



Physical Fitness and Physical Activity in Older Adults

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Physical activity in older adults

- **Goals**

- Maintaining self-sufficiency (the ability to perform activities of daily living (**ADL**))
- Maintaining or improving the quality of life
- Slowing down aging processes and their manifestations

Older adults

The diagram consists of three teal ovals on a light blue background. One oval at the top center contains the text 'Older adults'. Two ovals are positioned below it, one on the left and one on the right. The left oval contains the text 'Physical fitness' and the right oval contains the text 'Physical activity'. There are no lines or arrows connecting the ovals.

Physical
fitness

Physical
activity

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 (V_{O2max}),
 - 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	VO ₂ (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 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 ka)

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).**

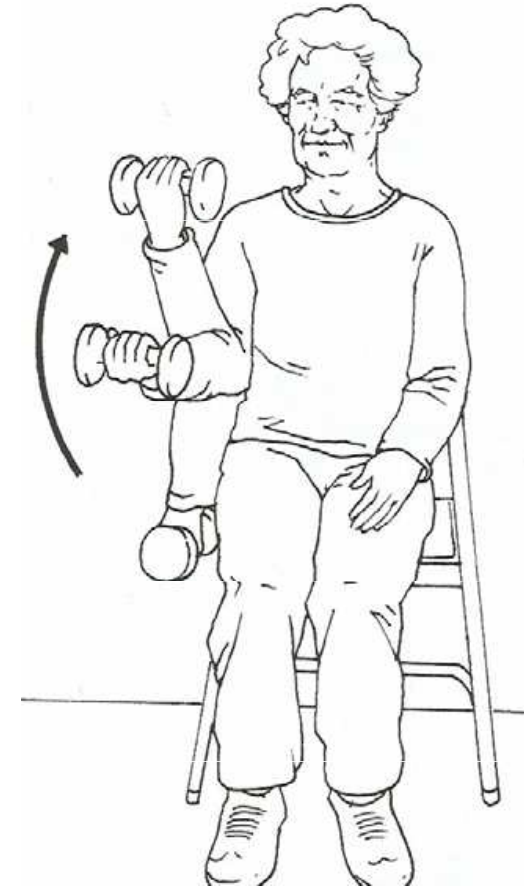


Muscle strength assessment

- **Senior fitness test – Arm Curl** - To assess upper-body strength
 - 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.

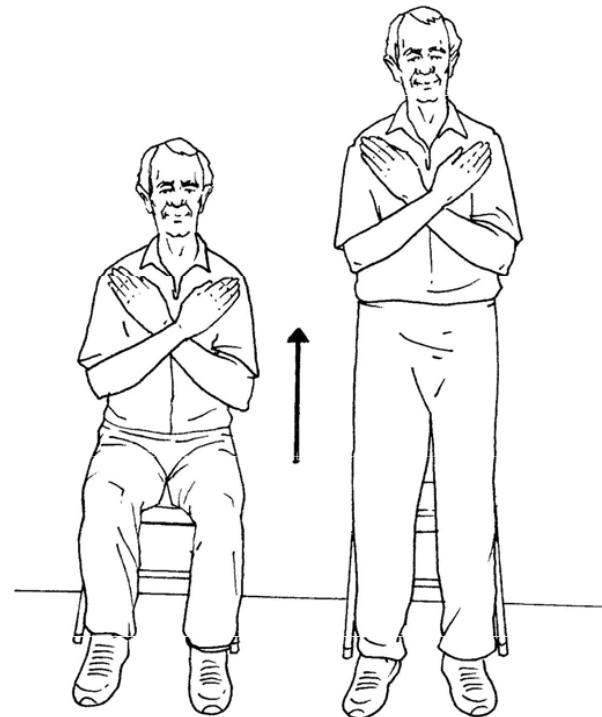


Physical performance assessment

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

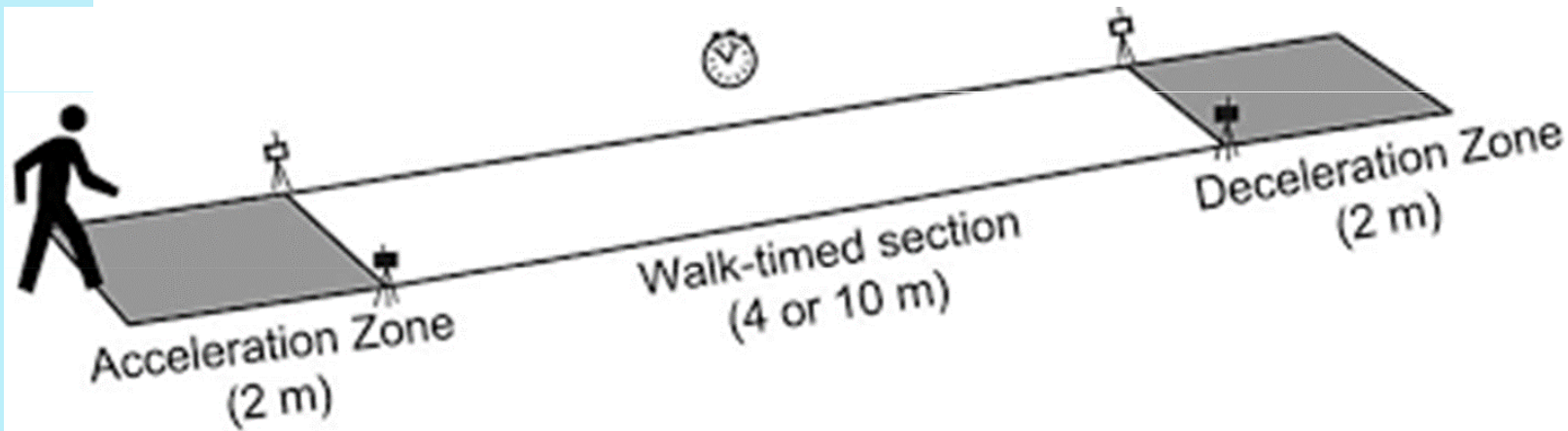
stands in 30 seconds

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



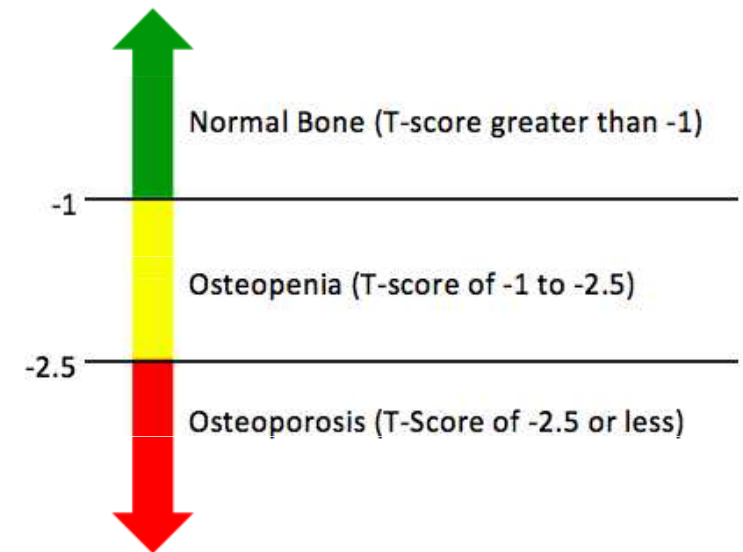
Normal comfortable speed or
maximum speed trials



Bone strength assessment

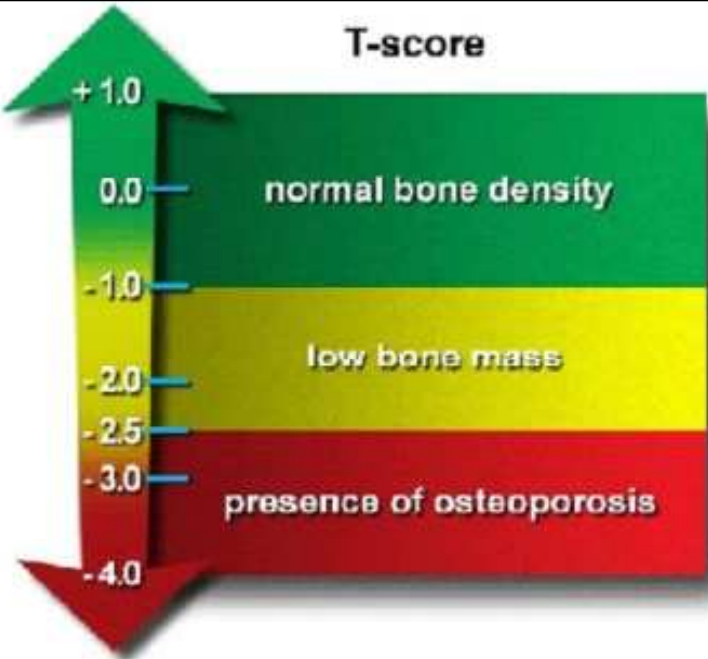
- A bone density test uses X-rays to measure how many grams of calcium and other bone minerals are packed into a segment of bone. The bones that are most commonly tested are in the spine, hip and sometimes the forearm.

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-score



T-scores

- WHO diagnostic 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)

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

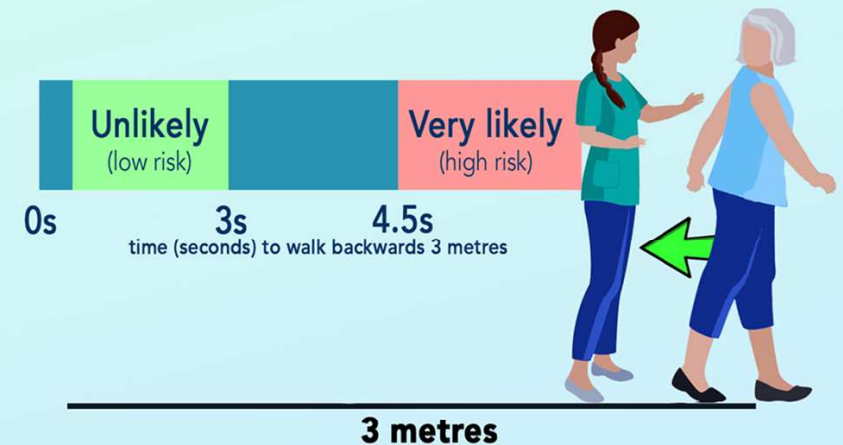
The 3-m backwards walk test

- ... 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...

THE 3-M BACKWARDS WALK TEST: A novel measure of falls risk

Review by Mariana Wingood (@elevatingEBP) for **PHYSIO NETWORK** in collaboration with @KWernliPhysio

Likelihood to have **reported falling** in past year based on time to complete 3MBW as 'fast and safely as possible':



Original article:

Carter V, Jain T, James J, Cornwall M, Aldrich A & Heer H (2018) The 3-m Backwards Walk and Retrospective Falls: Diagnostic Accuracy of a Novel Clinical Measure. J Geriatr Phys Ther, 00, 1-7.

Infographic by @KWernliPhysio

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



Podocam

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



Research focus

- **The impact of different types of physical activity in older adults**
- **Predictive model of fall prevention in older adults**
- **Analysis of walking of selected age groups**

Predictive model of fall prevention in older adults

MUNI/IGA/1643/2020

- We found very important to develop predictive model prevention for falls in older adults to prevent injuries leading to mortality and morbidity. In praxis, only single tests related to falls risk are used. However, the complex set of tests would bring valuable variables, which lead to results that are more accurate.
- **The aim of this study**
- The predictive models based on measured variables will be created as a tool for assessing the physical fitness of older adults with regard to fall prevention. The models could bring innovative approach to prevention of falls in older adults.
- Bringing the models, we would be able to predict the risk of falls in older adults, therefore to suggest appropriate targeted intervention fitness program or medical consultation

Predictive model of fall prevention in older adults

- **Methods:**
- ***Study design***
- It will be an observational cross-sectional study. Older adults will be tested and they will fill questionnaires at the Faculty of Sports Studies in Brno. Measured data will be processed by a statistical method of regression analysis. The predictive model based on the analysis will be created for fall prevention for older adults.
- ***Participants***
- The study will involve about 250-300 older adults (age 65-84) who do not suffer from acute or chronic diseases that would make it impossible to complete testing.

Predictive model of fall prevention in older adults

- *Single tests and observed parameters*
- **Anamnesis questionnaire** – anamnesis will contain personal anamnesis, demographic data, medication, socioeconomic status, level of physical activity and nutrition.
- **Anthropometry** – basic anthropometric data (weight, height, adipose and muscle tissue distribution) will be measured using Inbody 770.
- 6 minutes walking test – an exercise test used to assess aerobic capacity and endurance - **2-minute step test**
- **Hand grip strength test** – this test measures the maximum isometric strength of the hand and forearm muscles by dynamometer Takei 5401.
- **Chair stand test** – this test measures leg strength. Chair stand test is part of the Senior Fitness Test Protocol and is designed to test the functional fitness of older adults.

Predictive model of fall prevention in older adults

- *Single tests and observed parameters*
- **Timed Up and Go Test (TUG)** – highly reliable screening test for dynamic stability and the ability to predict falls among older adults.
- **Functional Reach Test (FRT)** – FRT is a outcome measurement and assessment tool for ascertaining dynamic balance.
- **Static balance** – we will analyze center of pressure (COP) parameters using Kistler stabilometric platforms.
- **Fear of falling** will be measured by questionnaire FES-I and by a fall risk assessment using the Downtownfall risk index
- **The Montreal Cognitive Assessment (MoCA)** - is a brief cognitive screening tool for mild cognitive impairment.

The impact of different types of physical activity in older adults

Comparison of Traditional and Recent Approaches in the Promotion of Balance and Strength in Older Adults

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Resistance training

...increased amount of muscle mass can induce many health benefits and increase life quality (Barbalho et al., 2018)



New recommendation
2–3 sets of 1–2 multijoint exercises per major muscle group, achieving intensities of 70–85% of 1 repetition maximum (1RM), 2–3 times per week, including power exercises performed at higher velocities in concentric movements with moderate intensities (Fragala, 2019)



Our training
3 sets per exercise per muscle group, 8–12 repetitions, intensity 70–80% of 1RM, exercise selection 8–10 different exercises, modality free-weight or machine-based exercises.

Proprioceptive training

Postural stability, gait, and balance decrease with age (Baloh, RW, Ying, SH, and Jacobson, KM. 2003)



...dynamic balance improvement is associated with a decrease in risk of falls and fear of falling and improvement in quality of life (Matsumura, Ambrose, 2006)



Our training specific proprioceptive exercises in static and dynamic positions with the bosu and gym ball as unstable training tools. Training was progressively structured in 2 or 3 phases (Antonio Marti'nez-amat, 2013)

Endurance training

Nordic walking is one form of exercise that has gained a lot of interest among middle-aged and older adults.



...higher heart rate and oxygen consumption and energy expenditure than walking without poles (Parkatti, Perttunen, and Wacker, 2012; Schiffer et al., 2006; Hansen & Smith 2009; Saunders, Hipp, Wenos, & Deaton, 2008).



Our training trainer taught the Nordic walking **technique** to the participants following the guidelines. The intervention included exercise in the **surrounding forest**. During the training, participants were instructed to walk **as fast as it was comfortable**. Training intensity was based on the **subjective perception of exertion**.

Parkour Concepts for Healthy Aging

1426/2020

- Background

Falls of the elderly are the third most common cause of death due to injury. Therefore, we are looking for ways to eliminate the risk of falling. We were inspired by the American physiotherapist Ben Musholt, who sees great potential in Parkour for seniors.

The aim of the exercise is **to teach seniors to evaluate obstacles of various types, to overcome them as effectively as possible and to learn to fall safely.**

The benefit of this type of exercise is the accumulation of self-confidence, which in itself will improve the daily life of a senior and allow him to run hobby activities.

Single tests and observed parameters

- Timed Up and Go Test (TUG) – highly reliable screening test for dynamic stability and the ability to predict falls among older adults.
- Functional Reach Test (FRT) – FRT is a outcome measurement and assessment tool for ascertaining dynamic balance.
- Static balance – we will analyze center of pressure (COP) parameters using Kistler stabilometric platforms.
- Fear of falling will be measured by questionnaire FES-I and by a fall risk assessment using the Downtownfall risk index
- Five point test - a Test of Nonverbal Fluency
 - Figural (or nonverbal) fluency is the ability of executive functions to provide information about divergent reasoning, divided attention, planning and mental flexibility.
 - <https://www.csnn.eu/en/journals/czech-and-slovak-neurology-and-neurosurgery/2014-6-3/the-five-point-test-a-test-of-nonverbal-fluency-normative-data-for-adults-50230>

















Analysis of walking of selected age groups

1708/2020

- The project is focused on the issue of the condition of the **foot arch**, **balance abilities** and the **spatiotemporal parameters of walking** in seniors.
- The relationship between spatio-temporal parameters of gait and adverse health conditions in the elderly is part of many scientific studies (Rodríguez-Molinero, et al., 2019; Ansai, Andrade, et al., 2019; Hollman, et al., 2011).
- The condition of the arch of the foot, the length and width of the stride, the walking cadence and its speed are considered markers for the prediction of falls, cardiovascular and neurodegenerative diseases in the senior population.

Analysis of walking of selected age groups 1708/2020

- Participants

Older adults living in their own home (n = 50) and seniors living in a home for the elderly with the ability to self-service (n = 50). A comparison between groups of seniors living in their dwellings and in institutional facilities is planned.

...the project follows on from last year's project

had measured 204 older adults

Conclusion

Walking/gait - a vital everyday movement

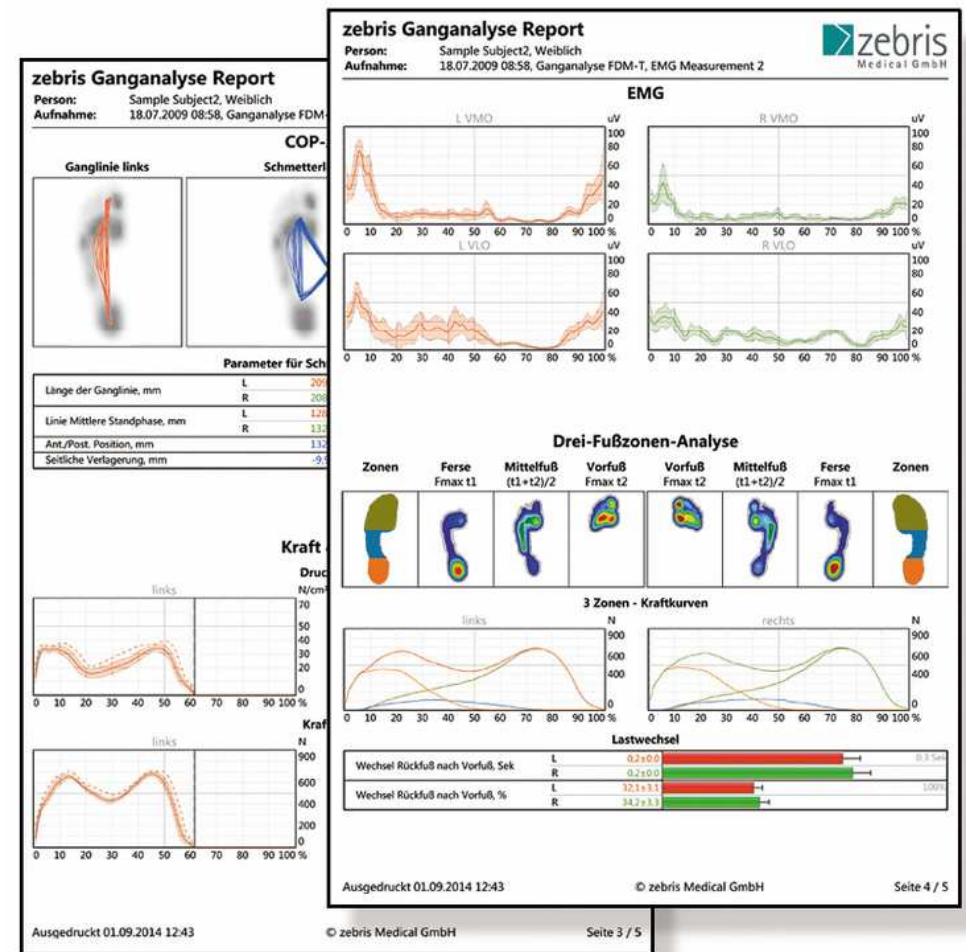
Walking/gait - diagnostic method

The reduction in gait speed is frequently used as a marker of frailty.

The spatial parameters of gait and their association with falls, functional decline and death in older adults.

A stride length shorter than half of the height is a sensitive risk marker for functional loss and falls.

(Rodríguez-Moliner, Herrero-Larrea, Miñarro, Narvaiza, Gálvez-Barrón, et al., 2019; Ansai, Andrade, Masse, Gonçalves, Takahashi, et al., 2019; Hollman, McDade, Petersen, 2011).





e057 Physical Activity in Older Adults

- 9:00 – 9:50 B11/236
- 14:00-14:50 Gym 118

- **September** B11/236 9:00 – 9:50 theoretical basis (oral lecture)
- **October** 14:00-14:50 Gym 118 physical fitness assessment (practical lesson)
- **November** – attending exercise lessons for seniors
- **December** - data processing, analysis and interpretation
– (last meeting December 8, 2021)