FITNESS ASSESSMENT IN OLDER ADULTS

Faculty of Sport Studies

PHYSICAL ACTIVITY IN OLDER ADULTS

- **Goals**
  - Maintaining self-sufficiency
  - Maintaining or improving the quality of life
  - Slowing down aging processes and their manifestations

PHYSICAL FITNESS IN OLDER ADULT

- the ability to perform activities of daily living (**ADL**) and instrumental activities of daily living (**IADL**) safely and without becoming unduly fatigued.
    - Activities of daily living (ADL) are basic tasks that must be accomplished every day for an individual to thrive (personal hygiene, continence management, dressing, feeding, ambulating - the extent of a person's ability to change from one position to the other and to walk independently.
    - Instrumental activities of daily living (IADL) are somewhat more complex but nevertheless also reflect on a person's ability to live independently and thrive (transportation and shopping, preparing meals, managing a person's household, managing medications, communicating with others, managing finances)

COMPONENTS OF PHYSICAL FITNESS

- Cardiorespiratory endurance
- Musculoskeletal fitness
- Body weight and body composition
- Flexibility
- Balance

CARDIORESPIRATORY ENDURANCE

- ability to the heart, lungs, and circulatory system to supply oxygen and nutrients efficiently to work muscles.
- **Assessment**
  - To measure the maximum oxygen consumption (V02max),
  - or the rate of oxygen utilization of the muscles during aerobic exercise, in order to assess cardiorespiratory endurance and functional aerobic capacity. Physical fitness evaluations should include a test of cardiorespiratory function during rest and exercise. Graded exercise tests (GXTs) are used for this purpose.
  - 6-minute walking test (easy to use in practice)
  - 2-minute step test

The 6 minute walk test - 6MWD

The 6MWD is a sub-maximal exercise test used **to assess aerobic capacity and endurance**. The distance covered over a time of 6 minutes is used as the outcome by which to compare changes in performance capacity.

6 Minute Walk Test Distance Conversion Table
Standard estimates from 6MWD (feet walked) to METs
Based on ACSM metabolic prediction equation formula for horizontal walking.*

Distance in feet	Distance in meters	MPH	Meters ·min-1	VO2(ml·kg-1·min-1)	METs
500	152	.94	25	6.04	1.73
510	155	.96	26	6.09	1.74
520	159	.98	26	6.14	1.75
530	162	1.00	27	6.19	1.77
540	165	1.02	27	6.24	1.78
550	168	1.04	28	6.29	1.80
560	171	1.06	28	6.35	1.81
570	174	1.08	29	6.39	1.83
580	177	1.10	29	6.45	1.84
590	180	1.11	30	6.50	1.86
600	183	1.13	30	6.55	1.87
610	186	1.15	31	6.59	1.89
620	189	1.17	32	6.65	1.90
630	192	1.19	32	6.70	1.91
640	195	1.21	33	6.75	1.93
650	198	1.23	33	6.80	1.94

MUSCULOSKELETAL FITNESS

- to the ability of the skeletal and muscular systems to perform work. This requires muscular strength, muscular endurance, and bone strength. Muscular strength is the maximal force or tension level that can be produced by a muscle group; muscular endurance is the ability of a muscle to maintain submaximal force levels for extended periods; bone strength is directly related to the risk of bone fracture and is a function of the mineral content and density of the bone tissue. Resistance training is one of the most effective ways to improve the strength of muscles and bones and to develop muscular endurance.

MUSCULOSKELETAL FITNESS ASSESSMENT

- The measurable variables are mass, strength and physical performance.

Variables	Measurement techniques
Muscle mass	Dual energy X-ray absorptiometry (DXA)
	Bioimpedance analysis (BIA)
Muscle strength	Handgrip strength
	Arm Curl
	Knee flexion/extension
Physical performance	Usual gait speed
	Chair stand
	Foot up and go

MUSCLE MASS ASSESSMENT

- A wide range of techniques can be used to assess muscle mass. Cost, availability and ease of use can determine whether the techniques are better suited to clinical practice or are more useful for research.
- Dual energy X-ray absorptiometry (DXA) is one of the methods for research and also clinical use to distinguish fat, bone mineral and lean tissues. This whole-body scan exposes the patient to minimal radiation. The main drawback is that the equipment is not portable, which may preclude its use in largescale epidemiological studies.
- Bioimpedance analysis (BIA) estimates the volume of fat and lean body mass. The test itself is inexpensive, easy to use, readily reproducible and appropriate for both ambulatory and bedridden patients.

MUSCLE STRENGTH ASSESSMENT

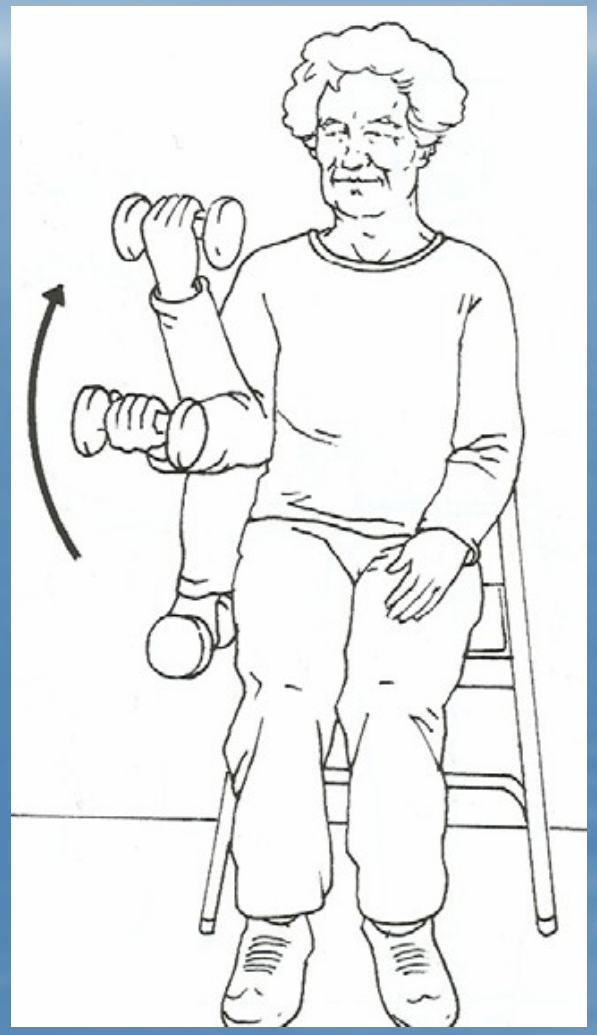
- Hand grip strength test
- Physical status according to the result given by the dynamometer (in kg)

Age	Male			Female		
	normal	strong	weak	normal	strong	weak
60—64	<30.2	30.2–48.0	>48.0	<17.2	17.2–31.0	>31.0
65—69	<28.2	28.2–44.0	>44.0	<15.4	15.4–27.2	>27.2
70—99	<21.3	21.3–35.1	>35.1	<14.7	14.7–24.5	>24.5

Isometric hand grip strength is strongly related with lower extremity muscle power, knee extension torque and calf cross-sectional muscle area. Low handgrip strength is a clinical marker of poor mobility and a better predictor of clinical outcomes than low muscle mass. In practice, there is also a linear relationship between baseline handgrip strength and incident disability for activities of daily living (ADL).

MUSCLE STRENGTH ASSESSMENT

- **Senior fitness test – Arm Curl -** To assess upper-body strenght
  - Number of biceps curls that can be completed in 30 seconds holding and hand weight of 5 pounds (2.27 kg) for women; 8 pounds (3.63 kg) for men

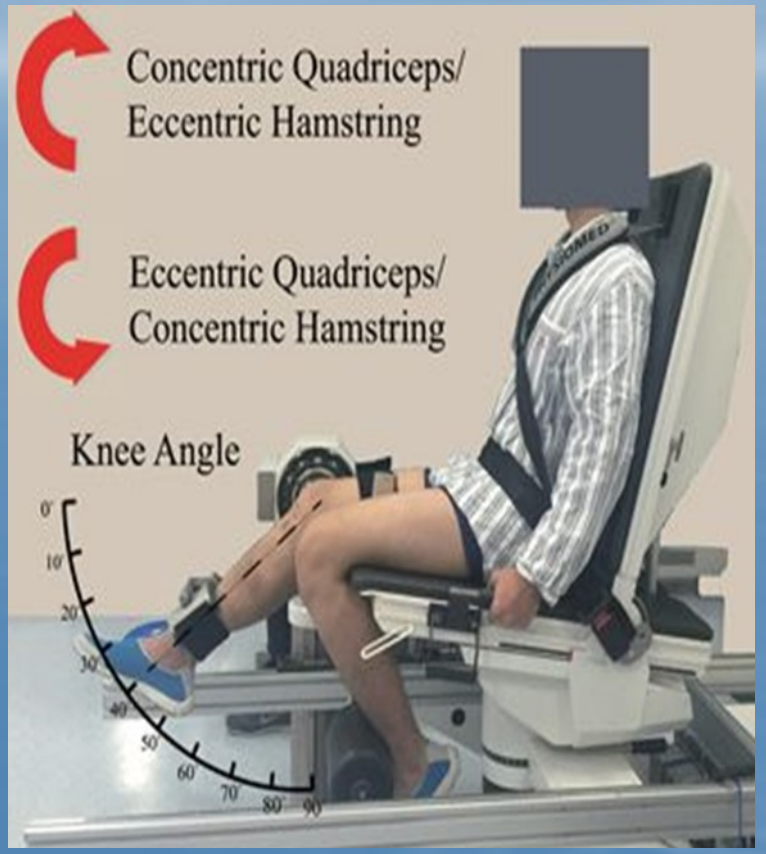


curls in 30 seconds

Age	Men	Women
60 – 64	19	17
65 – 69	18	17
70 – 74	17	16
75 – 79	16	15
80 – 84	15	14
85 – 89	13	13
90 +	11	11

MUSCLE STRENGTH ASSESSMENT

- Isokinetic dynamometry
  - Knee flexion/extension



Strength is about the magnitude of force generation, whereas power is about work rate (work done per unit time)**. In healthy older people, power is lost faster than strength**. Both are important, but **power is a better predictor of certain functional activities**.

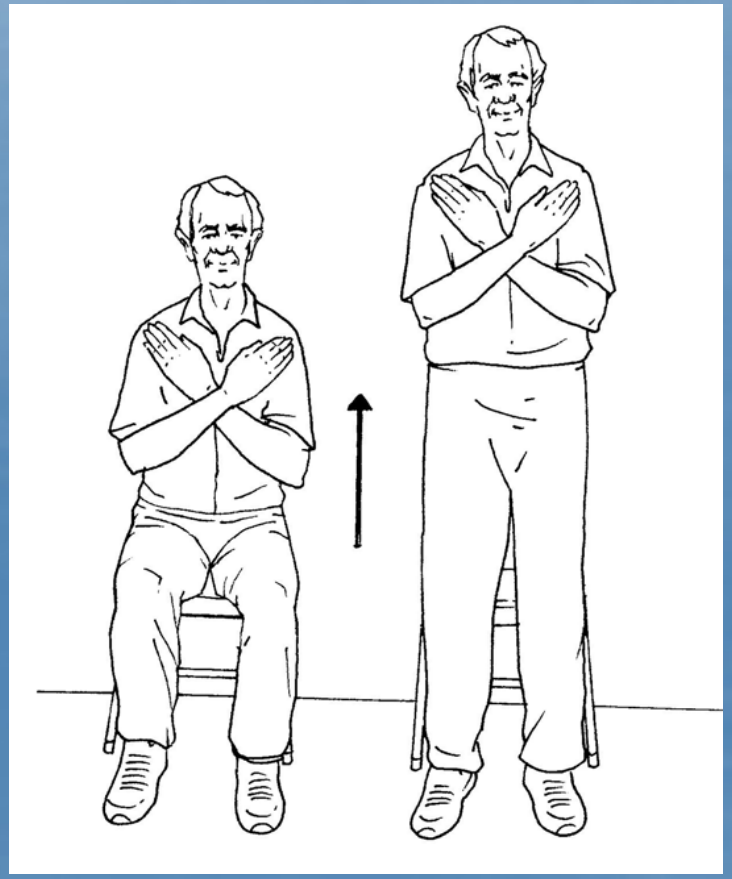
Strength can be measured isometrically or isokinetically, the latter being a closer reflection of muscle function in everyday activity.
It is usually measured as the force applied to the ankle, with the subject seated in an adjustable straight-back chair, the lower leg unsupported and the knee flexed to 90 . Modern, commercial isokinetic dynamometers allow both isometric and isokinetic measurements of strength as concentric torque at various angular velocities. Measurement is feasible in frail older people.

PHYSICAL PERFORMANCE ASSESSMENT

- Senior fitness test – **Chair stand** – To assess lower-body strenght
  - Number of full stands that can be completed in 30 seconds with arms folded across chest

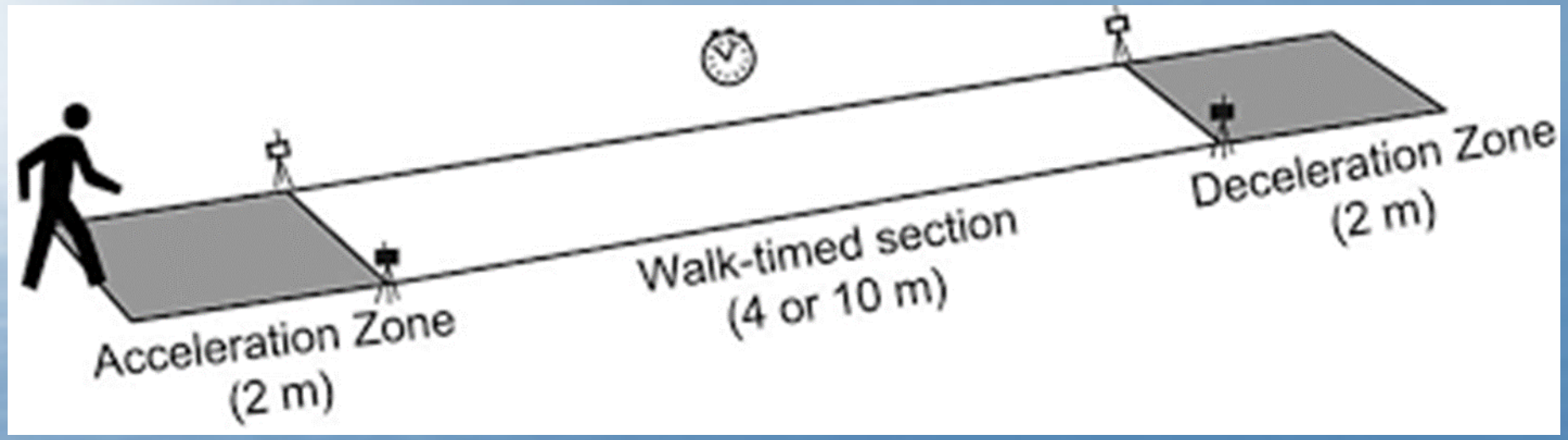
stands in 30 seconds

Age	Men	Women
60 – 64	17	15
65 – 69	15	15
70 – 74	15	14
75 – 79	14	13
80 – 84	13	12
85 – 89	11	11
90 +	9	9



PHYSICAL PERFORMANCE ASSESSMENT

Timed 10-Meter Walk Test



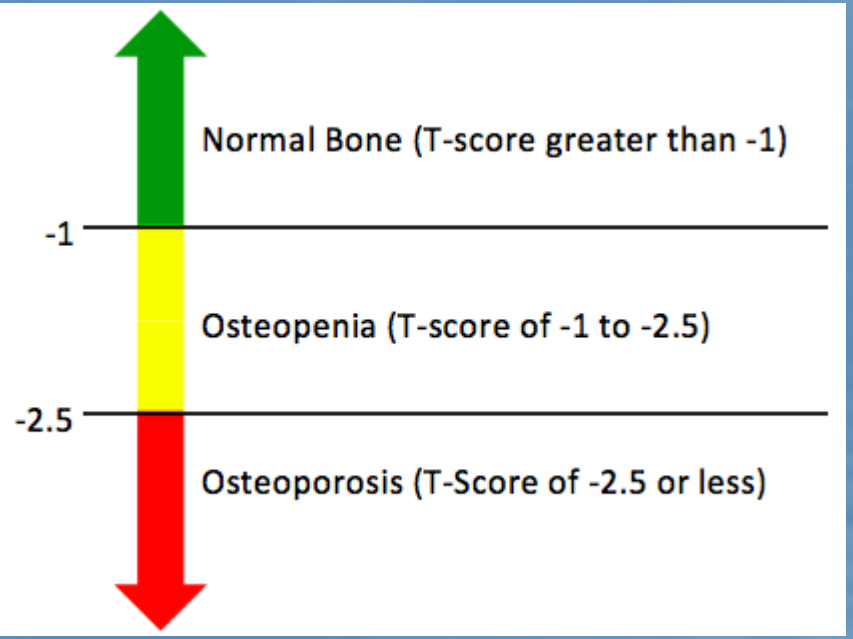
Normal comfortable speed or

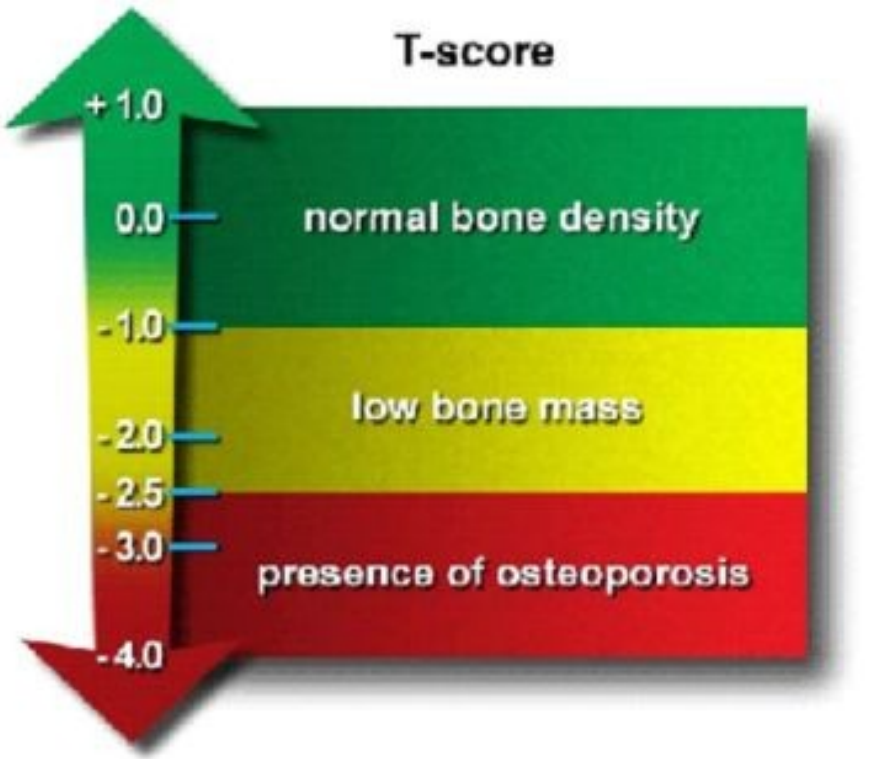
maximum speed trials

BONE STRENGHT ASSESSMENT

- A bone density test uses X-rays to measure how many grams of calcium and other bone minerals are packed into a segment of bone. The bones that are most commonly tested are in the spine, hip and sometimes the forearm.

DEXA scores are reported as "T-scores" and "Z-scores." The T-score is a comparison of a person's bone density with that of a healthy 30-year-old of the same sex. The Z-score is a comparison of a person's bone density with that of an average person of the same age and sex.





Using T-scores vs. Z-scores

T-scores

- WHO diagnositic classification in postmenopausal women and men age 50 and older
- WHO classification with T-score cannot be applied to healthy premenopausal women, men under age 50, and children

Z-scores

- For use in reporting BMD in healthy premenopausal women, men under age 50, and children
- Z-score -2.0 or less is defined as “below the expected range for age”
- Z-score above -2.0 is “within the expected range for age”

Bone Densitometry (DXA)

BODY WEIGHT AND BODY COMPOSITION

- Body weight refers to the size or mass of the individual.
- Body composition refers to body weight in terms of the absolute and relative amounts of muscle, bone, and fat tissues.
- Aerobic exercise and resistance training are effective in altering body weight and composition.

Assessment

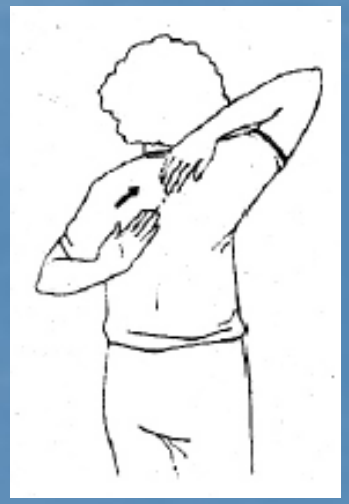
- Dual energy X-ray absorptiometry (DXA)
- Bioimpedance analysis (BIA) - InBody

FLEXIBILITY

- the ability to move a joint or series of joints fluidly through the complete range of motion. Flexibility is limited by factors such as bony structure of the joint and the size and strength of muscles, ligaments, and other connective tissues.

Assessment

- Senior fitness test (SFT) – Chair sit – and – reach test
- SFT – Back scratch test



BALANCE

- the ability to keep the body's center of gravity within the base of support when maintaining a static position, performing voluntary movements, or reacting to external disturbances.
- Functional balance refers to the ability to perform daily movement tasks requiring balance such as picking up an object from the floor dressing, and turning to look at something behind you.

- **Assessment**
  - Static balance
    - Posturography
    - The One-Legged Stance Test
  - Dynamic balance
    - The 3m backwards walk test
    - Foot up and go test
    - Reach test

There are inconsistencies in the terminology used - postural stability, postural control, postural responses, postural sway, postural balance, balance, balance ability, balance control, balance performance, dynamics of standing balance, and so on. We work with the following terminology - static balance and dynamic balance.

STATIC BALANCE - FORCE PLATES

- **Posturography** is the technique used to quantify postural control in upright stance in either static or dynamic conditions.
- The trials were performed under both **eyes closed** (EC) and **eyes open** (EO) conditions **in double leg stance and narrow**. Most researchers conducted between **2 and 5 repetitions** of postural sway recordings.
- The possible effect of fatigue, especially in a population of balance impaired or otherwise pathologically affected elderly subjects, has to be considered when increasing the trial number or duration.
- In studies was found higher overall reliability values under eyes closed conditions compared to open eyes.
- Changing from a narrow- to a broad-based stance invokes a change in balance strategy from ankle to hip to the trunk and in the degree of control by stiffness.
- The most common COP variable reported is the total **sway path length, sway area, medial-lateral sway length, anterior-posterior sway length, and velocity.**
- Even though it has been shown that COP measures differ between age groups, these measures' reliability is not influenced by gender.
- Resistance exercise interventions did not significantly change any of the variables in either eye open or closed conditions.

The One-Legged Stance Test

- measures postural stability (i.e., balance) and is more difficult to perform due to the narrow base of support required to do the test. ... The patient is then instructed to close his eyes and maintain balance for up to 30 seconds.

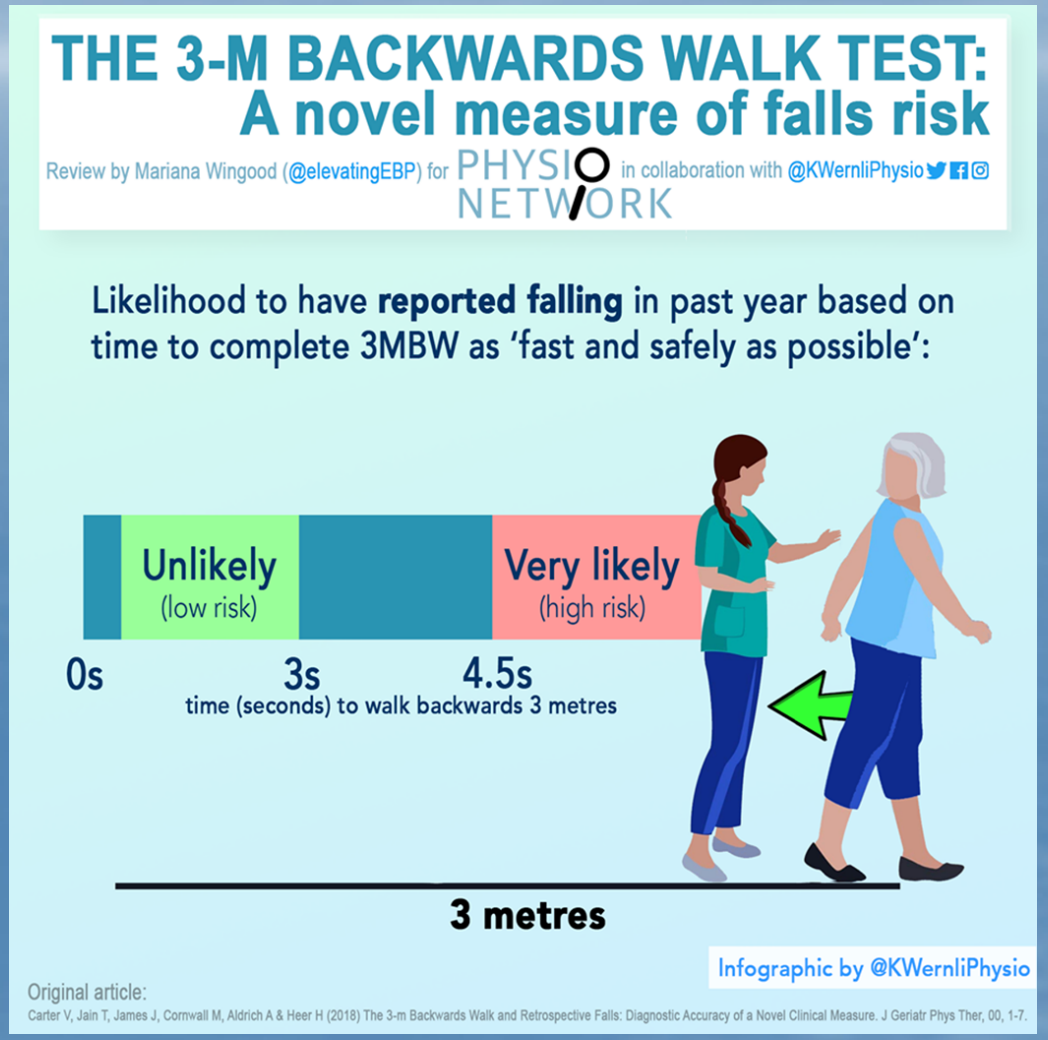
Simple Balance Test

AGE (YEARS)	OPEN EYES	CLOSED EYES
20-29	29 seconds	21 seconds
30-39	29 seconds	14 seconds
40-49	29 seconds	10 seconds
50-59	28 seconds	8 seconds
60-69	26 seconds	5 seconds
70-79	14 seconds	4 seconds

DYNAMIC BALANCE ABILITY – ASSESSMENT

THE 3-M BACKWARDS WALK TEST

- … Several measures of fall risk have been previously developed and include forward walking, turning, and stepping motions.
- … recent research has demonstrated that backwards walking is more sensitive at identifying age-related changes in mobility and balance compared with forward walking…



DYNAMIC BALANCE ABILITY ASSESSMENT

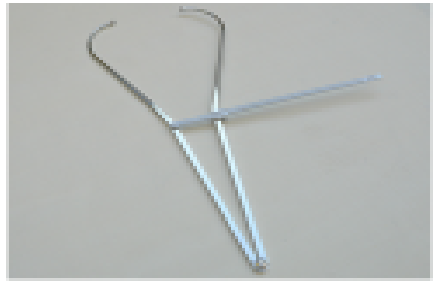
- Senior fitness test – **8 – Foot up and go**
  - Number of seconds required to get up from a seated position, walk 8 feet (2.44m), turn and return to seated position

Seconds to complete task

Age	Men	Women
60 – 64	4.8	5.0
65 – 69	5.1	5.3
70 – 74	5.5	5.6
75 – 79	5.9	6.0
80 – 84	6.4	6.5
85 – 89	7.1	7.1
90 +	8.0	8.0

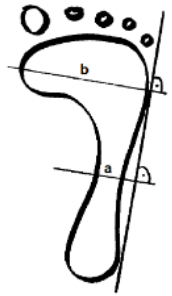
AS WE KNOW, BALANCE CAN BE INFLUENCED BY MORE VARIABLES (VISUAL SYSTEM, PROPRIOCEPTION, FOOT BREADTH, FOOT LENGTH, HALLUX VALGUS ANGLE, ARCH FOOT, HEIGHT, WAIST-TO-HIP RATIO, NAVICULAR DROP, CEREBELLUM DYSFUNCTION).

Anthropometry



- Foot breadth
  - distance between the most prominent point on the medial side of head of first metatarsal and the most prominent point on the lateral side of head of fifth metatarsal, both in contact with the floor (Geetha and Athavale, 2015)
  - Measured with sliding calliper
  - Greater correlation with the arch index (arch shape and balance) than the foot length
- Foot length
  - Distance between the most prominent toe and the most posterior point of the heel, both in contact with the floor
  - Sliding calliper
  - Better to compare with the arch height

- **Hallux valgus angle**
  - angle between the longitudinal axes of the proximal phalanx of the great toe and the first metatarsal bone (Seki et al., 2020)
  - Measured with goniometer
  - Up to 10-15° considered normal
  - Influenced by the anatomical alignment of the joint, heredity, hypermobility, shoes, …
  - High correlation with the COP total area with eyes closed in the elderly
- **Arch index** (Chippaux-Šmiřák method)
  - Lateral tangent line of the footprint, then perpendicular line at the widest point (b) and the narrowest point (a)
  - Length a (mm) divided by length b (mm) times 100
  - AI up to 45% considered as normal arched foot



Zdroj: Enviroexperiment, 2012

- **Height**
  - Strongest relationship with total area of COP (eyes opened)
- **Waist-to-hip ratio**
  - Waist: midway between the iliac crest and the lower rib margin by using an insertion tape
  - Hip: widest circumference over the buttocks and below the iliac crest
  - Waist measurement divided by hip measurement
  - Men 60-69: less then 0,91 – low risk, women 60-69: less then 0,76 – low risk
  - Higher WHR correlates with increased mortality risk

PODOCAM

- Device showing arch shape (footprint)
- To assess foot type

NAVICULAR DROP TEST

- Assessing the sagittal plane excursion of the navicular bone during loading
- Locating the navicular tuberosity on the non-weight-bearing foot
- Then the subject is asked to assume 50% weight bearing on the foot and the sagittal plane excursion of navicular bone is measured by a ruler
- Sagittal displacement of the navicular tuberosity may reflect excessive subtalar joint pronation (due to insufficient support of the MLA from ligaments and muscle tendons)
- Reliable means of measurement of foot pronation
- Excessive amount of navicular drop has been reported to be associated with knee joint pathology
- 6-9 mm displacement considered normal, less than 6 mm hypomobility, more than 9 mm hypermobility

CEREBELLUM EXAMS

- to exclude cerebellum dysfunction and to eliminate any dysfunction of both visual and proprioceptive system for maintaining balance
- finger-nose test (for each hand)
- diadochokinesis test (bringing an upper limb into opposite positions of pronation and supination)
- elimination of nystagmus
- Romberg´s test (feet together eyes opened – Romberg I; feet together eyes closed – Romberg II)

FITNESS ASSESSMENT IN OLDER ADULTS

Step 1

- to take into account the health condition in older adult

Step 2

- to choose test (reliability, validity)

Step 3

- to hold the methodology of test

Step 4

- evaluate the results correctly and to apply

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