Musculoskeletal Changes with Aging

- Muscle
- Bone
- Skin

“I would embrace the aging process if I could lift my arms.”
ARTERIES
Walls thicken. Cholesterol builds up along with calcium, reducing elasticity. "Even if you're a vegetarian, your arteries will harden," says David Snowdon. This raises blood pressure, which increases the risk of heart attack or stroke.

LUNGS
Losing elasticity, lungs cannot inflate or deflate completely. Between ages 20 and 80 their capacity may fall 40 percent, regardless of exercise. Coughing is more difficult as the diaphragm weakens.

METABOLISM
As cells become less sensitive to insulin, the body's ability to metabolize sugar declines. This often leads to a false diagnosis of diabetes.

BONES
Bone cells are constantly lost and replaced throughout life. At about age 35 loss accelerates, ultimately outpacing replacement. Menopause intensifies the loss; bones can become porous and brittle—a condition called osteoporosis.

MUSCLES
Muscle mass decreases 5 to 10 percent during every decade of increasingly sedentary adult life. A 75-year-old's hand grip is normally only three-fourths as strong as that of a 30-year-old. Regular exercise slows the decline.

HEART
Though its maximum rate slows, the healthy heart compensates for aging in subtle ways that keep its output the same as when it was younger. The heart walls thicken, for instance, pushing the blood through stiffening arteries. The older heart cannot squeeze as hard as it once could. Yet when the body moves—even just to stand up—blood still must get to the active muscles. To make this happen, the walls of the ventricles stretch, allowing more blood to move through the heart per beat.

HORMONES
At menopause a woman's ovaries produce less estrogen and progesterone, initiating abrupt changes in the body. In particular, bones lose some of their strength, and the risk of heart disease grows, catching up with that of men at about age 80. A man's testosterone level falls gradually, beginning in his 30s, and sex drive and reproductive capacity often decline. Eighty percent of all 80-year-old males have an enlarged prostate gland. Men's breasts also tend to swell.

JOINTS
Wear and tear results in osteoarthritis in many older people. Cartilage gradually erodes, and bone grinds against bone without a cushion. Joints become stiff and movement is painful.
Effects of Aging on Skeletal Muscle

- Strength decreases with age
- From age 30-80, a typical person's grip strength decreases 60%
- Leg strength is lost at a relatively faster rate than arm strength
- Activity may decrease the rate of decline, but will not completely prevent it
- The older muscle is more easily fatigued as well
Effects of Aging on Skeletal Muscle

- Muscle mass decreases in relation to body weight by about 30 to 50 percent in both men and women.
- The loss of muscle mass is not uniform; in general, the loss from the legs is greater than from the arms. Type I slow-twitch fibers are less affected by age than fast-twitch fibers.
- Increased time for muscle to contract in response to nervous stimuli.
- Reduced stamina.
- Increased recovery time.
- Loss of muscle fibers.
Figure 1: Skeletal Muscle Aging

Aging is associated with gradual loss of muscle mass and strength, a decline that begins as early as age 25.

There is more infiltration of fat into cells, and fast-twitch muscle fibres age at an accelerated pace compared to slow-twitch.

Factors that contribute to skeletal muscle aging include the decreased proliferative ability of muscle cells and the adverse effects of oxidative stress, which can cause premature muscle aging.
Muscle

Recovery of older muscle after injury is slowed and frequently incomplete

- Old muscles transplanted into young animals regenerate fairly well.
- Muscles taken from young animals and transplanted into old ones do not regain mass and generate force as effectively.
Bones

- Decline in bone mass is ~0.5%/year in healthy older people.
- Age-related changes in women are compounded by menopausal changes in bone mass and function.
- Vitamin D deficiency, common in older people, further accelerates bone loss.
- Once bones fracture, the repair mechanisms are impaired in aging.
Skin

- The ability to deliver heat to the skin for excretion is impaired
- Loss of subdermal fat decreases insulation and the ability of older people to conserve heat
- Tonic vasoconstriction in many older adults, as well as decreases in both number and production of sweat glands, also contribute to impaired thermoregulation with age
Improving physical function and blood pressure in older adults through cobblestone mat walking: a randomized trial.


- 108 physically fit adults aged 60-92
- Participants were randomized to a cobblestone mat walking condition (n=54) or regular walking comparison condition (n=54) and,
- Participated in 60-minute group exercise sessions, 3x per week for 16 consecutive weeks.

Cobblestone mat walking improved physical function and reduced blood pressure to a greater extent than conventional walking in older adults.
Spinal extension exercises prevent natural progression of kyphosis

J. M. Ball . P. Cagle . B. E. Johnson. C. Lucasey . B. P. Lukert


- **Part 1**
  - Measured kyphosis of 250 women between ages 39-79
  - Found the greatest change in the angle of kyphosis occurs during the decade between 50-60 years of age

- **Part 2**
  - studied the effect of performing exercise on improving the kyphosis in women age 50-60
  - all women were instructed in a set of nine exercises to strengthen the extensor muscles of the spine
Spinal Extension Exercises

- 81 women in the 50-60 age group:
  - 35 women had either performed the exercises consistently or not at all.
  - 15 of these women complied with the exercises three times a week
  - 20 did not do any of the exercises
Spinal Extension Exercise

A

B

C

D

E

F

G

H

I

J

K

L

Spinal Extension Exercise
Spinal Extension Exercise

- There was no difference between compliant and non-compliant groups in the baseline Cervical Depth.

- Cervical Depth decreased (improved) significantly (−.89±.11 cm, p=.05) in the compliant women.

- Thoracic area decreased (improved) in compliant women (−12.0±1.7 cm², p=.016).

- Height increased by 0.1±.05 cm in the compliant group while decreasing 0.1±.06 cm in the non-compliant group (p=.014).
Effect of Extension Exercises on Cervical Depth

Baseline

Change with exercises

p=.78

p=.0001
Effect of Extension Exercises on Thoracic Area

Baseline

Compliant: p = 0.73
Non-Compliant: cm²

Change with Exercises

Compliant: p = 0.0001
Non-compliant: cm²
Recommendations for Self Care
### Evidence for health benefits associated with regular physical activity (2008 Physical Activity Guideline)

<table>
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<th>Adults and older adults</th>
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<td><strong>Strong evidence</strong></td>
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<td>Lower risk of early death</td>
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<td>Lower risk of coronary heart disease</td>
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<td>Lower risk of stroke</td>
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<td>Prevention of weight gain</td>
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<td>Weight loss, particularly when combined with reduced calorie intake</td>
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<td>Improved cardiorespiratory and muscular fitness</td>
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<td>Prevention of falls</td>
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<td>Reduced depression</td>
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<td>Better cognitive function (for older adults)</td>
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<td>Better functional health (for older adults)</td>
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<td>Reduced abdominal obesity</td>
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<td><strong>Moderate evidence</strong></td>
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<td>Lower risk of hip fracture</td>
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<td>Lower risk of lung cancer</td>
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<td>Lower risk of endometrial cancer</td>
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<td>Weight maintenance after weight loss</td>
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<td>Increased bone density</td>
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<td>Improved sleep quality</td>
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The American Heart Association Recommendations for Physical Activity in Adults

For Overall Cardiovascular Health:

At least 30 minutes of moderate-intensity aerobic activity for a total of 150 minutes per week

OR

At least 25 minutes of vigorous aerobic activity for a total of 75 minutes per week

or a combination of the two

AND

For Lowering Blood Pressure and Cholesterol:

An average of 40 minutes of moderate-to-vigorous-intensity aerobic activity for 3 or 4 days per week

© 2015 Learn more at heart.org/ActivityRecommendations.
10-point scale of perceived exertion

- **10**: All-out effort
- **9**: Vigorous-intensity effort
- **8**: Large increase in heart rate and breathing
- **7**: Moderate-intensity effort
- **6**: Moderate increase in heart rate and breathing; can "talk" while "walking"
- **5**: Light-intensity effort
- **4**: Slew walking with frequent stopping
- **3**: Sitting
- **2**: No movement

Aging and Vision
Claudine Wujcik, MS, OTR/L
- Vision or **visual acuity** is tested by reading a **Snellen eye chart** at a distance of 20 feet.

- If you have **20/20 vision**, it means that when you stand 20 feet away from the chart you can see what a "normal" human being can see.
Aging Eye

- **Normal** age related eye changes begin at age 40.
  - The **lens** becomes **less elastic**. It loses its ability to change shape.

- Getting older also means that your are more likely to have vision changes due to an illness or disease.

- **Legal blindness** is usually defined as visual acuity **less than 20/200 with corrective lenses**.
Normal Eye Changes

- **Nearsightedness (myopia)** is when a person is able to see near objects well and has difficulty seeing objects that are far away.

A person is able to see near objects well and has difficulty seeing objects that are far away.
Normal Eye Changes

- **Farsightedness (hyperopia)** is when a person is able to see distant objects well and has difficulty seeing objects that are near.
Normal Eye Changes

- **Astigmatism** is an uneven curvature of the cornea and causes a **distortion** in vision.
Cataracts are a cloudiness in the lens that blocks light from reaching the retina.
Macular degeneration occurs when the macula (fine detail in central vision) deteriorates for unknown reasons.

Loss of central vision.
Aging Eye – Medical Concerns

- **Glaucoma** occurs if the aqueous humor does not drain out correctly. Pressure builds up in the eye, results in **tunnel vision**.
Medical Diagnosis

**Trauma**
- Direct trauma or chemical injuries can cause damage to the eyes and prevent adequate vision

**Diabetes**
- Diabetic Retinopathy
  - blockage, leakage and scarring of blood vessels in the eye that can lead to blindness

**High Blood Pressure**
- Hypertensive Retinopathy
  - narrowing of eye blood vessels causes vision deficits/loss and spots on the retina known as cotton wool spots
  - Swelling of the macula or optic nerve
**Medical Diagnosis**

**Stroke/CVA**
- Hemianopsia – visual field loss
- Cortical blindness
- Scotoma – blind spot
- Diplopia – doubled vision
- Loss central/tunnel or peripheral vision
- Vertigo – dizziness
- Nystagmus (random eye movements)
- Light sensitive

**Brain Injury**
- Damage to brain, usually occipital lobe(s)

**Multiple Sclerosis**
- Nerve damage causes inflammation in the eye
- Optic neuritis - inflammation of optic nerve disrupts central vision
- Diplopia
- Loss of seeing contrasting or vivid colors
- Nystagmus
- Blurred vision
When to see an Occupational Therapist

Compensatory Strategies

Home

- **Proper lighting**
  - Night lights, flashlights, desk lamps, sit with back toward window
- Change the environment to make it **safe**
- **Contrasting colors**
  - Stairs, kitchen, bathroom, bedroom, household products

- Labeled **tray dividers**
- Hang clothes by **color** and use different **color hampers** for different color clothes
- Use **microwave** if unsafe to use stove
- Keep everything **in its place**
When to see an Occupational Therapist
Compensatory Strategies

**Everyday**

- **Visual Scanning & Tracking** – Turn head right and left
- Know your **environment**
- **Organize** grocery list by isles
- Ask pharmacist to print **larger labels** or wording

- **Pill organizer** or make each bottle different (Velcro)
- **E-reader**
- **Large print** checks
- **Colored** pen/paper
- Use **magnifiers**
Keep Eyes Healthy

- **American Academy of Ophthalmology** recommends -
  - By **age 40** everyone should have a comprehensive dilated eye exam to establish a baseline for eye health.
  - After **age 65** you should have your eyes checked every one to two years.

- **Comprehensive Eye Exam** detects early signs of various eye problems
  - Many age-related eye diseases have **no symptoms** until they're at advanced stages.
  - If you are **at high risk** for eye disease, such as having diabetes, visit your eye doctor yearly, no matter your age.
Everyday Eyes

- Stay active, sleep
- Control blood pressure and diabetes
- No smoking
- Healthy weight - diet rich in fish and leafy, green vegetables like spinach and kale

Outdoor activities -
- Sunglasses that block ultraviolet rays
- Wide-brim hat

Protective eyewear - when participating in sports, work or hobbies that can cause eye injury
References

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Aging and Cognition
Heather Egnor, MS, CCC/SLP
Anatomy of the Brain
Change in Brain Structure

- Volume of the brain decreases 7 cm³ per year after 65
- Greatest loss in the frontal and temporal lobes
- Greater loss of white matter than grey matter
- Cerebral blood flow decreases heterogeneously by 5-20 percent
Neuron Anatomy

Figure 1: Anatomy of a neuron

http://www.lef.org/~media/lef/images/protocols/images/cognitive-decline_01-big.ashx
Neuron Loss by Brain Structure

- Most prominent in the cerebellum and cerebral cortex
- Hypothalamus, pons, and medulla have modest if any loss
- Loss is related to programmed cell death (apoptosis) rather than inflammation or ischemia
- Neurons also get smaller
Changes in Cognition – Preserved skills

- Procedural memory (skills, ability that are overlearned)
- Primary memory (knowledge that is overlearned)
- Semantic memory (vocabulary)
- Remain stable or improve through the seventh decade, but then decline
- Ability to recognize familiar objects or faces and maintain appropriate visual perception is stable throughout the lifetime
Changes In Cognition – Skills susceptible to decline

- Episodic memory (remembering events)
- Working memory (mental calculations)
- Executive function (necessary for a person to manage IADLs)
- Processing speed
- Attention span (especially in distraction)
- Rapid alternating attention (multitasking)
- Problem solving
- Processing and learning new information
- Naming objects
- These changes occur after age 70
The Great News!

- Despite measurable changes on cognitive testing, the successful 95 year old remains able to function in society, the work place, and at home!
- Few real-life situations require performance at maximum level
Risk of Further Deterioration: The Impact on IADLs

- Instrumental Activities of Daily Living
  The activities that people do once they are up, dressed, put together. These tasks support an independent lifestyle. Many people can still live independently even though they need help with one or two of these IADLs.
IADLs

- Cooking/preparing meals (sequencing tasks, measuring ingredients)
- Driving/handling transportation
- Getting around the community
- Using the telephone or computer
- Shopping (making lists, finding items in the store)
- Keeping track of finances (budgeting, paying bills and writing checks)
- Managing medication (keeping track of medications and taking them as prescribed)
- Using communication devices
- Making and keeping appointments
MCI (Mild Cognitive Impairment)

Per the American College of Physicians, MCI affects approximately 20% of persons over 70 years old.

The potential causes of MCI are similar to that of Alzheimer’s, the only real difference is the limited EXTENT of change in MCI vs Alzheimer’s.

A person may never progress and eventual is considered “normal” – e.g. his age group catches up with him in forgetfulness!

However, 12-15% of persons with MCI convert to Alzheimer’s disease each year for that cohort.
Dementia Types

Not all dementias are the same!

- Alzheimer’s Dementia
- Vascular Dementia (multi-infarct dementia)
- Dementia with Lewy Bodies
- Dementia related to Parkinson’s Disease
- Frontotemporal Dementia (e.g. Pick’s disease, PPA)
- There are 60-90 other diseases that have a kind of dementia as a possible component
Alzheimer’s Dementia

- Most common: accounts for 60-80%
- Clinical symptoms in the later stages include memory impairment, impaired judgment, disorientation, confusion, and trouble speaking, swallowing and walking
- Additionally, behavioral problems that develop as a result of the neuropathology (e.g., paranoia, hallucinations, and repetitiousness) may interfere with communication.
Midsagittal Section of Normal Brain and Brain with Alzheimer’s

[Image of a brain showing normal and Alzheimer's sections with highlighted areas for language and memory]
Vascular Dementia

- Second most common type of dementia
- Impairment caused by decreased blood flow to various parts of the brain (small or large infarcts)
- Associated with usual vascular risk factors: DM, HTN, hyperlipidemia, CVA, CAD
- Symptoms often overlap with those of Alzheimer’s, although memory might not be as effected
- Initial impairment is likely to be executive dysfunction rather than a memory impairment (e.g. making a poor financial planning decision, poor organizational skills, etc)
- Associated with depression and apathy
Dementia – Uncontrollable Risk factors

- Age
- Genetic factors
- MCI
- Inflammatory Markers
Dementia – Controllable Risk Factors

- Cardiometabolic Risk Factors
  - Hypercholesterolemia
  - Diabetes Mellitus
  - Hypertension
  - Etc
How Can I preserve my abilities?

- Long-term regular physical activity, including walking, is associated with significantly better cognitive function and less cognitive decline in older women.

- “Cognitive training” activities for older adults have been shown to decrease decline in ability to perform IADLs. They can also lead to gray matter volume increases in the “exercised” areas.
How Can I Preserve My abilities?

- Visit new places
- Revisit or start new hobbies
- Play along with game shows or play board games
- Learn a new language
- Call someone you haven’t spoken to in a while
- Improve your computer literacy
- Discuss newspaper or TV news stories
- Write your life story
- Take a new path when taking a walk or driving somewhere
- Try reading a different genre (e.g. historical fiction instead of romance)
- Volunteer!
- Try doing things with your nondominant hand
- Try thinking games and puzzles… Not just word searches or crosswords or even Sudoku…
How Many Squares?

- 16?
- 20?
- 21?
- 30?
- 64?
Take Home Points

- Exercise for your body AND your brain!
- Control those risk factors you can control—primarily through diet and exercise.
- You can relearn and safely perform your daily activities such as: bathing, dressing, cooking, paying bills, shopping, etc.
- Consider seeing a Physical Therapist, Occupational Therapist, or Speech Language Pathologist if you notice a decline in your ability to perform your daily activities.

Thank You for Coming!