



Kin-age-ilogy

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Objectives

What is Kin-
age-iology?

Aging Curves
– How can we
bend them?

**Senescent
Changes with
Aging**

FUNCTION
Assessment

What is Kin-age-iology?

Kin-age-iology is Brian's new term to using the principles and practices of Kinesiology to help successfully age.

What is Successful Aging?

The process of growing older and actively engaging in life while maintaining physical health, cognitive abilities, and strong social relationships.



Aging Curves: Muscle Fiber Changes

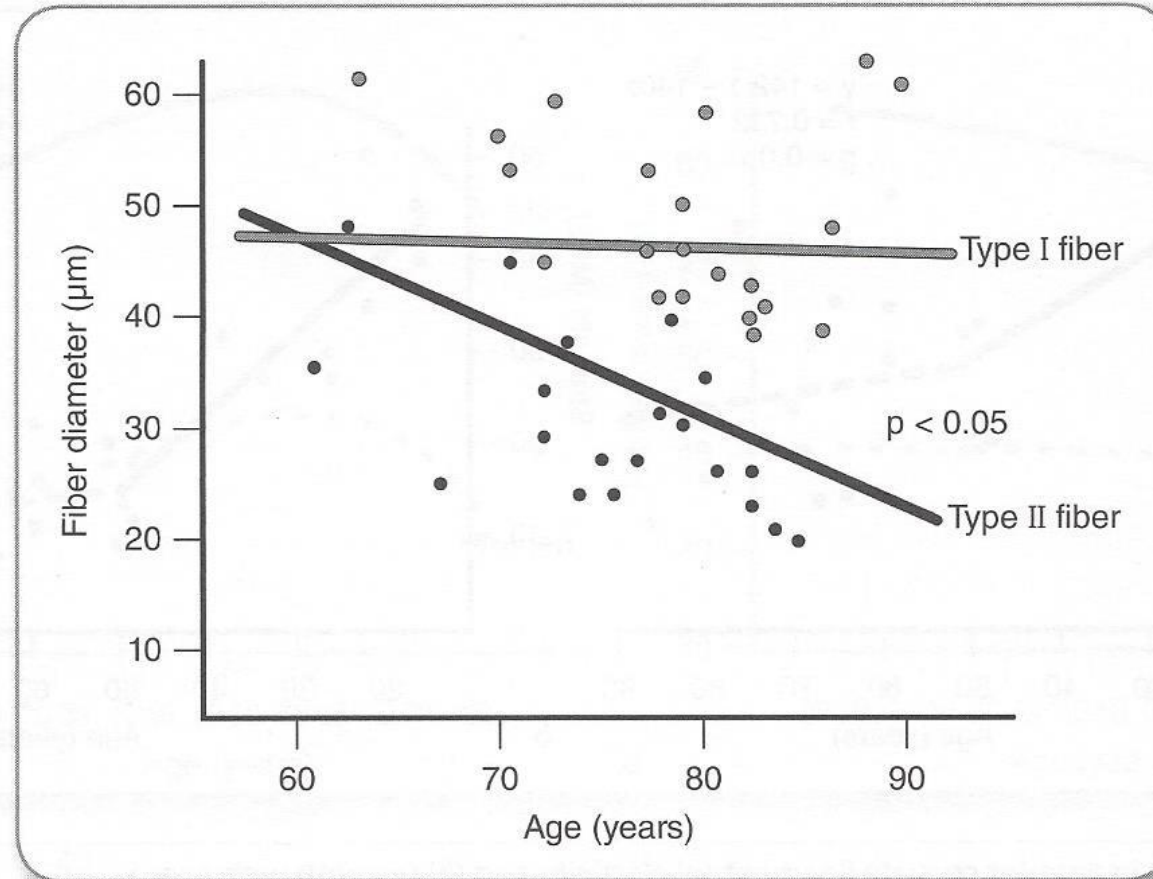


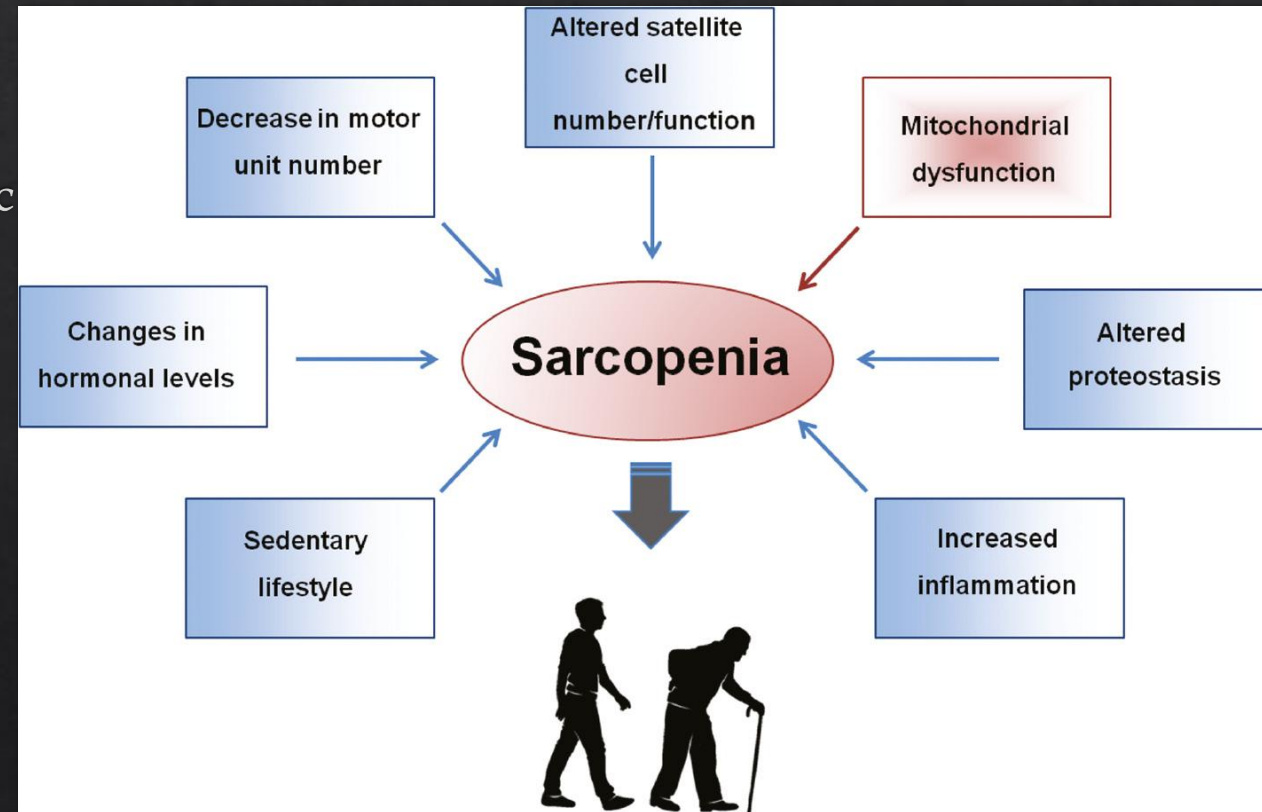
Figure 1.3 The age-associated patterns of change in mean cross-sectional areas of type II (fast-twitch) and type I (slow-twitch) muscle fibers. Data are from the vastus lateralis muscles of men 15 through 83 years of age.

Data from Lexell, Taylor, and Sjostrom 1988.

Signorile, J.,
2011)

Implications of Muscle Amount, Strength, and Power loss

- ◇ Sarcopenia
- ◇ Type 2 muscle fibers denervated and then reinnervation by type 1 motor units + decreased use of powerful movements + the other items in the pic to the right = **strength and power loss**
- ◇ Inability to complete **ADL's**.
- ◇ **Muscle power loss** affects the ability to prevent a catastrophic fall.
- ◇ **Slow walking speeds**, inability to rise from a chair, poor endurance and higher risk of disability.
- ◇ **Muscles are the body's primary reserve of amino acids. Loss of muscle mass will affect your immune system.**
 - 10% depletion = higher infection risk
 - 20% depletion – decreased wound healing/weakness / greater risk of infection.
 - 30% depletion – catch pneumonia / bed sores/ even less healing capacity
 - 40% depletion – death looms / pneumonia overtakes



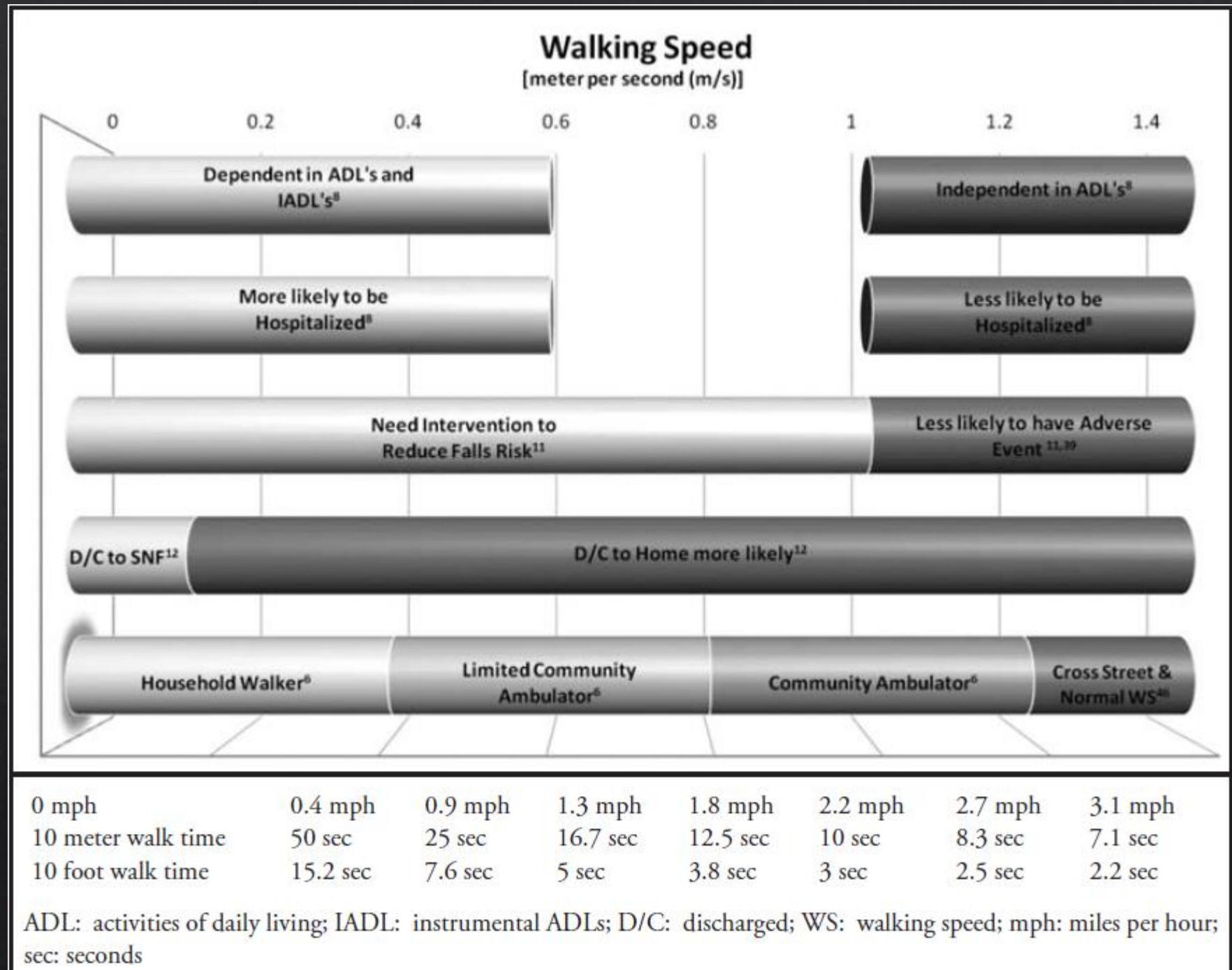
Walking Speed Threshold:

1.8 mph

2.7 mph – crossing street

3.1 mph – ADLs in dependent

Below 2.2 mph (1 m/s) = higher risk for cognitive decline and dementia.



Aging Curves – Muscle Amount

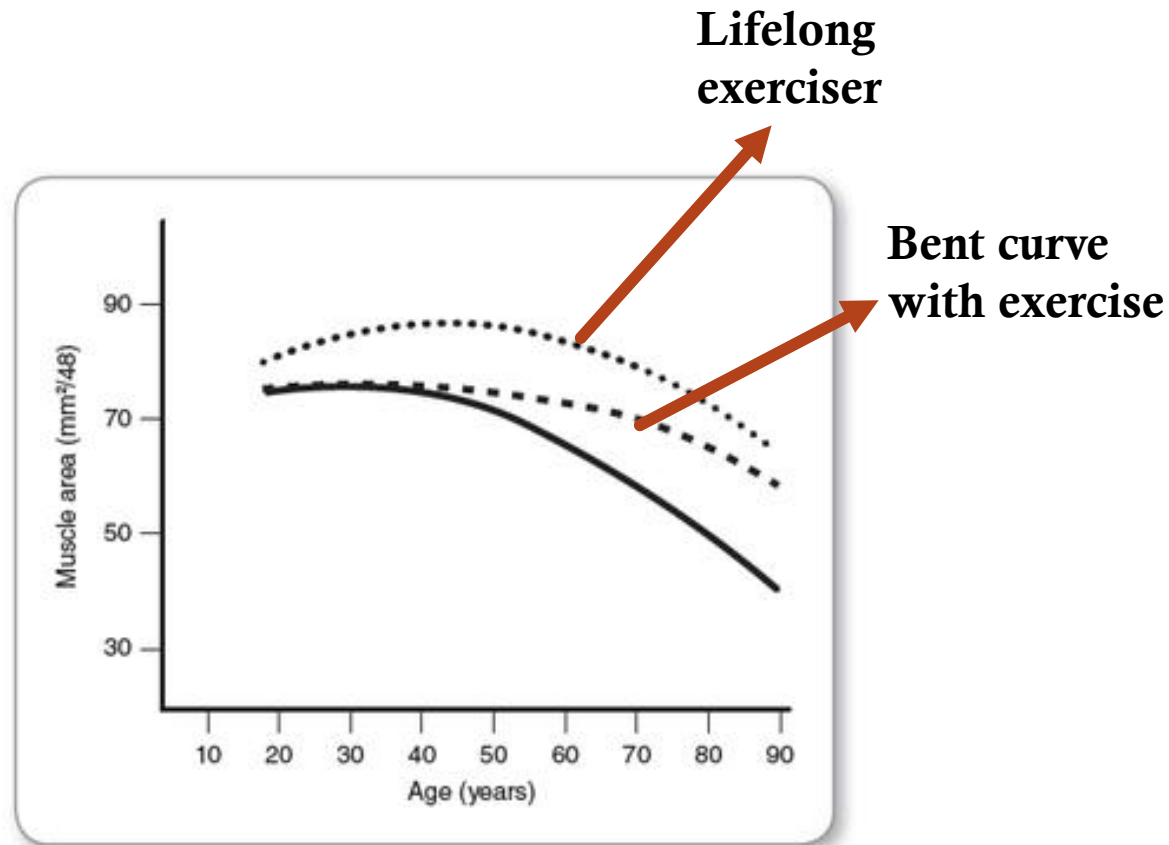


Figure 1.10 The capacity of exercise to "bend the aging curve" using the neuromuscular aging curve as an example. The long solid line shows the neuromuscular aging curve as originally presented in figure 1.2a. The dashed line shows how that curve may be "bent" through exercise training. The dotted line shows what an aging curve might look like for a person who has been a lifelong exerciser.

Aging Curves: Bone Mineral Changes

Signorile, J.,
2011)

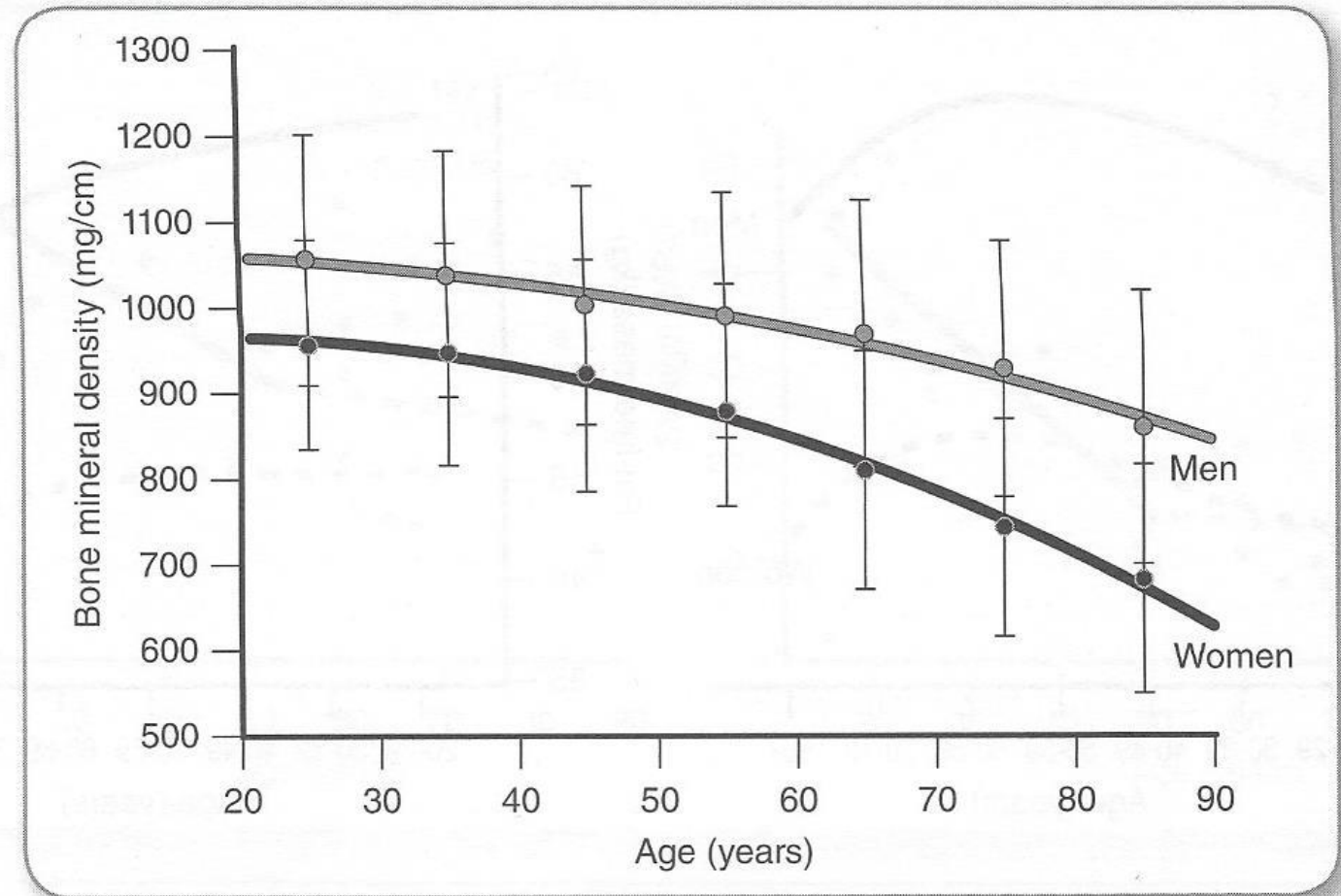


Figure 1.6 Declines in bone mineral density across age for men and women.

Data from Department of Medicine, University of Washington.

Aging Curves: Ligament Strength

Load at failure is less in ligaments with age.

Signorile, J.,
2011)

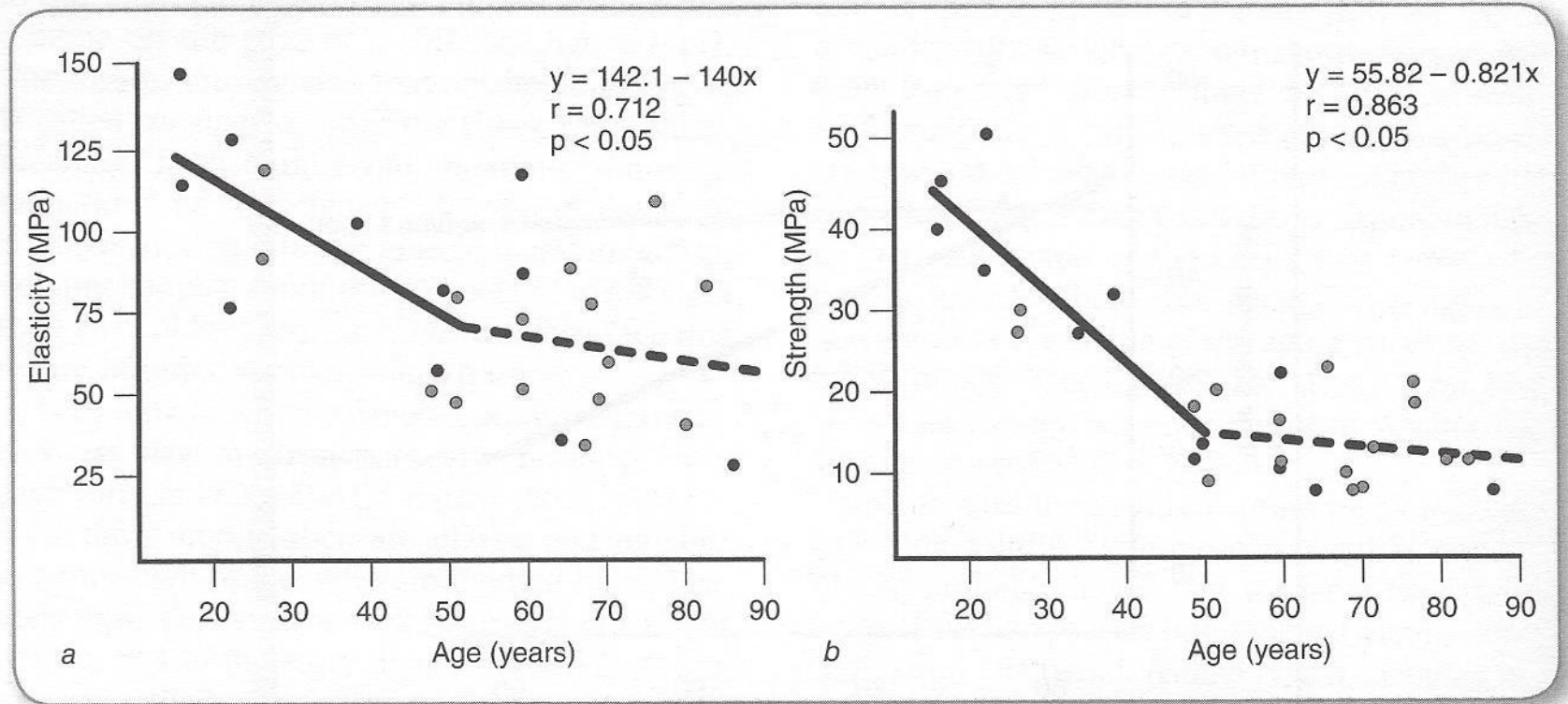


Figure 1.4 Changes in anterior cruciate ligament (a) elasticity and (b) strength with age.

Reprinted, by permission, from F.R. Noyes and E.S. Grood, 1976, "The strength of anterior cruciate ligament in humans and rhesus monkeys: Age-related and species-related changes," *Journal of Bone and Joint Surgery* 58A: 1074-1082.

Aging Curves: Cardiovascular fitness ($\dot{V}O_2$ Peak)

Signorile, J.,
2011)

$\dot{V}O_2$ Max declines 10% per decade
after the age of 40.

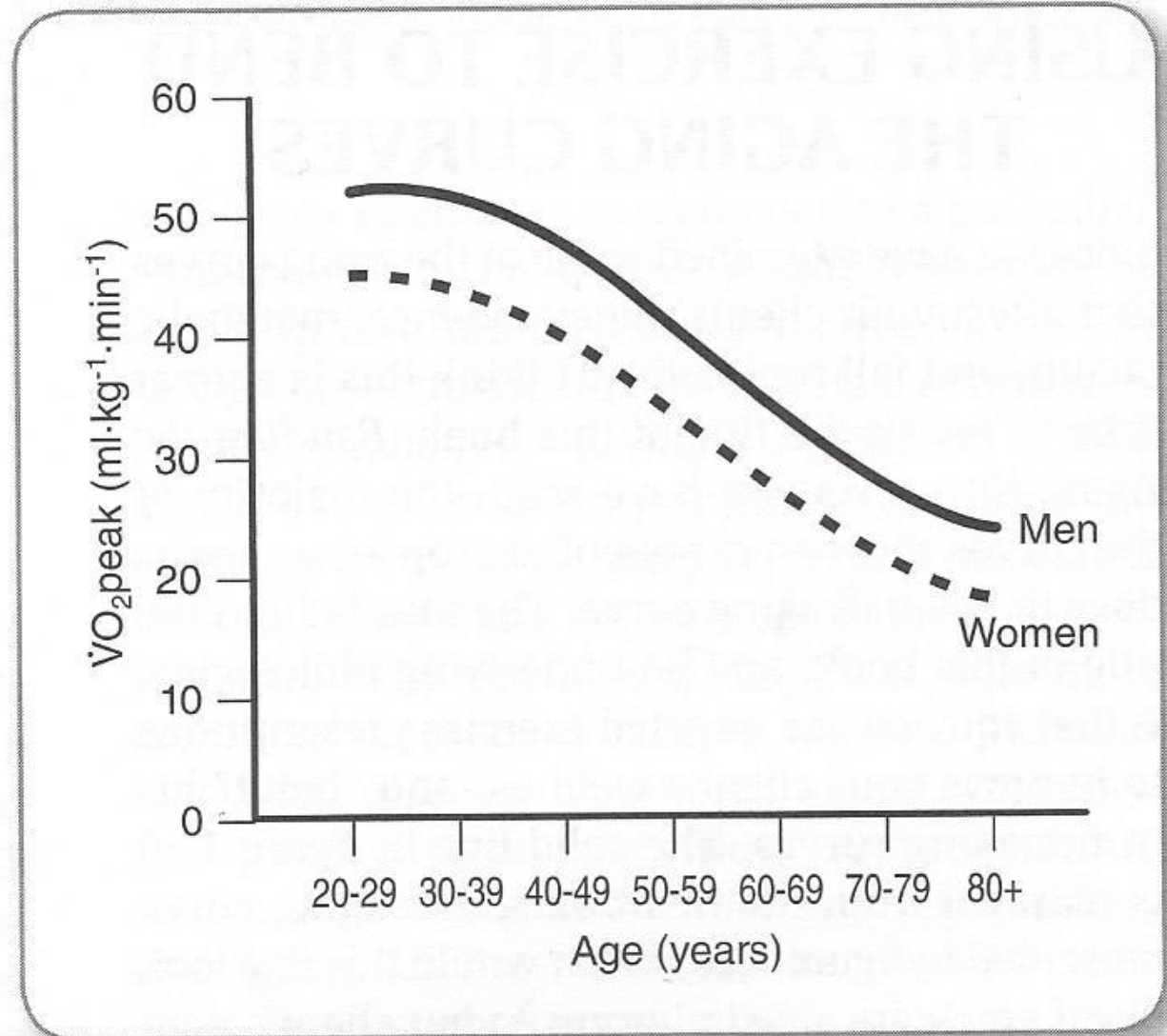
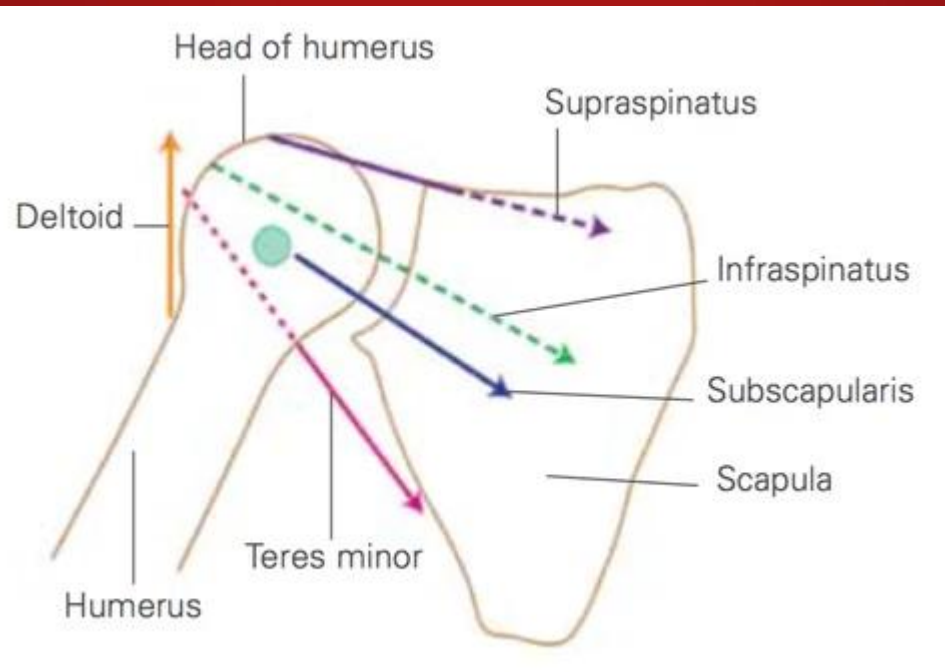


Figure 1.8 Declines in $\dot{V}O_2$ peak relative to body weight in men and women across age groups.



Senescent Changes: Shoulders

- ▶ Depth of the glenoid labrum decreases with age.
- ▶ Decrease in range of motion by a few degrees.
- ▶ Degeneration of rotator cuff tendons. Leads to pain and weakness in the acromion region, biceps anteriorly, deltoid, or mid humerus.
- ▶ Active and passive range of motion in internal rotation decreases with age.
- ▶ Degenerative changes in the **acromioclavicular joint** are common with increasing age.



Senescent Changes: Knee

Declining vascular supply and nutrition in the meniscus – gives rise to complex tears.

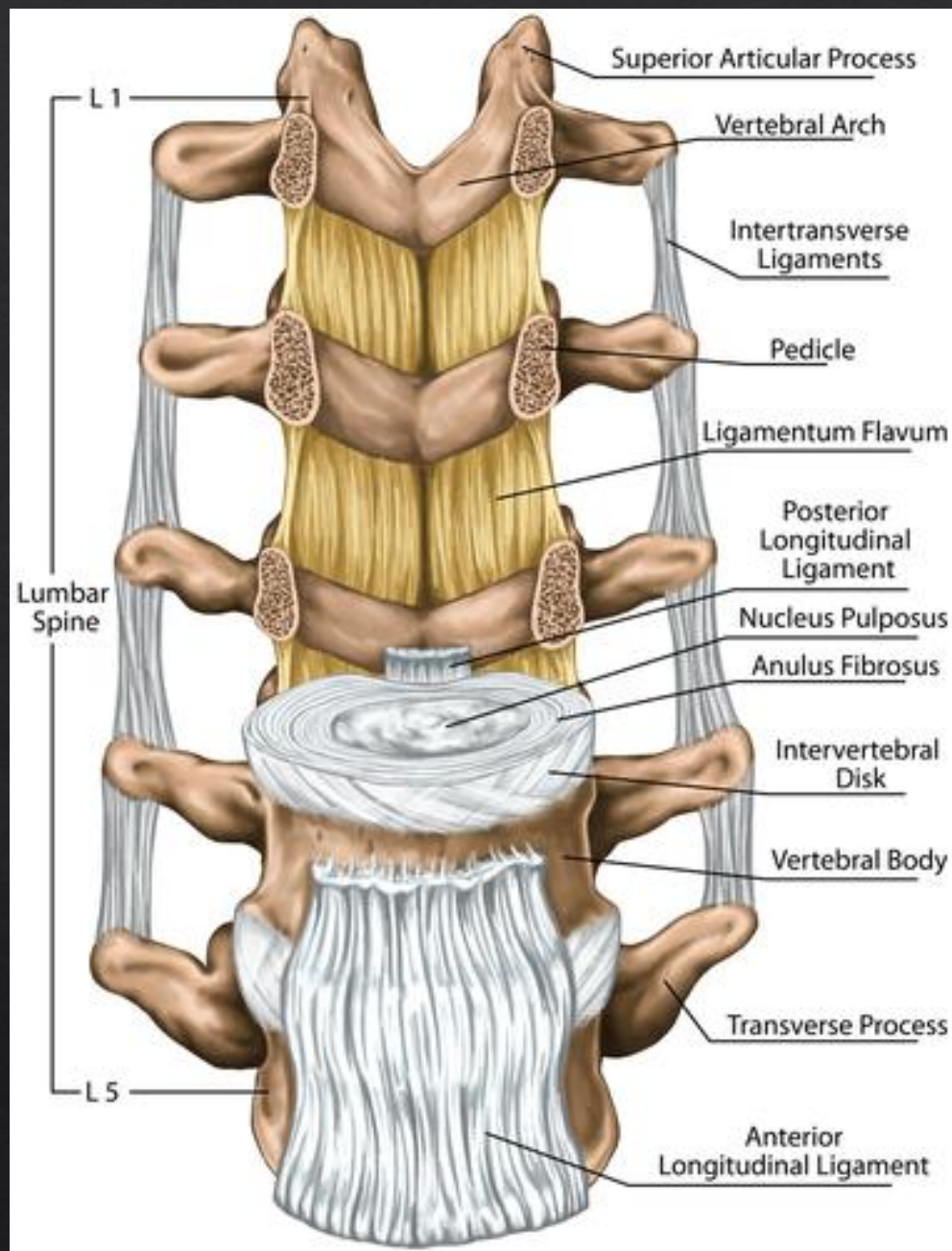
Osteoarthritis may be an issue.

Important to observe the mobility of the hip and ankle joints.

Senescent Changes: Spine

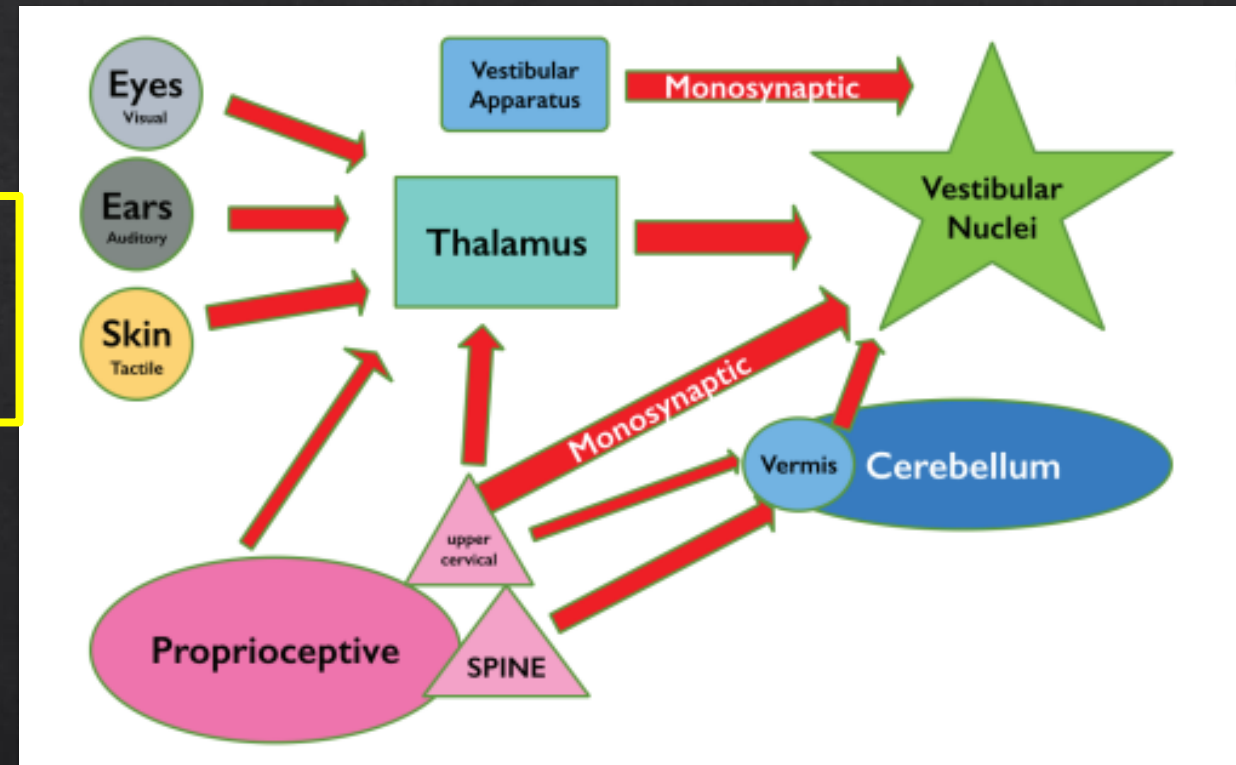
Segmental
Instability

Bony overgrowth
attempts to restore
stability but also
leads to spinal
stenosis.



- Between the ages of 35-60 there is a steady loss of brain volume of approximately 0.2%/ year. Then accelerates to 0.5% after age 60!
- Blood flow to the brain decreases due to gradual cerebral artery narrowing. **Increase stroke risk.**
- Changes in neurotransmitters.
- BDNF (Brain-derived neurotrophic factor) decreases with age. (Implications – neuroplasticity/neuron survival/ and new memory circuit growth in Hippocampus!)**
- Vision, hearing, touch, smell, taste, and vestibular declines. The Vestibular nuclei are the information hub. Look at all the inputs!
- Decline in proprioception, therefore.
- Changes in nervous system function are affected by nutrition status and physical inactivity.
- Cognition (attention/memory/learning/problem solving/decision-making) declines can vary. Fluid intelligence is most affected by normal aging. Crystallized intelligence can improve up until mid 50's and stays constant till mid-70's. **Deficits mainly show when pathological dementia occurs.**

Nervous System Changes

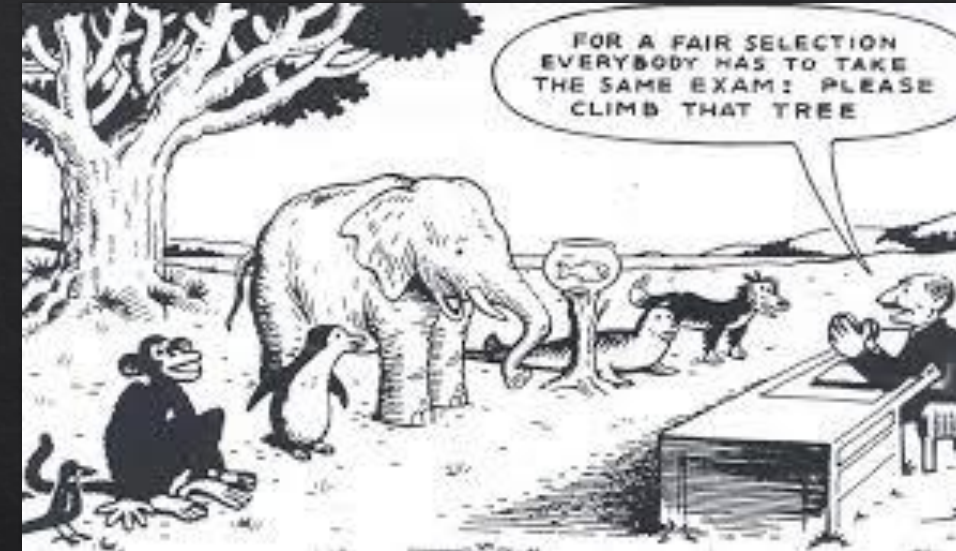


Pic: Original Strength

Fluid intelligence – problem solving and reasoning
Crystallized intelligence – vocabulary, acquired knowledge, and facts.

FUNCTION Assessment (Fulton, 2026)

- ◇ Health span and longevity depend on two overarching levers – **disease deferral** (delays onset or slows the progression of chronic disease) and **functional extension** (physical and cognitive capacities and **reserve**).
- ◇ **Physical reserve** is comprised of:
 1. Muscle fibers and motor units (recruit & coordination)
 2. Mitochondrial density and efficiency (energy, endurance, and recovery)
 3. Cardiovascular Efficiency (heart, BV's, oxygen delivery and use)
 4. Metabolic flexibility (glucose control and fuel switching efficiency)
 5. Neural Processing Speed (balance, reaction time, and coordination)
 6. Low chronic inflammation (tissue response improves, signalling is clearer, and recovery is quicker)



Fitness vs Function

- ◇ **VO₂ Max** is touted as the gold standard predictor for lifespan. It is a powerful one!
- ◇ It is a composite metric (captures many systems at once) – reflects performance of the lung, heart, blood vessel, mitochondria, muscle and psychological tolerance of effort.
- ◇ However, it is not about one metric but an integration of the 5 main domains that improve longevity otherwise we would see elite performers dominating longevity stats.



FUNCTION Tier of Tests (Fulton, 2026)	Domain	Tier 1 - Essentials	Tier 2 – Greater Insight	Tier 3 – Avenger Advanced Integration
	Strength and Power	30 sec. Chair Stand Stair Climb**	Vertical Jump Push –ups Grip Strength	Weighted Carry Dead Hang Hand grip Endurance
	Cardiovascular and Recovery	6- min. Walk** Resting Heart Rate	3-minute Step Rockport 1 mile Walk 12- minute Run/Walk	Submaximal Treadmill VO ₂ VO ₂ Max Field Test Lab VO ₂ Max Test Heart Rate Recovery
	Mobility and Balance	Single leg stand Gait speed	Timed Up and Go Sit-Rise Tandem Walk	SLB (eyes closed) 360 deg. Turn Tri-toe reach Single leg squat
	Flexibility and Structure	Hamstring Flexibility Spinal Rotation	Shoulder Flexibility Chest Expansion Seated Sit and Reach	Standing forward reach Hip Flexor Length Deep Squat Mobility
	Neuromotor and Cognition	Ruler Drop Reaction Time Color-Card ** not today	Walk and Talk Finger Tap Speed Clock Drawing	Ball Toss/Catch with Cognitive Load Dual Task Gait Target Reaction Go/No-go Trail Making A or B

Resting Heart Rate

Resting Heart Rate (RHR)						
Units: beats per minute (RHR)						
Age	Female			Male		
	Median	75th	90th	Median	75th	90th
40-44	70	64	58	68	62	56
45-49	70	64	58	68	62	56
50-54	71	65	59	69	63	57
55-59	71	65	59	69	63	57
60-64	72	66	60	70	64	58
65-69	72	66	60	70	64	58
70-74	73	67	61	71	65	59
75-79	74	68	62	72	66	60
80-84	74	68	62	72	66	60
85-89	75	69	63	73	67	61
90+	76	70	64	74	68	62

number. Track changes over time—trends tell the real story.

Single Leg Stand

One-Leg Stand Test (Balance, Eyes Open)

Units: seconds maintaining balance on one leg (max 45 seconds)

Age	Female			Male		
	Median	75th	90th	Median	75th	90th
40-44	40	43	45	41	44	45
45-49	38	42	45	39	43	45
50-54	36	40	44	37	41	44
55-59	33	38	42	34	39	43
60-64	30	36	41	31	37	42
65-69	27	33	39	28	34	40
70-74	23	29	36	24	30	37
75-79	19	25	32	20	26	33
80-84	15	21	28	16	22	29
85-89	12	18	25	13	19	26
90+	9	15	21	10	16	22

30 Sec. Chair Stand

30-Sec Chair Stand (30-Second Sit-to-Stand)						
Units: Count repetitions in 30 seconds						
Age	Female			Male		
	Median	75th	90th	Median	75th	90th
40-44	18	21	25	20	23	27
45-49	17	20	24	19	22	26
50-54	16	19	23	18	21	25
55-59	15	18	22	17	20	24
60-64	14	17	21	16	19	23
65-69	13	16	20	15	18	22
70-74	12	15	19	14	17	21
75-79	11	14	18	13	16	20
80-84	10	13	17	12	15	19
85-89	9	12	16	11	14	18
90+	8	11	15	10	13	17

Toe Touch Test

Hamstring Flexibility (ART / Fingertip-to-Floor)						
Units: cm distance from fingertips to floor ("- " = gap, "+" = beyond floor)						
Age	Female			Male		
	Median	75th	90th	Median	75th	90th
40-44	-2	0	4	-3	0	3
45-49	-3	-1	3	-4	-1	2
50-54	-4	-2	2	-5	-2	1
55-59	-5	-3	1	-6	-3	0
60-64	-6	-4	0	-7	-4	-1
65-69	-7	-5	-1	-8	-5	-2
70-74	-8	-6	-2	-9	-6	-3
75-79	-9	-7	-3	-10	-7	-4
80-84	-10	-8	-4	-11	-8	-5
85-89	-11	-9	-5	-12	-9	-6
90+	-12	-10	-6	-13	-10	-7

Spinal Rotation Test

Spinal Rotation Test						
Units: degrees of trunk rotation from seated position						
Age	Female			Male		
	Median	75th	90th	Median	75th	90th
40-44	40	45	50	42	47	52
45-49	39	44	49	41	46	51
50-54	38	43	48	40	45	50
55-59	37	42	47	39	44	49
60-64	36	41	46	38	43	48
65-69	35	40	45	37	42	47
70-74	34	39	44	36	41	46
75-79	33	38	43	35	40	45
80-84	32	37	42	34	39	44
85-89	31	36	41	33	38	43
90+	30	35	40	32	37	42

How to Improve the Tier 1 Domain Tests

Domain	Tests	Physical Activities to Improve
Strength and Power	30 sec. Chair Stand	Squats, Step ups, lunges, Chair stands (5 reps to start.
	Stair Climb	Use stairs regularly.
Cardiovascular and Recovery	6-Minute Walk	Brisk walks (3-5x /week)
	Resting Heart Rate	Aerobic conditioning, sleep, hydration
Mobility and Balance	Single Leg Stand	Foot/ankle strength and single leg activity
	Gait speed	Walk with purpose (aerobic intervals), leg strength, and balance activities
Flexibility and Structure	Hamstring Flexibility	Posterior leg flexibility / ab and gluteal strength
	Spinal Rotation	Gentle Spinal Twists
Neuromotor and Cognition	Ruler Drop Reaction Time	Practice catching small objects/ Walk and respond drills/ boxing target mitt drills
	Color card	Stroop activities / Timed puzzles/ Concentration grids

What the Percentiles Mean

Percentiles are forecasts showing :

- ◇ How much reserve you have
- ◇ Above the minimum needed for daily life
- ◇ How long that reserve is likely to last as normal age-related decline unfolds

The lower your percentile the earlier you reach the critical threshold that may affect your independence for an activity. GOAL for each Test is to eventually reach the 75th percentile and stay there or rise above.

Percentile	Time for a flight of stairs	Speed to safely cross the street	Rising from a chair with no hands	Standing on one leg to dress oneself
25th	Mid 70s	Early 70s	Early 70s	Mid 70s
50th	Early 80s	Early 80s	Early 80s	Late 80s
75th	Mid 90s	Early 90s	Late 80s / Early 90s	In to their 90s

**Wendy Ida
61 years old**



Got into fitness at 43

**Ernestine Shepherd
75 years old**



Started working out at 56



Questions?

