-related vision changes?

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Senses: Hearing Loss with Age

By age 65, about one-third of adults have some significant hearing impairment

- Shortening of loudness scale (loud-soft discrimination) causes sensorineural hearing loss
- May result in need for hearing aids or cochlear implants

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Senses: Taste and Smell Changes with Age

Mechanisms of sense and smell

- Ability to taste and smell declines with age
- Possible causes of non-age related decline

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Physical Changes: Bones and Muscles

- Calcium loss causes less dense, more brittle bones
- Greater for women
 - Smaller bones and greater decline with age
 - Osteoporosis (BMD)

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Figure 2.5: The greatest bone mass is found around age 30 for both men and women, with the later decline being faster for women after 50

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Why does bone loss matter?

Osteoporosis and bone-related fractures

- Physical and economic cost of treatment
 - Regular health professional visits
 - Vitamin D
 - Estrogen and other medications
 - Monitoring patient adherence to treatment

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Osteoarthritis

- Soft cartilage at bone ends wears away with age
- More frequent in women, older and overweight people
- Can lead to depression, anxiety, and variety of limitations

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Can osteoarthritis be treated?

- Anti-inflammatory and pain-relief medications
- Appropriate balance of rest and exercise
- Weight management
- Alternative and complementary treatments
- Surgical joint replacement

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Cardiovascular and Respiratory Systems




- Heart of older person functions as well as younger on daily basis but slower to respond to challenge
- Walls of arteries thicker and less supple and do not adjust to blood flow as well; higher blood pressure
- Regular exercise can reduce some of aging effects

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- Figure 2.6: The proportion of men and women taking blood pressure medication increases sharply with age from the late 30s to mid-70s

Age Group	Men (%)	Women (%)
20-34	~8	~5
35-44	~20	~15
45-54	~35	~35
55-64	~48	~55
65-74	~62	~72
75%	~68	~82

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Cardiovascular and Respiratory Systems

Maximum oxygen uptake

- Reflects the body's ability to take in and utilize oxygen during exercise.
- Peaks in adolescence and declines steadily with age.
- Varies significantly depending on activity level.




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Brain and Nervous Systems

- Loss of brain cells (neurons) in primary aging is less than previously believed.
- Loss of total number of neurons but not all loss translates to functional decline.
- Life-long plasticity (new dendrites and pruning).
- Slowing of transmission across the synapses between neurons.

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What about neurogenesis?

Neurogenesis: growth of new neurons in adulthood

- Occurs in olfactory bulb and hippocampus of adult brain (memory)
- Slows down with aging
- Affected by corticosteroids (hormonal response to stress and immune system challenges)

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Immune System

B cells

- B cells make antibodies which react to infectious agents.
- B cells show abnormalities with age, accounts for increase of autoimmune disorders.

T cells

- T cells reject and consume harmful foreign cells.
- With age, T cells show reduced abilities to fight new infection.

Immune function is worsened by psychological stress and depression.

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Stop and think...

- What have you heard about menopause?
- Do you think men undergo a similar period of change in midlife?
- What picture does the media give us of this part of adulthood?

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Hormonal System

In men

- Gradual decline in testosterone.
- Decrease in viable sperm, muscle mass, sexual desire, and sexual response.
- Erectile dysfunction is associated with age and can be treated with medication.

In women

- Menopause occurs signaling an end to reproductive abilities.
- Ovarian failure related to drop in estrogen and changes in progesterone.
- Average age of menopause is 51.

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What does recent research confirm?

- Massachusetts Women’s Health Study (MWHs)
- Study of Women’s Health Across the Nation

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Consider...

Is hormone replacement therapy safe?
Why or why not?

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Changes in Physical Behavior

- Athletic abilities
- Stamina, dexterity, and balance
- Sleep
- Sexual activity

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Stop and think...

- Based on what you have learned so far, what would you guess the peak ages would be for gymnasts, golfers, and marathon runners?

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Changes in Physical Behavior

Athletic Abilities

- In many sports, top performers are in teens or 20s
 - Gymnasts
 - Short-distance runners
 - Long-distance runners

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Master's Events

- Figure 2.7: Running time on 100-meter sprint for men and women master athletes increases with age

Age (Years)	Males (Sec.)	Females (Sec.)
35	11.5	12.5
40	11.8	13.0
45	12.2	13.5
50	12.5	14.0
55	13.0	14.5
60	13.5	15.0
65	14.0	16.0
70	14.5	17.0
75	15.5	18.5
80	16.5	20.0
85	17.5	21.5
90	18.5	23.0

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Stamina, Dexterity, and Balance:
Do you know the difference?

- Stamina:
- Dexterity:
- Balance:

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Changes in Physical Behavior

- Sleep
- Changes in the neurological system increase likelihood of insomnia.
- Some sleep problems are due to health problems and medications.
- Behavior changes can improve sleep (e.g., being active).

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Sexual Activity

- The climacteric is age-related loss of reproductive ability.
- Frequency of sexual activity drops from the 20s into late adulthood.
- This research is limited by reliance on surveys.

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AARP Modern Maturity Sexuality Survey (2007)

Factors that affect probability that an older person will have sexual relations:

1. Physical ability
2. Sexual desire
3. Sexual partner
4. Privacy
5. Other forms of sensual activity

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Individual Differences in Primary Aging

- Genetics
- Lifestyle
- Psychosocial factors
- Economics

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Individual Differences in Primary Aging: Genetics

- Twin study data indicate longevity is moderately heritable.

How might this be related to predisposition for certain diseases versus presence of “longevity gene”?

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Individual Differences in Primary Aging: Lifestyle

Lifestyle affects primary aging

- Balance of physical exercise: aerobic exercise, flexibility, and strength training
- Diet

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Individual Differences in Primary Aging: Psychosocial Factors

True or false?

- Psychosocial factors in early and middle adulthood can have a profound and long-lasting effect on health and well-being in later years.

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Individual Differences in Primary Aging: Economics

Good health

- Not distributed equally within community or worldwide
- Dependent in later years on earlier health, access to preventative health care, good nutrition, education, income

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Can we turn back the clock of primary aging?

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Recurring and Unanswered Questions

- How quickly do we age?
- How can primary and secondary aging be untangled?
- Why do individuals age at different rates and in different ways?

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Chapter Review

1. The ____ theory of aging says that we age as a result of damage from free radicals that are released during normal cell metabolism.
2. The ____ theory of aging says that we age because our cells are programmed to stop dividing once we reach a certain age.

Chapter Review

3. The ____ theory says that our longevity is controlled by the number of calories we metabolize in our lifetime.

4. ____ increases gradually, starting toward the end of young adulthood, remains stable in middle adulthood, and then begins to decline in later adulthood.

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Chapter Review

5. ____ rates are high and increasingly steady for adults of all ages in the United States and other developed countries.

6. The main causes of obesity are eating a(n) ____ diet and leading a ____ lifestyle.

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Chapter Review

7. ____ begins to wrinkle toward the end of young adulthood and become more noticeable in the middle years.

8. ____ begins to decline in early adulthood, but is not noticeable until middle age.

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Chapter Review

9. _____ density peaks around 30 and then begins to decline for both men and women. The decline is gradual for men and sharp for women at menopause.
10. _____ and strength decline slowly and do not affect the daily activities of most adults. Resistance training and stretching exercises can help slow down the decline.

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Chapter Review

11. The brain loses _____ with age, but not at the high rate once believed. However, the nervous system is capable of making adjustments to the losses, and there is evidence that new ones can be created in parts of the adult brain.
12. The _____ system does not function as well in later adulthood as it did in earlier years.

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Chapter Review

13. There is a gradual decline in _____ production and _____ ability in both men and women from early adulthood into middle age, with a sharp decrease for women at menopause.
14. _____ becomes lighter as we age, and insomnia is more common.

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Chapter Review

15. _____ activity is a complex set of behaviors determined by physical ability, desire, availability of a partner, and privacy.
16. Primary aging is affected by many individual differences. _____ spare some people from predispositions to certain conditions, such as glaucoma and osteoporosis. _____ factors, such as exercise and healthy diet, promote slower decline.

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