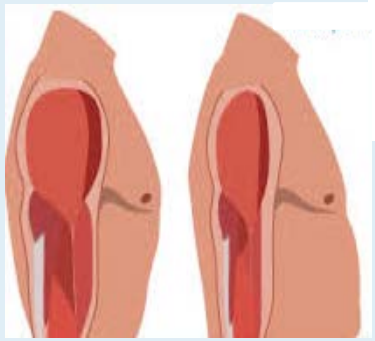

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Klinik für Geriatrie

Sarkopenie:
Diagnostik und klinische Aspekte

Prof. Dr.med. R.Theiler

Leiter Osteoporose und Sarkopenie Ambulatorium
Klinik für Altersmedizin , USZ

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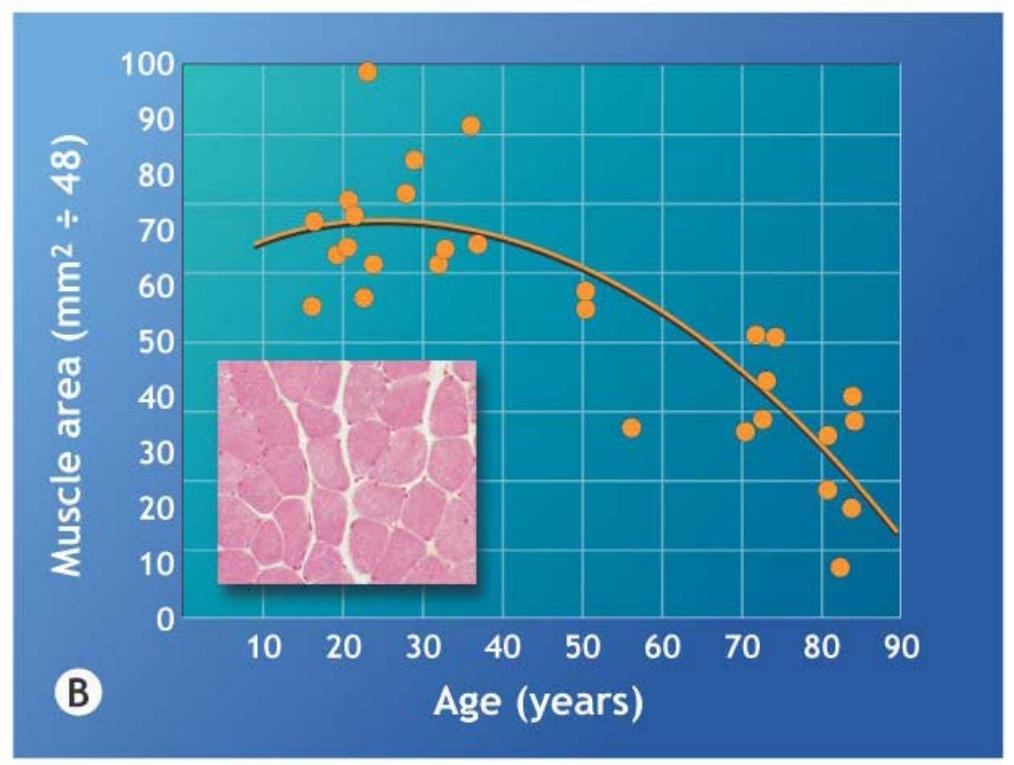
DO HEALTH

Inhalte

- Veränderung der Definitionen Sarkopenie
- Messmethoden
- Klinische Relevanz: Frakturen und Frailty Syndrom
- Sturzrisiko und Einflussfaktoren
- Trainingstherapie bei älteren Erwachsenen
- Medikamente

Loss of muscle mass with age

Muscle mass is reduced by about 40% between age 20 and to age 80 – preferentially at the lower limb



- 0.5-1% / year after age 25
- 1-2% / year after age 50

Lexell et al. *J. Neurol. Sci. 84:275, 1988.*
Koopman R, van Loon LJ. *Journal of applied physiology 2009*

DO HEALTH

Muscle changes that occur with aging

Muscle has two basic fiber types:

- Type I fibers -- slow contraction time, endurance (hours).
- Type II fibers -- fast contraction time, high force production and low resistance to fatigue (<5 minutes).

With aging, there is preferential loss of Type II fibers, reducing the capacity for fast reactions (i.e. fall prevention).

With aging, motor neurons decline, reducing the signal for muscle contraction.

With aging, fatty infiltration in muscle, myosteatosis, increases.

Verdijk, L.B., et al., *Satellite cell content is specifically reduced in type II skeletal muscle fibers in the elderly.* Am J Physiol Endocrinol Metab, 2007. **292**(1): p. E151-7.
Nair, K.S., *Aging muscle.* Am J Clin Nutr, 2005. **81**(5): p. 953-63.
Brown, W.F., *A method for estimating the number of motor units in thenar muscles and the changes in motor unit count with ageing.* Journal of Neurology, Neurosurgery and Psychiatry, 1972. **35**(6): p. 845-52.

The clinical consequences have been well documented

In both the men and the women age 70 to 79 in the Health ABC study (n = 1880), the 1% per year decline in muscle mass was accompanied by a 3% per year decline in muscle strength.

Loss of muscle mass has been directly linked to:

- weakness
- functional impairment
- falls
- frailty
- fractures

Goodpaster, B.H., et al., The loss of skeletal muscle strength, mass, and quality in older adults: the health, aging and body composition study. J Gerontol A Biol Sci Med Sci, 2006.

Bischoff-Ferrari HA. Relevance of vitamin D in muscle health. Rev Endocr Metab Disord. 2012.

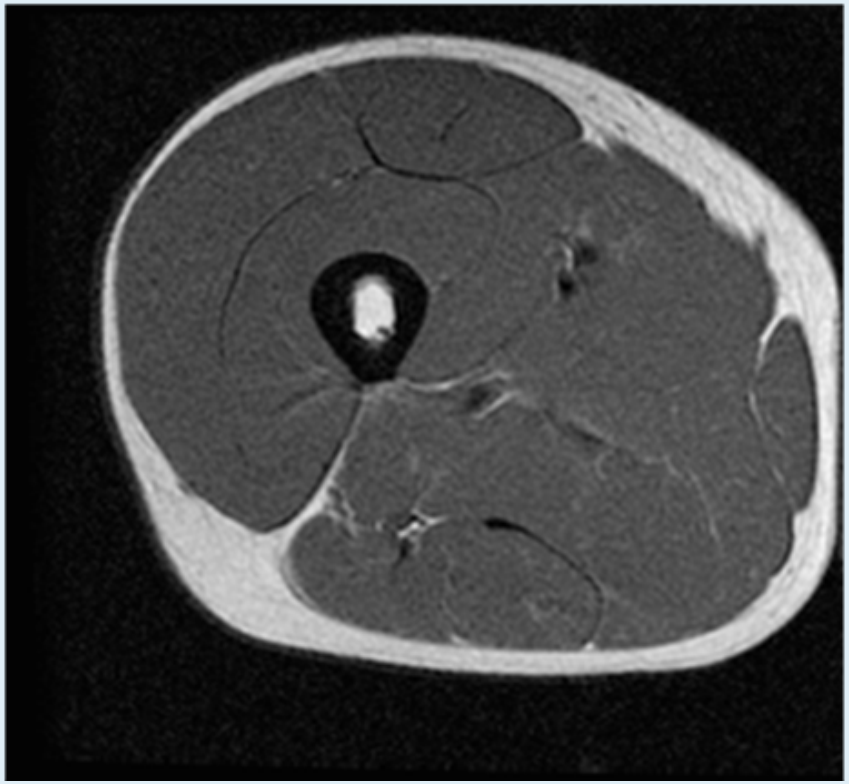
Definition of Sarcopenia

The loss of
skeletal muscle
mass and strength (quality)
with advancing age

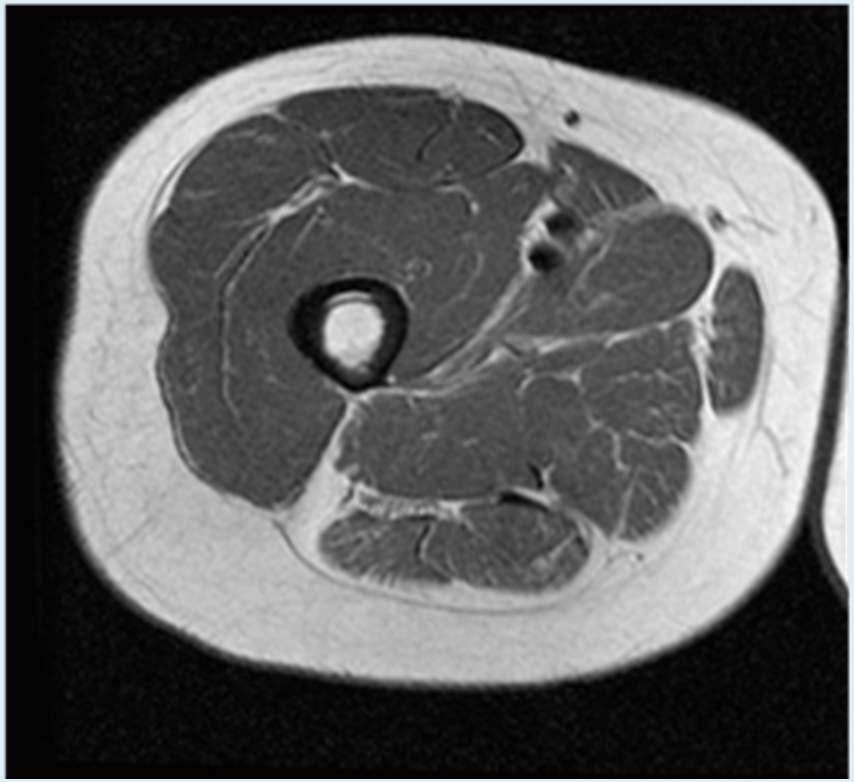
SARCOPENIA is a word coined from Greek
by Irwin H. Rosenberg in 1988

Sarx means flesh and
penia means loss

Sarcopenia



Young man
25 yrs



Older man with sarcopenia
85 yrs

- Less muscle mass
- Reduced muscle quality

Why is sarcopenia a concern?

- Sarcopenia is considered to be central in the development of frailty – and loss of autonomy
- Both falls and hip fractures are considered key consequences of sarcopenia that lead to frailty

Cesari M, Fielding R, Benichou O, et al. Pharmacological Interventions in Frailty and Sarcopenia: Report by the International Conference on Frailty and Sarcopenia Research Task Force. The Journal of frailty & aging 2015.

Prevalence of sarcopenia

It has been estimated that

- 5-13% of seniors age 60–70 and
- 11-50% of seniors age 80+

are affected by sarcopenia **– depending on the definition**

Rizzoli R, Reginster JY, Arnal JF, et al. Quality of life in sarcopenia and frailty. Calcif Tissue Int 2013;93:101-20.

Bischoff-Ferrari HA, Orav JE, Kanis JA, et al. Comparative performance of current definitions of sarcopenia against the prospective incidence of falls among community-dwelling seniors age 65 and older. Osteoporos Int 2015.

Perez-Zepeda MU, Gutierrez-Robledo LM, Arango-Lopera VE. Sarcopenia prevalence. Osteoporos Int 2013;24:797.

von Haehling S, Morley JE, Anker SD. An overview of sarcopenia: facts and numbers on prevalence and clinical impact. Journal of cachexia, sarcopenia and muscle 2010;1:129-33.

Cruz-Jentoft AJ, Landi F, Schneider SM, et al. Prevalence of and interventions for sarcopenia in ageing adults: a systematic review. Report of the International Sarcopenia Initiative (EWGSOP and IWGS). Age Ageing 2014.

Internationally accepted operational definition for sarcopenia is missing

	ALM	TBLM	Fat mass	Grip Strength	Gait Speed
Baumgartner	✓				
Delmonico I	✓				
Delmonico II	✓		✓		
Cruz-Jentoft	✓			✓	✓
Fielding	✓				✓
Morley	✓				✓
Muscaritoli		✓			✓
Studenski I	✓				
Studenski II	✓			✓	

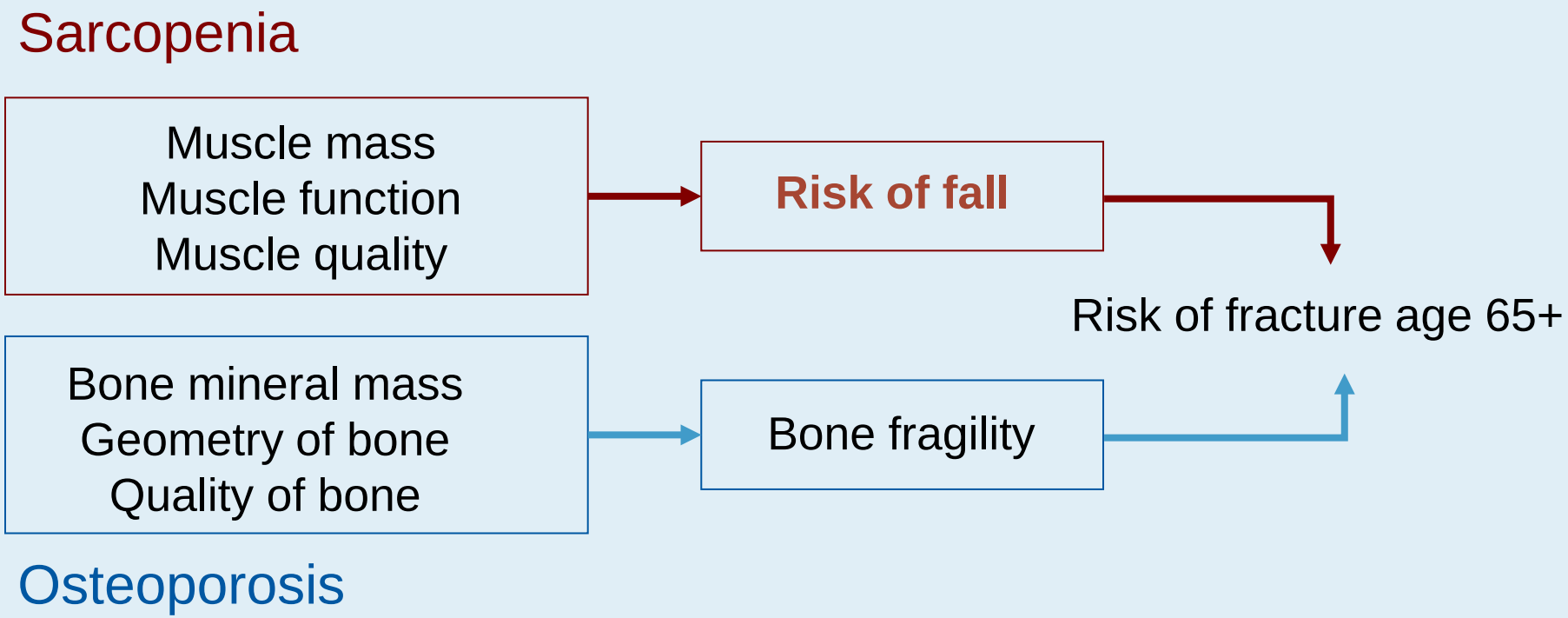
Validation Process is ongoing

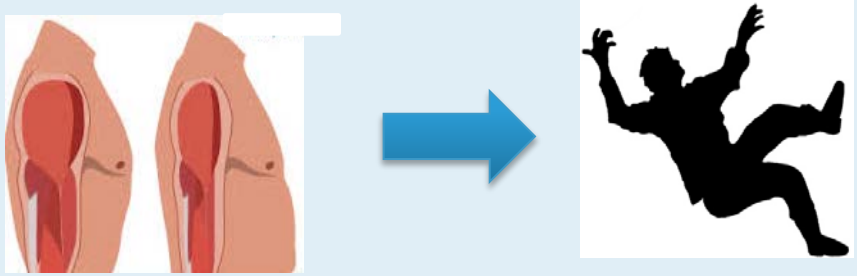
Developing an operational definition for sarcopenia includes demonstrating that the subjects meeting the definition have an increased risk of an important clinical outcome

- there is agreement that falls and fractures are an important clinical outcome to consider

Cruz-Jentoft AJ, Landi F, Schneider SM, et al. Prevalence of and interventions for sarcopenia in ageing adults: a systematic review. Report of the International Sarcopenia Initiative (EWGSOP and IWGS). Age Ageing 2014.

Conceptual framework





Comparative performance of current definitions of sarcopenia against the prospective incidence of falls among community-dwelling seniors age 65 and older

Bischoff-Ferrari HA, Orav JE, Kanis JA, Rizzoli R, Schlögl M,
Staehelin HB, Willett WC, Dawson-Hughes B

OP International 2015

Study description

Study Population (Boston STOP-IT Trial)**:**

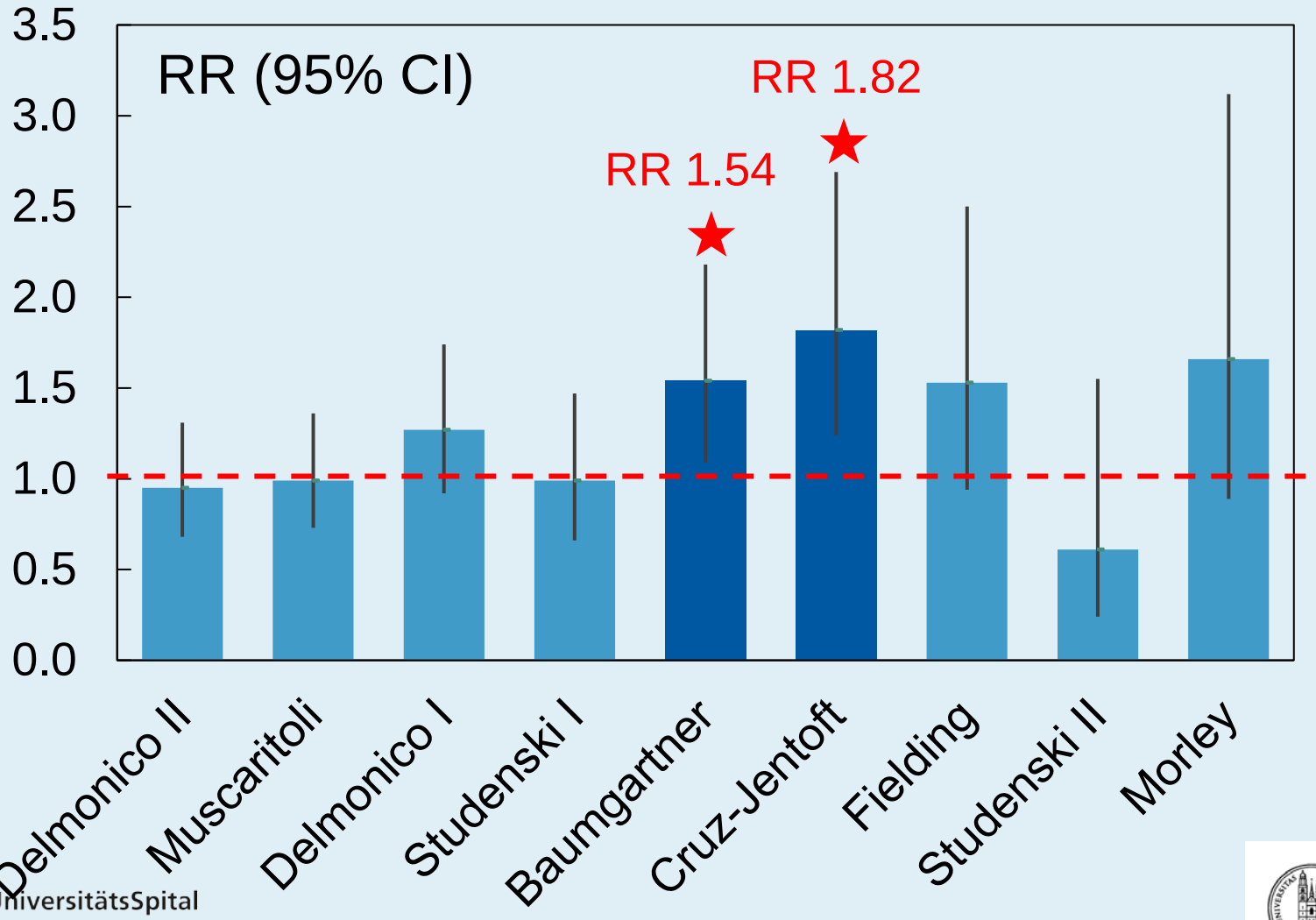
- 445 seniors (mean age 71 years, 45% men) living in the community
- followed with a detailed fall assessment for 3 years
- 231 fell, sustaining 514 falls, over the 3-year follow-up

Bischoff-Ferrari HA et al. OP International 2015

9 Operational definitions of sarcopenia

	ALM	TBLM	Fat mass	Grip Strength	Gait Speed
Baumgartner	✓				
Delmonico I	✓				
Delmonico II	✓		✓		
Cruz-Jentoft	✓			✓	✓
Fielding	✓				✓
Morley	✓				✓
Muscaritoli		✓			✓
Studenski I	✓				
Studenski II	✓			✓	

Results prospective rate of falls
in sarcopenic versus non-sarcopenic individuals



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Bischoff-Ferrari HA et al. OP International 2015

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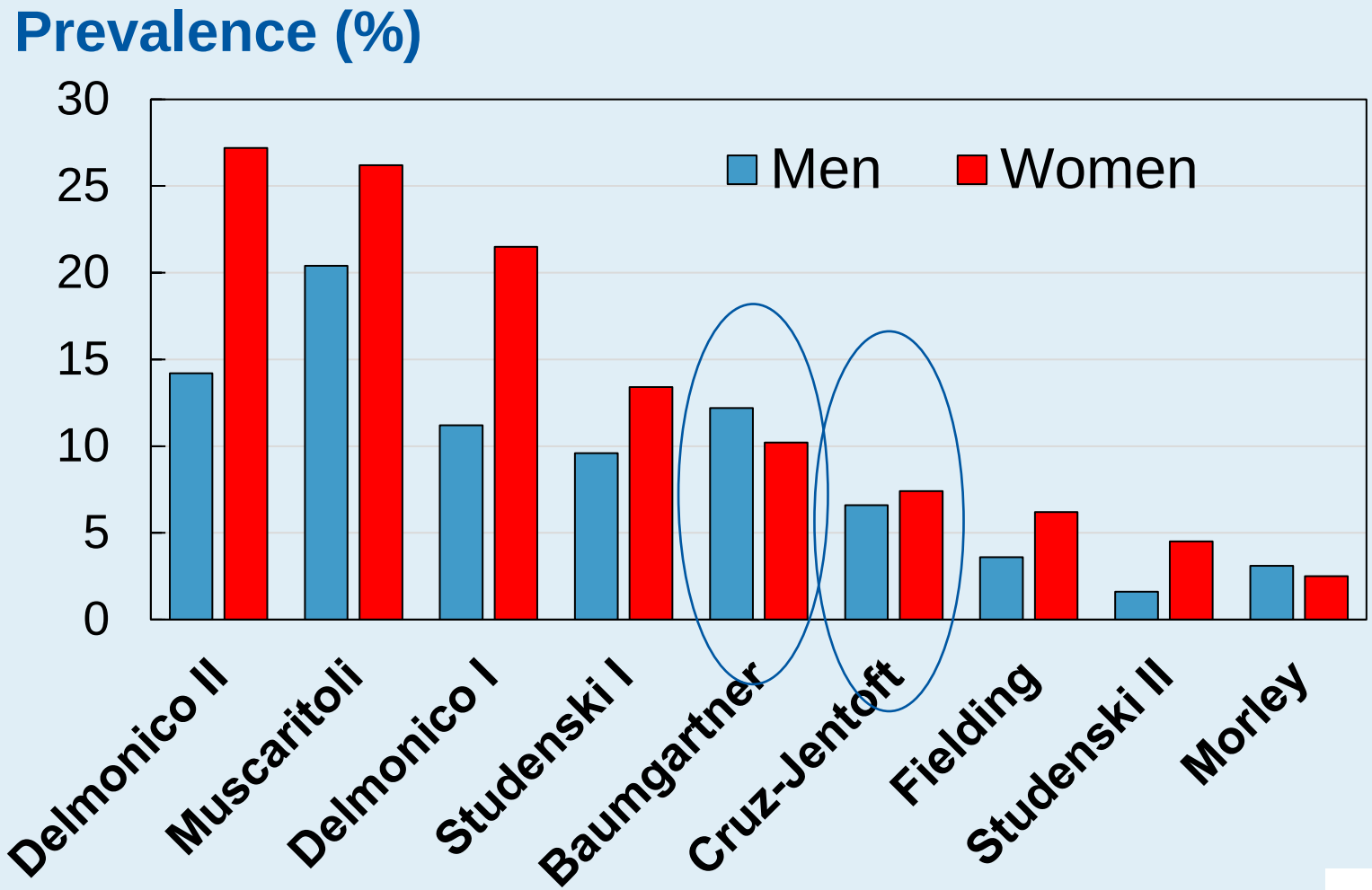
Prevalence of Sarcopenia varied between definitions



Summary

With the same cut-off for low appendicular lean mass, the additional requirement of decreased function in the Cruz-Jentoft definition

- increased the prediction of the rate of falls among sarcopenic individuals from an odds ratio of 1.54 (Baumgartner) to 1.82 (Cruz-Jentoft)

- but also reduced the respective prevalence of sarcopenia from 11% (Baumgartner) to 7% (Cruz-Jentoft)

Mass alone may depict earlier disease stage and allow early treatment.

Mass alone does not depend on test person or the motivation of the patient.

Sarcopenia based on muscle mass alone and hip fracture risk

In the **Health ABC** study of 3,075 adults age 70-79, **higher ALM/ht² alone** was associated with

- reduced risk of hip fracture in men [HR (95% CI) = 0.58 (0.36, 0.91)]
- but not in women [HR = 1.04 (0.66, 1.63)]

In a **large cohort of 22,482 senior Chinese men and women**, **ALM/ht² alone** was associated with

- reduced risk of hip fracture in men [OR = 0.240 (0.138, 0.4180)]
- reduced risk of hip fracture in women [OR = 0.479 (0.278, 0.823)]

Malkov, S., et al., *Hip Fractures Risk in Older Men and Women Associated With DXA-Derived Measures of Thigh Subcutaneous Fat Thickness, Cross-Sectional Muscle Area, and Muscle Density.* J Bone Miner Res, 2015.
Hong, W., et al., *Prevalence of Sarcopenia and Its Relationship with Sites of Fragility Fractures in Elderly Chinese Men and Women.* PLoS One, 2015.

Outlook

http://do-health.eu/wordpress/

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DO-HEALTH will validate the sarcopenia instrument library against incident falls, frailty, fractures, and loss of autonomy
+ will test 3 health-promoting interventions
to prevent sarcopenia and its consequences

SEVENTH FRAMEWORK PROGRAMME

THEME [HEALTH.2011.2.2.2-1]
[Investigator-driven clinical trials for therapeutic interventions in elderly populations]
Proposal no: 278588-2

Principal Investigator (sponsor):
Prof. Heike A. Bischoff-Ferrari, MD, DrPH
Centre on Agingand Mobility
University of Zurich
Rämistrasse 100
8091 Zurich, Switzerland

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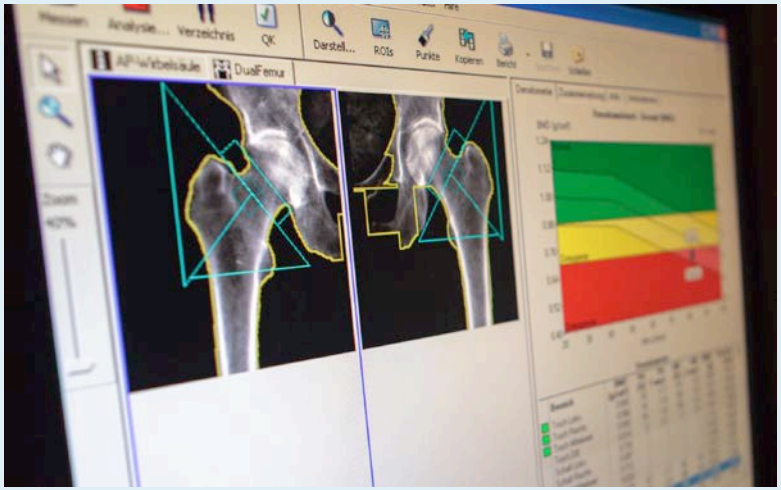
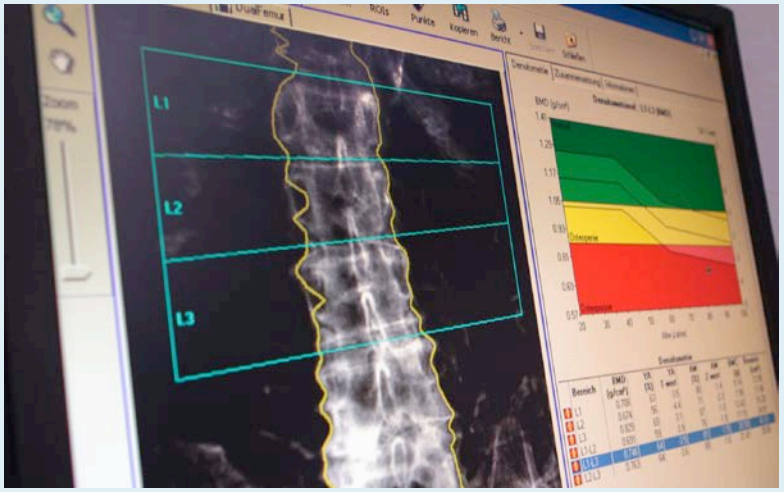
DEXA measures bone and lean mass

The two key location for measuring bone density with DEXA are the hip and spine

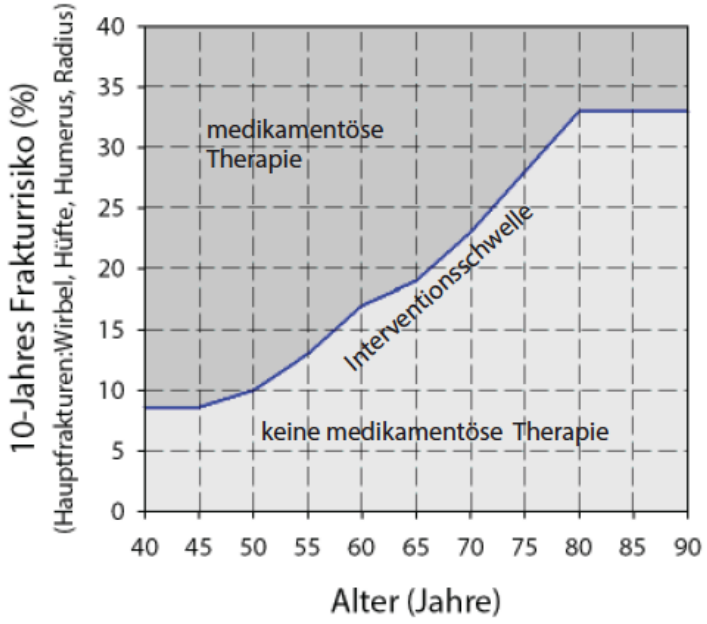




- Vertebral Morphometry/Rx – aim to identify verterbral fractures as a key indicator for a high risk of sustaining another vertebral fracture
- FRAX is a tool used in clinical care to include important additional risk factors to calculate the absolute 10 year probability of fracture at the hip and any major OP fracture

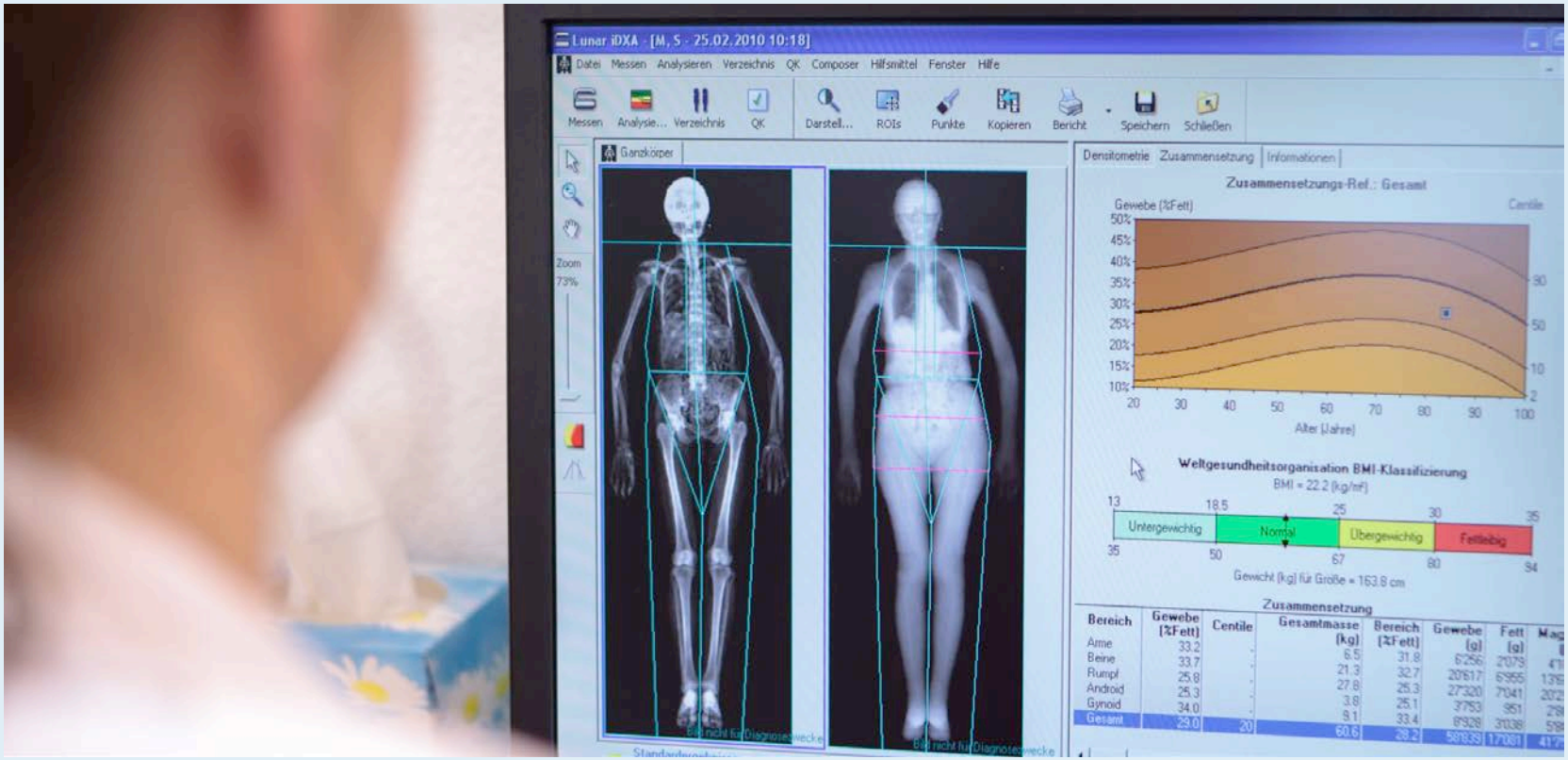
- Ohne Frakturen

Eine medikamentöse Therapie wird empfohlen, wenn das auf der Grundlage der derzeit verfügbaren epidemiologischen Daten geschätzte absolute 10-Jahresrisiko für eine osteoporotische Fraktur dem absoluten Risiko einer Person gleichen Alters mit prävalenter Fraktur entspricht oder der T-Score -2.5 (LWS oder Femur) beträgt:



Alter	10-Jahres-Frakturrisiko (FRAX®) (Hauptfrakturen: Wirbel, Hüfte, Humerus, Radius)		
50 Jahre	≥10%	55 Jahre	≥13%
60 Jahre	≥17%	65 Jahre	≥20%
70 Jahre	≥23%	75 Jahre	≥28%
≥ 80 Jahre	≥33%		

Measuring muscle mass with DEXA



Bioimpedanzmessung

Sarcopenia: revised European consensus on definition and diagnosis

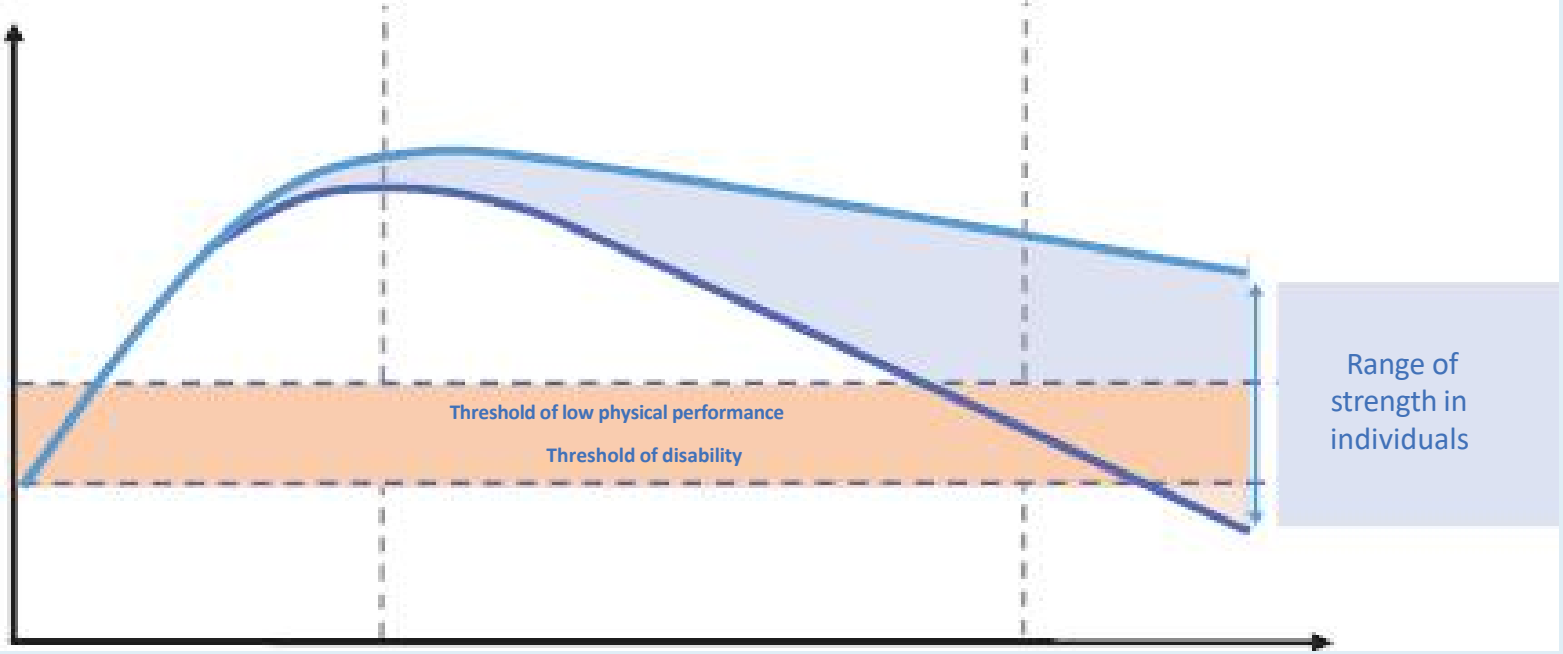


Figure 3. Muscle strength and the life course. To prevent or delay sarcopenia development, maximise muscle in youth and young adulthood, maintain muscle in middle age and minimise loss in older age

Table 2. Choosing tools for sarcopenia case finding and for measurement of muscle strength, muscle mass and physical performance in clinical practice and in research

Variable	Clinical practice	Research studies	Video for practical instruction, reference
Case finding	SARC-F questionnaire	SARC-F	Malmstrom et al. (2016) [12]
	Ishii screening tool		Ishii et al. (2014) [40]
Skeletal musclestrength	Grip strength	Grip strength	Roberts et al. (2011) [41]
	Chair stand test (chair rise test)	Chair stand test (5-times sit-to-stand)	American Academy of Orthotists & Prosthetists https://www.youtube.com/watch?v=_jPl-IuRJ5A
Skeletal musclemass orSkeletalmuscle quality	Appendicular skeletal muscle mass (ASMM) by Dual-energy X-ray absorptiometry (DXA)*	ASMM by DXA	Schweitzer (2015) [42] Mitsiopoulos (1998) [43]
	Whole-body skeletal muscle mass (SMM) Magnetic	Whole-body SMM or ASMM by Resonance Imaging (MRI, total body protocol)	Shen (2004) [44] Sergi (2017) [45] Maden-Wilkinson (2013) [46] Heymsfield (1990) [47] Kim (2002) [48] Yamada (2017) [49]
	or ASMM predicted by Bioelectrical impedance analysis (BIA)*		
		Mid-thigh muscle cross-sectional area by Computed Tomography (CT) or MRI	Lee (2004) [50]
	Lumbar muscle cross-sectional area by CT MRI	Lumbar muscle cross-sectional area by CT or	Van der Werf (2018) [51] Derstine (2018) [52]
	or MRI	Muscle quality by mid-thigh or total body muscle quality by muscle biopsy, CT, MRI or Magnetic resonance Spectroscopy (MRS)	Goodpaster (2000) [53] Reinders (2016) [54] Grimm (2018) [55] Distefano (2018) [56] Ruan (2007) [57]
Physical performance	Gait speed	Gait speed	NIH Toolbox 4 Meter Walk Gait Speed Test https://www.nia.nih.gov/research/labs/leps/short-physical-performance-battery-sppb https://www.youtube.com/watch?v=xLScK_NXUN0
	Short physical performance battery (SPPB)	SPPB	Short Physical Performance Battery Protocol https://research.ndorms.ox.ac.uk/prove/documents/assessors/outcomeMeasures/SPPB_Protocol.pdf NIH Toolbox https://www.nia.nih.gov/research/labs/

Greifkraftmessung: Cut off

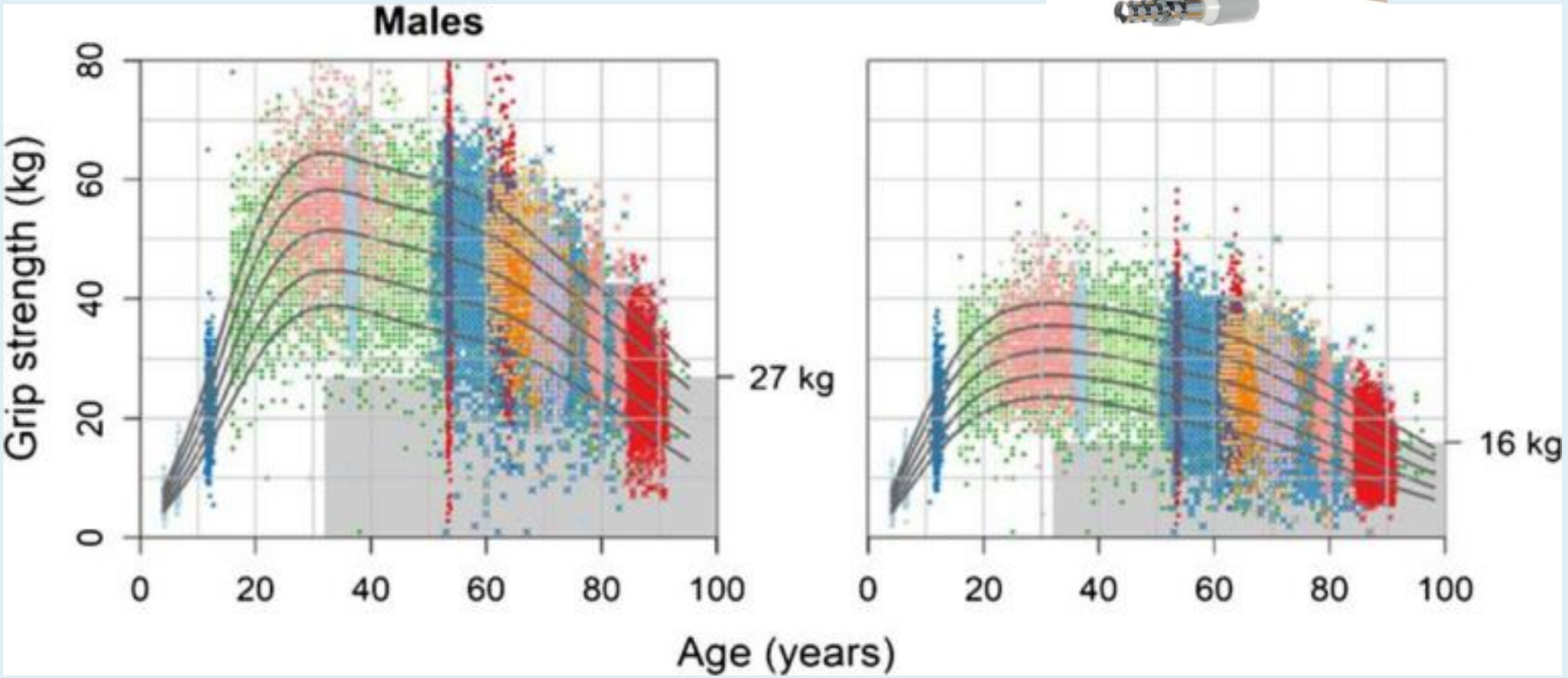
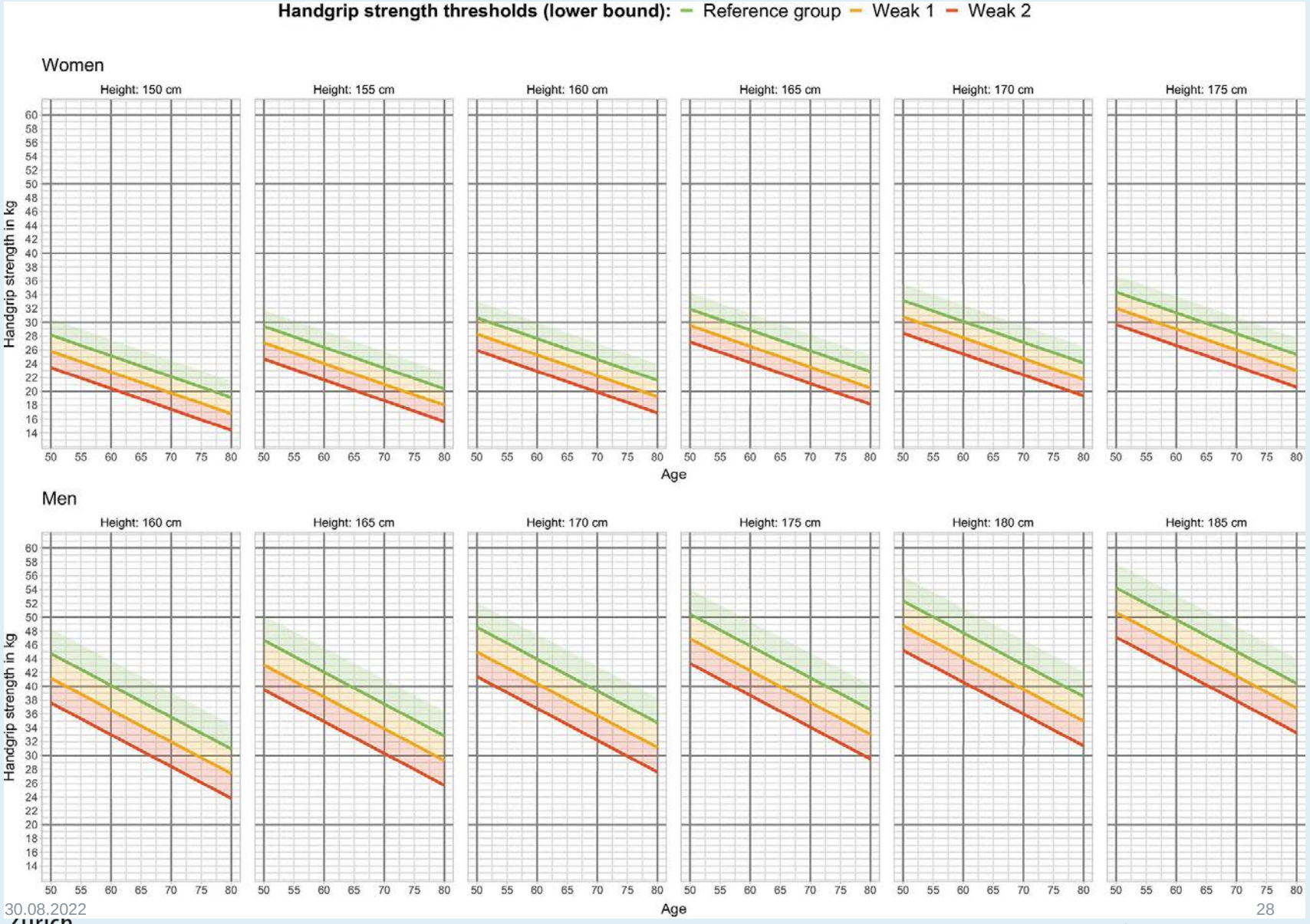


Figure 2. Normative data for grip strength across the life course in men and women in the UK (Dodds RM, et al. PLoS One.
2014;9:e113637). Centiles shown are 10th, 25th, 50th, 75th and 90th. Cut-off points based on T-score of ≤ -2.5 are shown for
males and females (≤27 kg and 16 kg, respectively). Color-coding represents different birth cohorts used for the study
(Figure adapted with permission from R Dodds and PLOS One).


Handgrip strength thresholds (lower bound): Reference group Weak 1 Weak 2
Women
Height: 150 cm
Height: 155 cm
Height: 160 cm
Height: 165 cm
Height: 170 cm
Height: 175 cm
Handgrip strength in kg
Age
Men
Height: 160 cm
Height: 165 cm
Height: 170 cm
Height: 175 cm
Height: 180 cm
Height: 185 cm
Handgrip strength in kg
Age

A. J. Cruz-Jentoft et al.

Table 3. EWGSOP2 sarcopenia cut-off points

Test	Cut-off points for men	Cut-off points for women	References
EWGSOP2 sarcopenia cut-off points for low strength by chair stand and grip strength			
Grip strength	<27 kg	<16 kg	Dodds (2014) [26]
Chair stand	>15 s for five rises		Cesari (2009) [67]
EWGSOP2 sarcopenia cut-off points for low muscle quantity			
ASM	<20 kg	<15 kg	Studenski (2014) [3]
ASM/height^2	<7.0 kg/m^2	<5.5 kg/m^2	Gould (2014) [125]
EWGSOP2 sarcopenia cut-off points for low performance			
Gait speed	≤0.8 m/s		Cruz-Jentoft (2010) [1]
			Studenski (2011) [84]
SPPB	≤8 point score		Pavasini (2016) [90]
			Guralnik (1995) [126]
TUG	≥20 s		Bischoff (2003) [127]
400 m walk test	Non-completion or ≥6 min for completion		Newman (2006) [128]

Strong Relation Between Muscle Mass Determined by D 3 creatine Dilution, Physical Performance, and Incidence of Falls and Mobility Limitations in a Prospective Cohort of Older Men

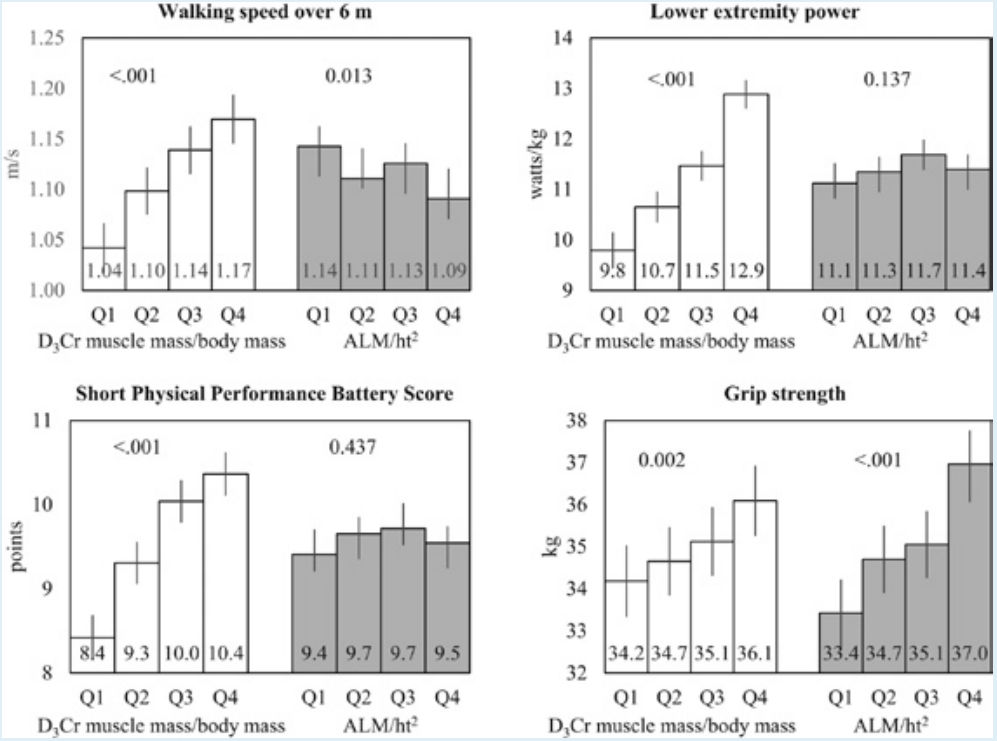


Figure 2. Adjusted* means of walking speed over 6 m, lower extremity power, SPPB score, and grip strength across quartiles of D3 Cr muscle mass/ body mass or ALM/ht2 . *Adjusted for age, clinical center, race, alcohol use, smoking, congestive heart failure, chronic obstructive pulmonary disease, diabetes, myocardial infarction, physical activity, exhaustion, and cognitive function. Quartile cut-points for D3 Cr muscle mass/body mass: Q1: <0.27 Q2: ≥0.27–0.30, Q3: ≥0.30–0.34, Q4: ≥0.34. Quartile cut-points for ALM/ht 2 (kg/m2): Q1: <6.9, Q2: ≥6.9–<7.5, Q3: ≥7.5–<8.1, Q4: ≥8.1. ALM = Appendicular lean mass.

Frailty Definition nach Fried

GRAFIK 1

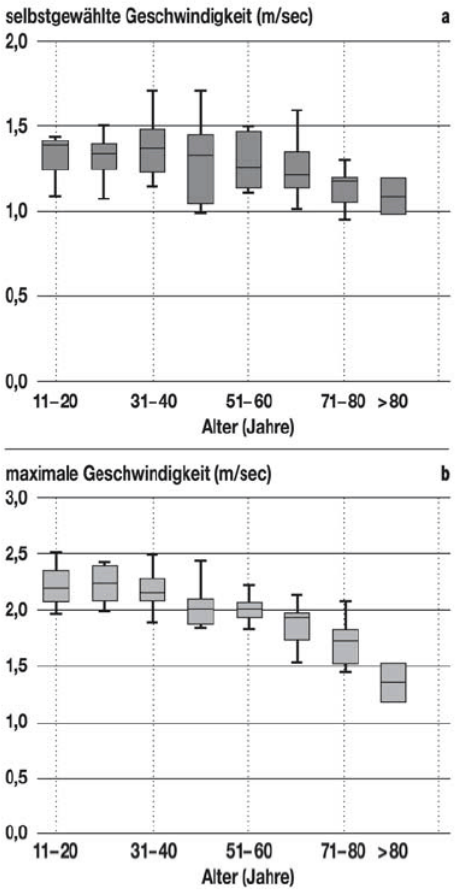


TABLE 1

Fried frailty model (Fried et al. [4])

Components of frailty (criteria)	Assessment
Unintended weight loss in past year >4.5 kg	0 component present: robust 1–2 components present: pre-frail ≥ 3 component present: frail
Self-reported exhaustion	
Weakness (grip strength)	
Slow walking speed	
Low physical activity	

A detailed worksheet in German is available at www.hs-gesundheit.de/to/frailtyphaenotyp (e8).

TABELLE 1

Wichtige anamnestische Informationen bei Gangstörungen

Dauer/Verlauf	– episodisch (z. B. blutdruckabhängig) oder dauerhaft (z. B. Polyneuropathie) – plötzlich beginnend (z. B. Schlaganfall) oder langsam progedient (z. B. spinozerebelläre Ataxie)
Auslöser/Verstärkungsfaktoren	– Umgebung (z. B. Dunkelheit, unebener Untergrund bei bilateraler Vestibulopathie) – situativ (z. B. phobisch) – Dual-task (z. B. Ansprechen während des Gehens) – Medikamenteneinnahme
Begleitsymptome	– Schwindel (z. B. Schwankschwindel bei zerebellärer Ataxie) – Angst (z. B. Sturzangst) – Schmerzen (z. B. Arthrose) – Sensibilitätsstörungen (z. B. Polyneuropathie)
Medikamente/Alkohol	– Benzodiazepine, Barbiturate, Antidepressiva, Neuroleptika, Antiepileptika, Parkinson-Medikation, Analgetika – Blutdruckmedikation, Antiarrhythmika, Antidiabetika – Alkoholkonsum
Begleiterkrankungen	– Herz/Lunge (z. B. Herzinsuffizienz mit verminderter Belastbarkeit) – metabolisches Syndrom (z. B. Diabetes mit Polyneuropathie)
Stürze	– einmalig (z. B. mit nachfolgender Angst zu stürzen) – rezidivierend (z. B. progressive supranukläre Blickparese) – Mechanismus (z. B. Stolpern, Tonusverlust, Synkope)

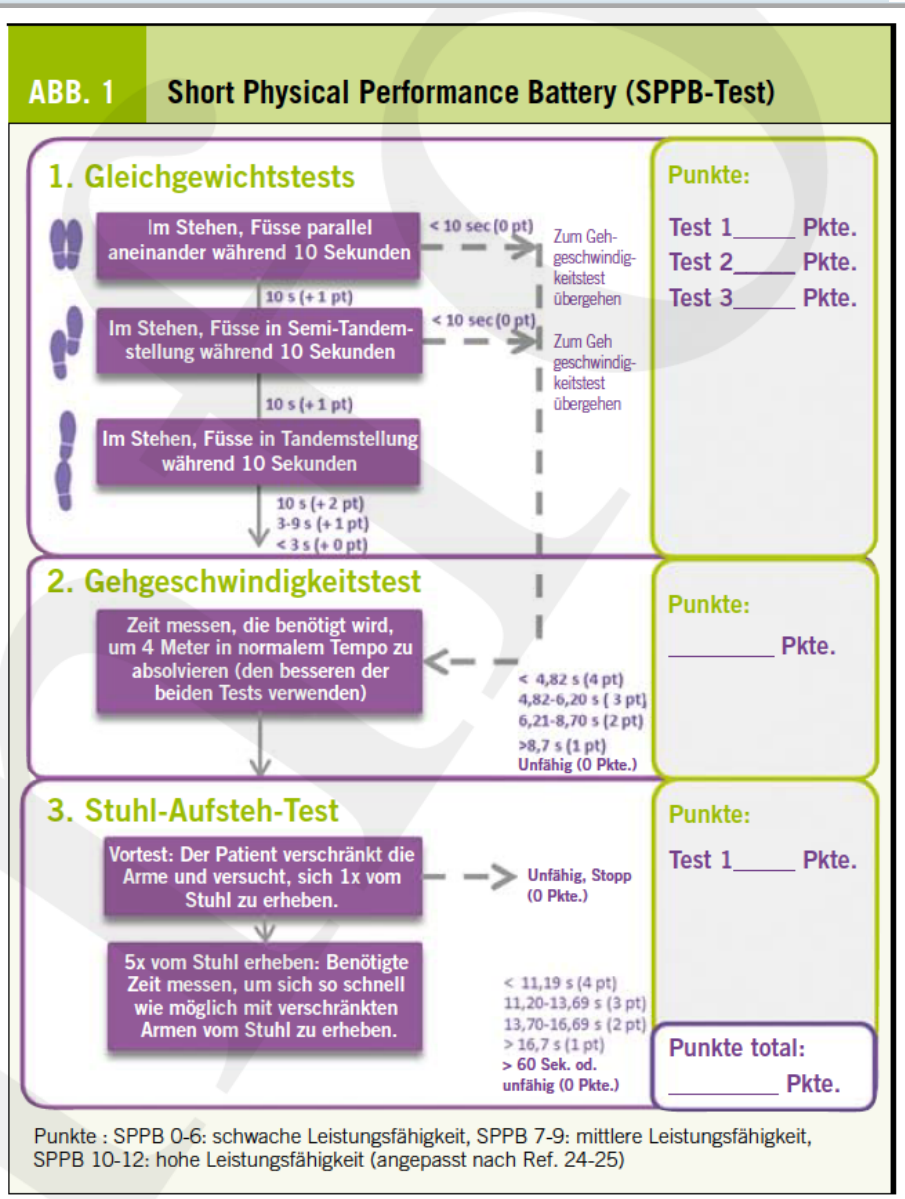
TABELLE 3

Auswahl neurologischer Gangstörungen mit bevorzugtem Auftreten in höherem Lebensalter

Diagnose	Klinische Zeichen	Therapieoptionen
Sensorische Defizite		
Polyneuropathie	– Gangunsicherheit, vor allem bei geschlossenen Augen – distal betonte Sensibilitätsstörung – Ausfall ASR	– Therapie der Grunderkrankung (z. B. Diabetes mellitus) – Vermeidung neurotoxischer Substanzen (z. B. Alkohol) – Krankengymnastik
bilaterale Vestibulopathie	– Gangunsicherheit im Dunkeln und auf unebenem Grund – Oszillopsien (Bildverwacklungen) – pathologischer Kopfimpulstest	– Therapie der Grunderkrankung (z. B. Morbus Menière) – Vermeidung ototoxischer Substanzen (z. B. Aminoglykoside) – Gleichgewichtstraining
Visusminderung	– Gangunsicherheit, vor allem auf unebenem Grund – ophthalmologische Auffälligkeiten	– Therapie der Grunderkrankung (z. B. Katarakt) – Anpassung Sehhilfe
Neurodegeneration		
Parkinson-Syndrome	– hypokinetische Gangstörung und Begleitsymptome (Tremor, autonom, okulomotorisch, zerebellär, demenziell) – verminderte „Dual-task"-Fähigkeit	– L-Dopa-Therapie/Therapieversuch bei atypischem PS – Krankengymnastik
zerebelläre Ataxie	– ataktische Gangstörung – Extremitätenataxie – Okulomotorikstörung	– Vermeidung toxischer Substanzen (z. B. Alkohol) – Krankengymnastik
demenzielle Syndrome	– verlangsamtes Gehen – Sturzneigung – räumliche Orientierungsstörung – verminderte „Dual-task"-Fähigkeit	– Behandlung der Grunderkrankung – körperliche Aktivität korreliert mit kognitiven Leistungen, daher Krankengymnastik
andere		
vaskuläre Enzephalopathie (MRT Abbildung 1b)	– „frontale Gangstörung" (kleinschrittig, breitbasig, gute Armmitbewegungen) – kognitive Einschränkungen (verminderte „Dual-task"-Fähigkeit)	– Behandlung Gefäßrisikofaktoren (Hypertonus) – Krankengymnastik
Normaldruckhydrozephalus (MRT Abbildung 1a)	– apraktische Gangstörung – Trias: Gangstörung, kognitive Defizite, Harninkontinenz – Besserung nach Liquorablass	– intermittierende Liquorpunktionen oder ventrikulo-peritonealer Shunt (Besserung insbesondere der Gangstörung)
ängstliche Gangstörung („fear of falling")	– „Walking on ice" (breitbasig, haltsuchend) – keine Störung im „Dual-task" – Besserung bei geringer Unterstützung oder Ablenkung	– Aufklärung – gezielte Krankengymnastik – Verhaltenstherapie und ggf. medikamentöse Behandlung der Angst (SSRI)
toxisch (Medikamente, Alkohol)	– fluktuierende Gangstörung – Anamnese – bei Alkohol: PNP und zerebelläre Ataxie möglich	– Vermeidung/Ausschleichen der auslösenden Substanz

ASR, Achillessehnenreflex;
PNP, Polyneuropathie;
PS, Parkinson-Syndrom;
SSRI, selektiver Serotonin-Wiederaufnahmehemmstoff

Short Physical Performance Battery Test



Test /Uebung: Hüft, Kniestrecker, Rumpf

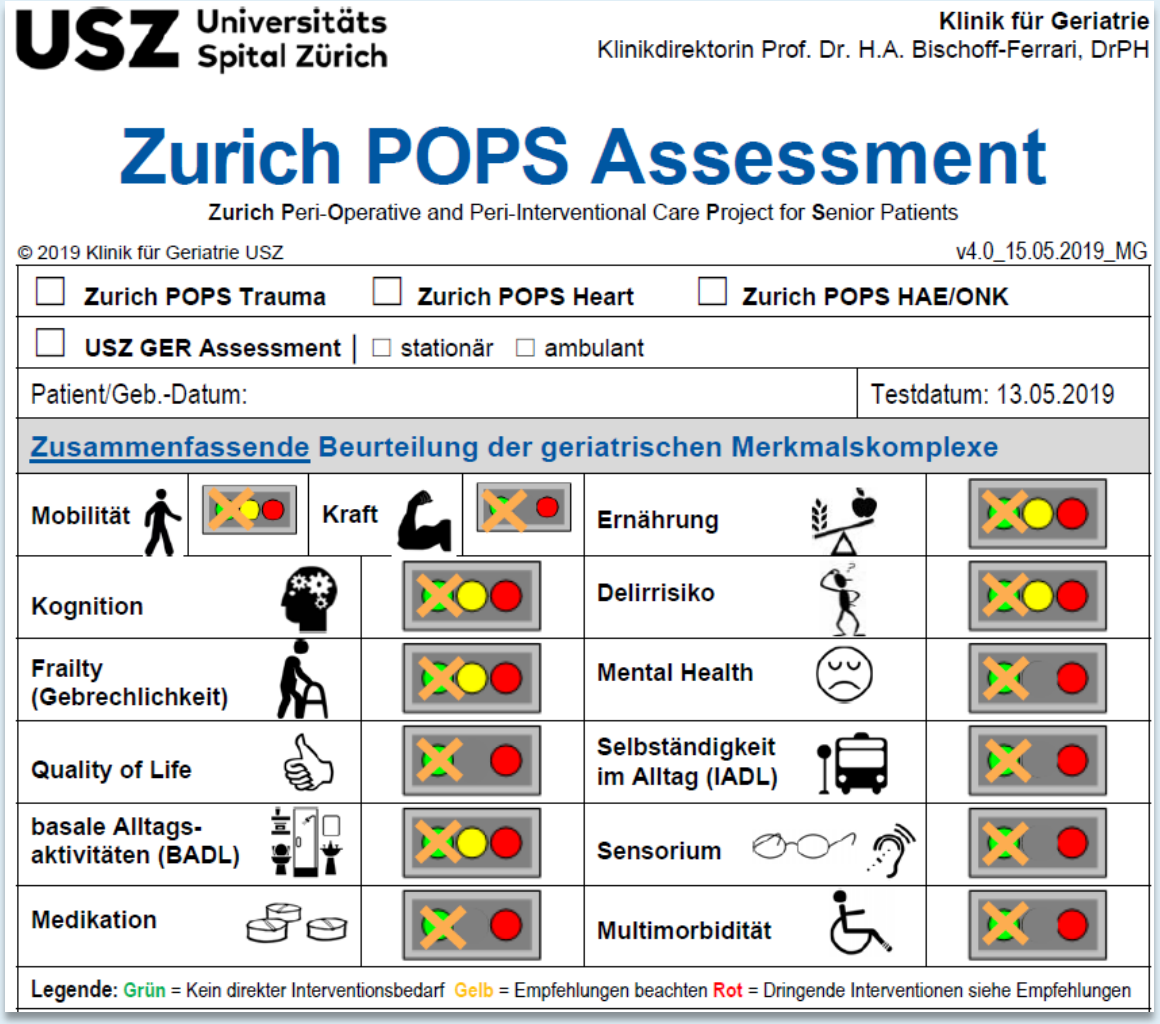
Normwerte pro Minute

Alter	Männer	Frauen
50 - 54	40	36
55 - 59	38	34
60 - 64	33	29
65 - 69	31	27
70 - 74	29	26
75 - 79	28	25
80 - 84	25	23
85 - 89	23	21
90 - 94	20	16

Robust, Prefrail, Frail: Präoperataives Screening

GER Assessment

- Mobilität und Kraft
- Ernährungssituation
- Kognition und emotionale Situation
  - Delirrisikoabschätzung
- Frailty (Gebrechlichkeit)
- Quality of Life
- Activities of Daily Living (ADL/IADL)
- Sensorische Einschränkungen
- Polypharmazie, Polypragmasie
- Multimorbidität



USZ Universitäts Spital Zürich

Klinik für Geriatrie
Klinikdirektorin Prof. Dr. H.A. Bischoff-Ferrari, DrPH

Zurich POPS Assessment

Zurich Peri-**O**perative and Peri-Interventional Care **P**roject for **S**enior Patients

© 2019 Klinik für Geriatrie USZ — v4.0_15.05.2019_MG

☐ **Zurich POPS Trauma** ☐ **Zurich POPS Heart** ☐ **Zurich POPS HAE/ONK**

☐ **USZ GER Assessment** | ☐ stationär ☐ ambulant

Patient/Geb.-Datum: | Testdatum: 13.05.2019

Zusammenfassende Beurteilung der geriatrischen Merkmalskomplexe

Mobilität	**Kraft**	**Ernährung**	
Kognition		**Delirrisiko**	
Frailty (Gebrechlichkeit)		**Mental Health**	
Quality of Life		**Selbständigkeit im Alltag (IADL)**	
basale Alltags-aktivitäten (BADL)		**Sensorium**	
Medikation		**Multimorbidität**	

Legende: Grün = Kein direkter Interventionsbedarf Gelb = Empfehlungen beachten Rot = Dringende Interventionen siehe Empfehlungen

UniversitätsSpital Zürich

Trainingsinterventionen bei älteren Erwachsenen und Frakturpatienten

Prof. Dr. med. Robert Theiler
Leiter Spezialsprechstunde Osteologie und Sarkopenie
Klinik für Geriatrie

Interessenkonflikte: Keine

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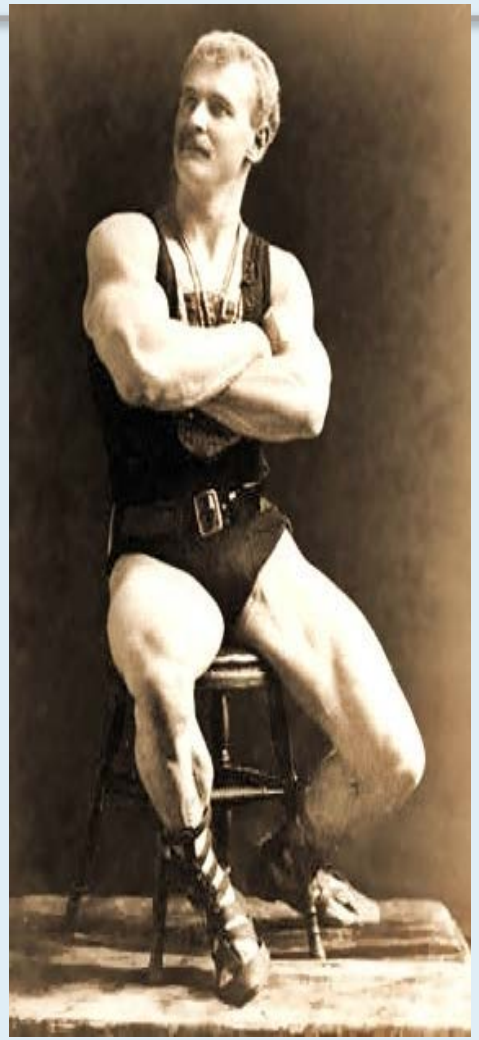
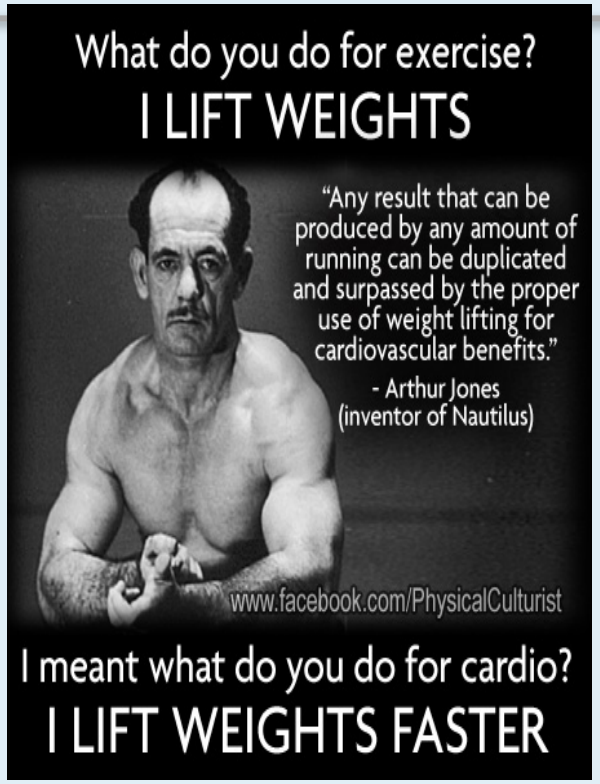
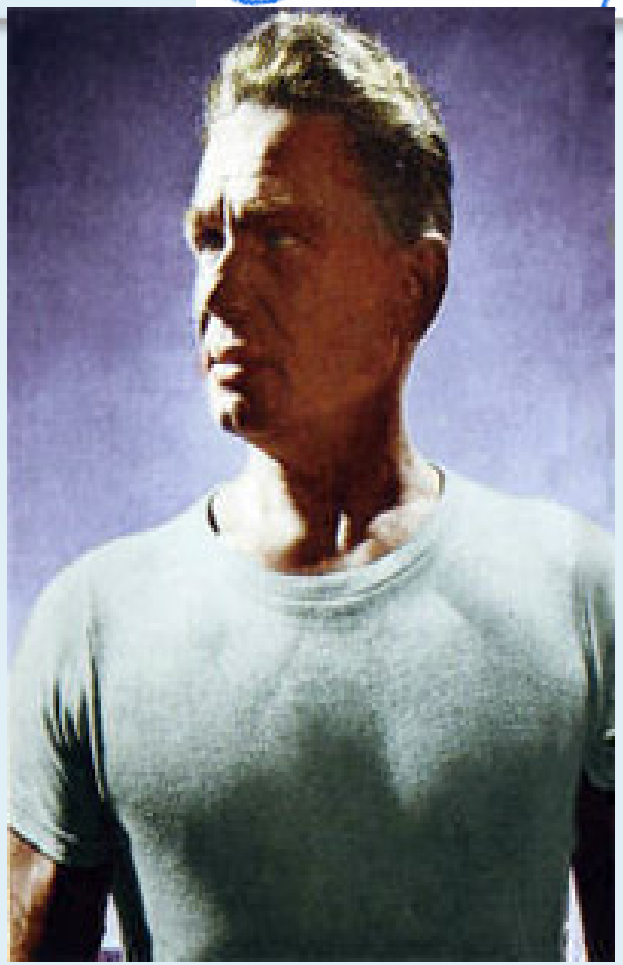
DOHEALTH
Universität Zürich[UZH]

Geschichte Kraft-Training

- 1835-1920: Dr. Gustav Zander
- 1865-: Max Herz
- 1820-1884: Archibald Mc Laren
- 1904: Freikörperkultur (Müller)
- 1867-1925: Eugen Sandow
- 1836-1937 Pierre de Coubertin / 1891 1. Olympische Spiele
- 1954 American College of Sport Medicine (ACSM)
- 1975 Dr K.Cooper Aerobics
- 1926-2007: Dr. A.Jones Nautilus MaschinenMedX
- 1972 Center for Exercise Science/ University of Florida
- 1967 Kieser Training
- 2006 Initiative: Exercise is Medicine (AMA and ACSM)





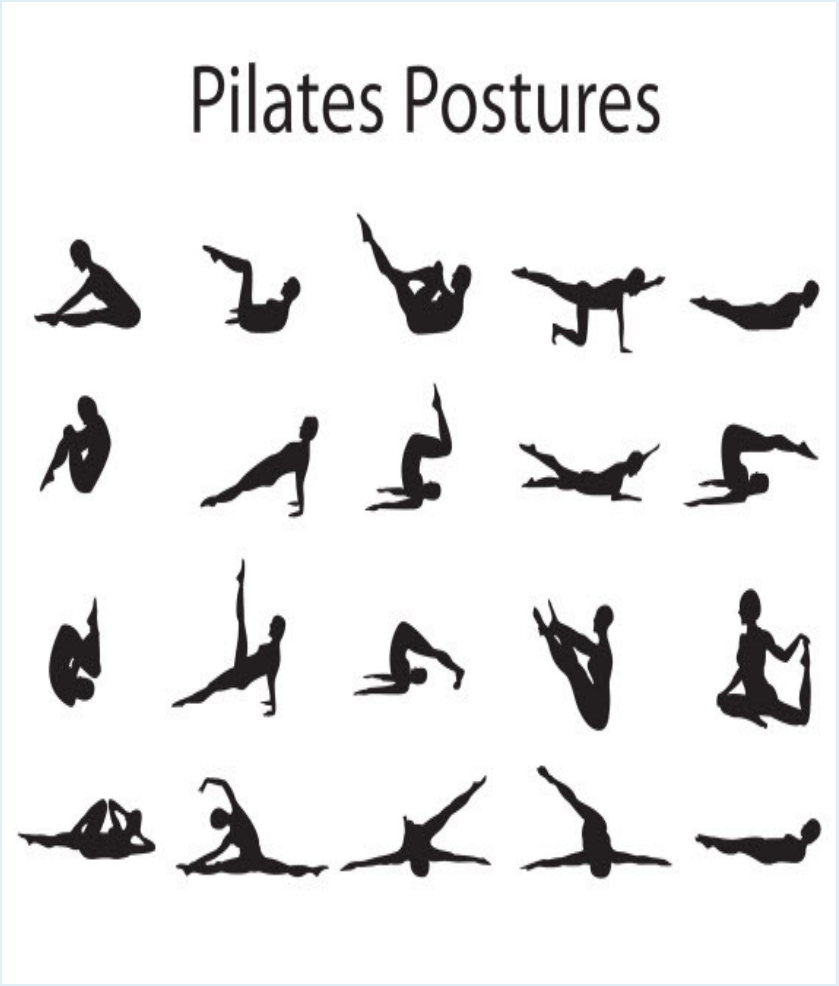


Sandow

Dr Jones

J.Pilates

Pilates: Matten und Geräteübungen



Cell Metabolism
Perspective

Exercise Promotes Healthy Aging of Skeletal Muscle

Gregory D. Cartee,[1,2,3] Russell T. Hepple,[4,5,6] Marcas M. Bamman,[7,8,9] and Juleen R. Zierath[10,11,12,*]
[1]Muscle Biology Laboratory, School of Kinesiology
[2]Department of Molecular and Integrative Physiology
[3]Institute of Gerontology
University of Michigan, Ann Arbor, MI 48109, USA

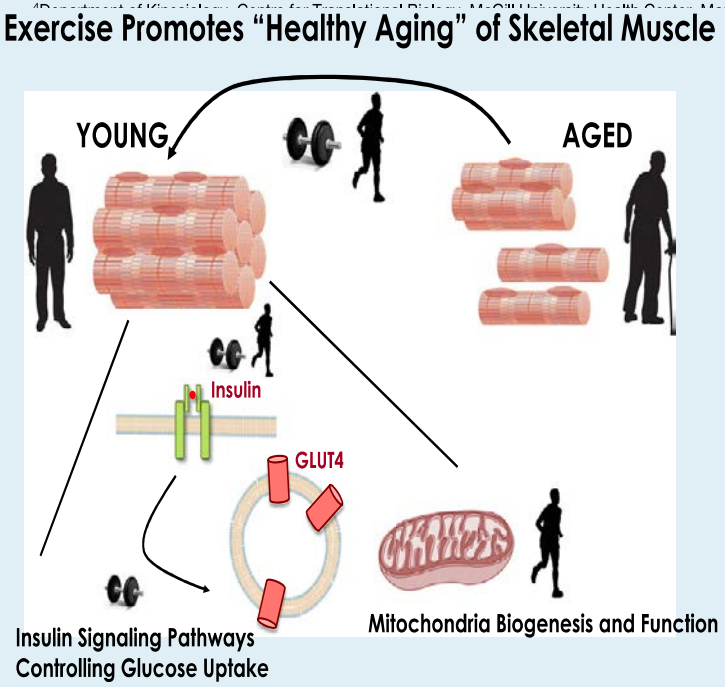


Figure 1. Exercise Is a Potent Countermeasure against Secondary Aging

Endurance exercise enhances muscle insulin sensitivity in older individuals and prevents declines in mitochondrial respiratory capacity with aging. Resistance exercise induces remarkable gains in strength and power in older adults.

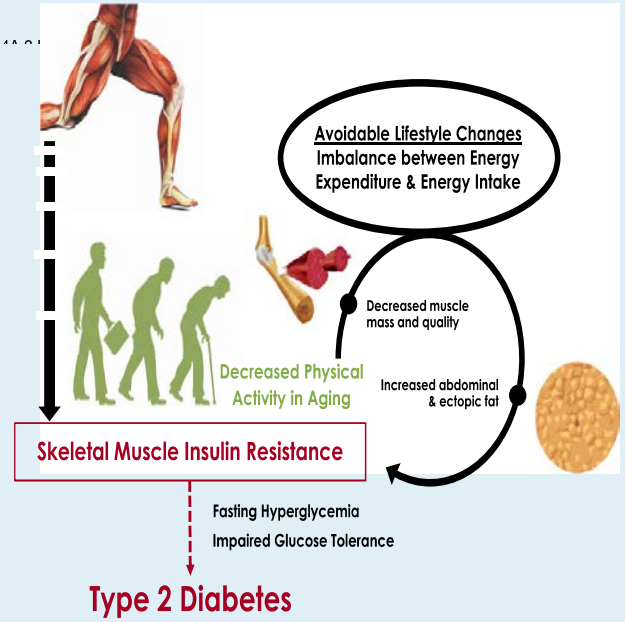


Figure 2. Age-Related Changes in Body Composition and Insulin Sensitivity in Older Individuals Are Influenced by Physical Activity and Exercise Training

Advancing age is typically characterized by altered body composition (increased abdominal and ectopic fat accumulation and attenuated mass and metabolic quality of skeletal muscle) together with reduced physical activity, leading to insulin resistance in skeletal muscle. These age-related changes can be exacerbated by lifestyle behaviors that produce a major imbalance between energy expenditure and energy intake, leading to further dysregulation of glucose metabolism and increasing the likelihood of type 2 diabetes.

Ziel: Uebungsprogramme auf Typ II Muskelfasern ausgerichtet

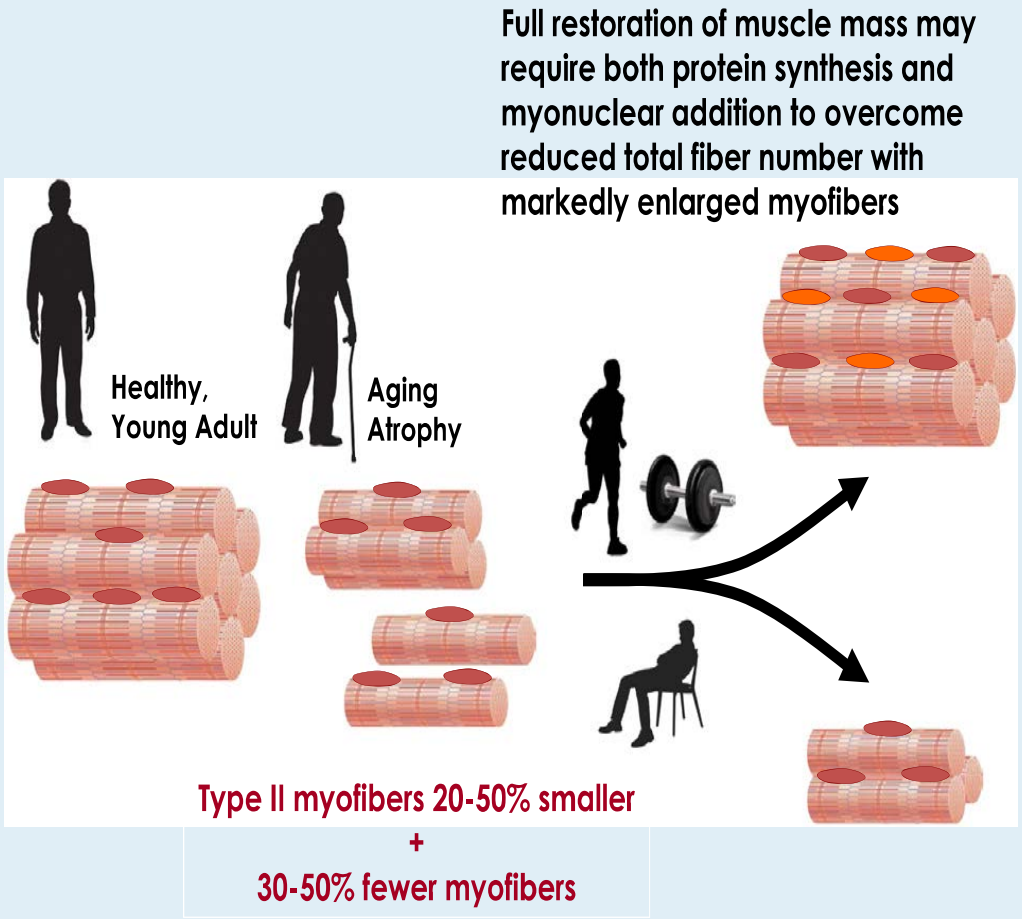


Figure 3. Conceptual Model of Aging Muscle Atrophy and the Impact of Progressive Resistance Exercise Training

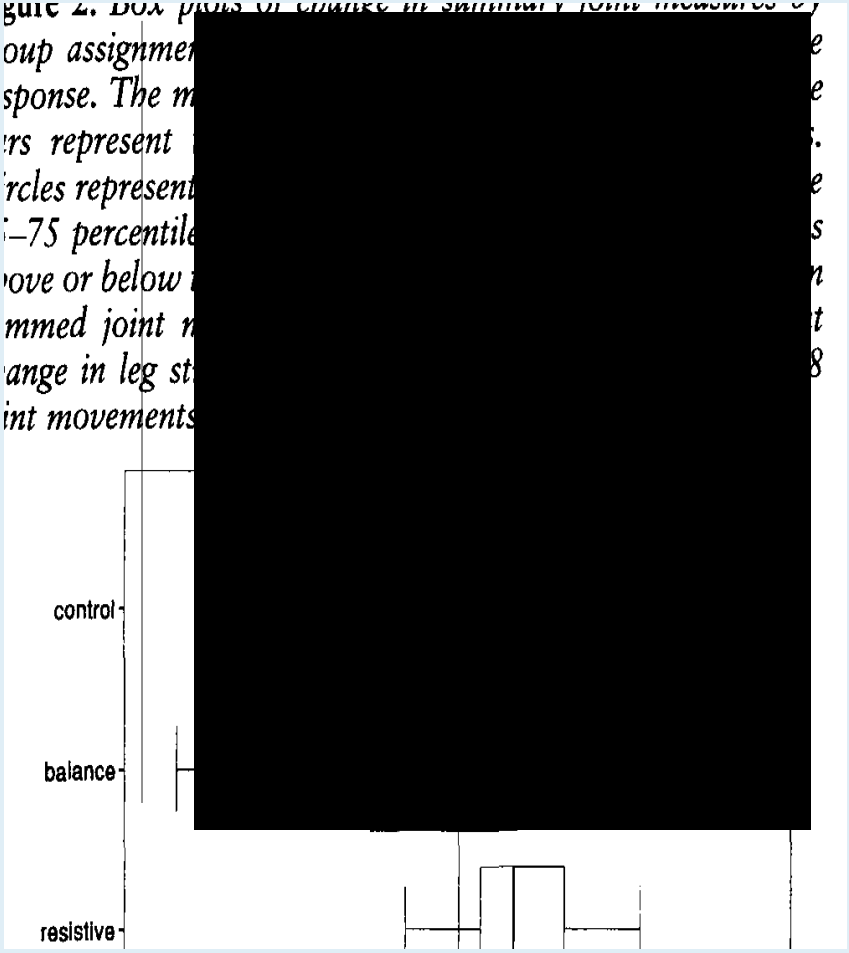
Cell Metabolism 23, 2016: 1034-47

from the National Institute of Aging.
Address correspondence to James O. Judge, MD, Travelers Center on Aging, University of Connecticut Health Center, Farmington, CT 06030–5215.

interventions designed to reduce functional declines
muscle weakness.

JAGS 42:937–946, 1994

0002-8614/



JAGS 1994;42:937-946

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72 to 98), 94 percent of the subjects completed the study. Muscle strength increased by 113±8 percent in the subjects who underwent exercise training, as compared with 3±9 percent in the nonexercising subjects (P<0.001). Gait velocity increased by 11.8±3.8 percent in the exer-

ing is a feasible and effective means of counteracting muscle weakness and physical frailty in very elderly people. In contrast, multinutrient supplementation without concomitant exercise does not reduce muscle weakness or physical frailty. (N Engl J Med 1994;330:1769-75.)

THE decline in muscle strength and mass during aging[1,2] has been linked to physical frailty, falls, functional decline, and impaired mobility in very elderly people.[3-5] Although many factors, including chronic illness, a sedentary lifestyle, nutri ciencies, and aging itself, may contribute weakness and loss of skeletal-muscle mass i

advanced age,[6-10] currently only skeletal-muscle disuse[11,12] and undernutrition[13-15] are potentially preventable or reversible with targeted interventions.

Muscle dysfunction associated with malnutrition lementation in elderly men, a l muscle hyper-

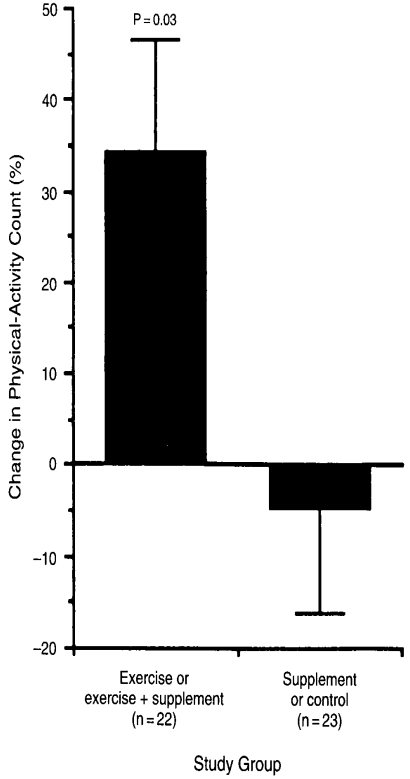


Figure 3. Mean (±SE) Changes in the Level of Spontaneous Physical Activity, According to the Presence or Absence of Exercise.

Bars indicate the percentage of change in the physical-activity count after adjustment for age, sex, functional status, base-line muscle strength, and hypertension. Nutritional supplementation had no effect on the mean daily physical-activity level, which was calculated from measurements over a 72-hour period. Exercise training was associated with a significant increase in the mean daily level of physical activity.

Community dwelling Seniors:

JAMA,2013(309):1406-07

Evidence Profile

No. of randomized trials: 159

Study years: 1990-2011

No. of participants: 79 193

Men: 23 758 (30%) Women: 55 435 (70%)

Race/ethnicity: Unavailable

Age, mean (range): 75 (51-101) years

Setting: Community

Countries: Australia, Austria, Belgium, Brazil, Canada, Chile, China, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, New Zealand, Norway, Sweden, Switzerland, Taiwan, Thailand, United Kingdom, United States

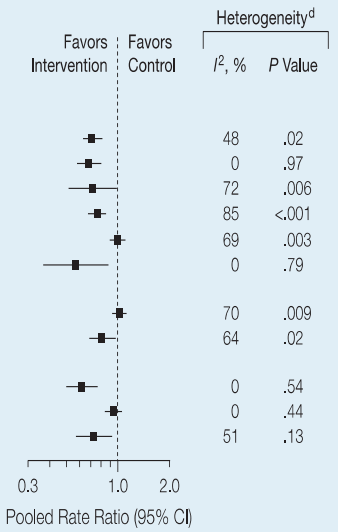
Comparison: Intervention to prevent falls vs control group

Primary outcomes: Rate of falls; number of fallers

Secondary outcomes: No. of participants sustaining fall-related fractures

Figure. Rate Ratios (All Falls) for Selected Fall-Prevention Interventions vs Control in Community-Dwelling Older People[a]

Intervention[b]	No. of Trials[c]	No. of Participants	Pooled Rate Ratio (95% CI)	Heterogeneity[d] I^2, %	Heterogeneity[d] *P* Value
Exercise programs (multiple-component)					
Group classes	16	3622	0.71 (0.63-0.82)	48	.02
Home-based programs	7	951	0.68 (0.58-0.80)	0	.97
Tai Chi classes	5	1563	0.72 (0.52-1.00)	72	.006
Multifactorial interventions	19	9503	0.76 (0.67-0.86)	85	<.001
Vitamin D supplementation	7	9324	1.00 (0.90-1.11)	69	.003
Selected for lower levels of serum vitamin D	2	260	0.57 (0.37-0.89)	0	.79
Not selected for lower levels	5	9064	1.02 (0.93-1.13)	70	.009
Home safety assessment and modification	6	4208	0.81 (0.68-0.97)	64	.02
Higher risk of falling	3	851	0.62 (0.50-0.77)	0	.54
Not selected on fall risk	3	3357	0.94 (0.84-1.05)	0	.44
Cardiac pacing[e]	3	349	0.73 (0.57-0.93)	51	.13



[a] Based on data from Gillespie LD, Robertson MC, Gillespie WJ, et al. Interventions for preventing falls in older people living in the community. *Cochrane Database Sys Rev*. 2012;(9):CD007146. doi:10.1002/14651858.CD007146.pub3. Absolute numbers for analyses are not provided because the absolute number of falls in each group was not always available. For these analyses, the "absolute number" was a rate of falls, eg, falls per person-year, or in some cases a reported rate ratio.

[b] Control groups received no intervention, usual care, or an intervention that was not expected to reduce falls, eg, social visits.

[c] The number of trials does not add to 159 because not all of the trials evaluated in the Cochrane review are summarized here.

[d] Variation across the results from individual studies due to clinical and/or statistical diversity. A *P* value <.10 represents a statistically significant variation. I^2 measures the variation in results between studies that is due to heterogeneity rather than sampling error (chance) (range, 0%-100%).

[e] For people with carotid sinus hypersensitivity and history of syncope and/or falls.

Effectiveness of two year balance training programme on prevention of fall induced injuries in at risk women aged 75-85 living in community: Ossébo randomised controlled trial

Fabienne El-Khoury,[1,2,3] Bernard Cassou,[4,5,6] Aurélien Latouche,[7] Philippe Aegerter,[4,5,8] Marie-Aline Charles,[2,3] Patricia Dargent-Molina[2,3]

Table 2 | Consequences of falls and estimates of effect intervention (two year balance training programme for prevention of fall induced injuries) in women aged 75-85

Consequences	Control (n=354)	Exercise (n=352)	HR* (95% CI)
Total No of falls (rate†)	640 (0.92)	533 (0.79)	0.88 (0.77 to 1.00)
No of participants who had at least one fall	222	189	—
No of injurious falls (rate†):			
Total	397 (0.56)	305 (0.45)	0.81 (0.67 to 0.99)
Moderate	310 (0.44)	237 (0.35)	0.81 (0.65 to 1.00)
Serious	87 (0.12)	68 (0.10)	0.83 (0.60 to 1.16)
No of participants who had at least one injurious fall	189	170	—

*Hazard ratio (adjusted for centre) computed with a "shared frailty" model. All women were included in analysis until their last time point. Covariance for random effect: 0.17 (SE 0.04; P<0.001) for all falls; 0.53 (SE 0.09; P<0.001) for injurious falls; 0.57 (SE 0.10; P<0.001) for moderate injurious falls; 0.35 (SE 0.25; P=0.30) for severe injurious falls.
†Rate per woman year=total number of events (fall related outcomes) divided by total number of woman years of follow-up in each group.

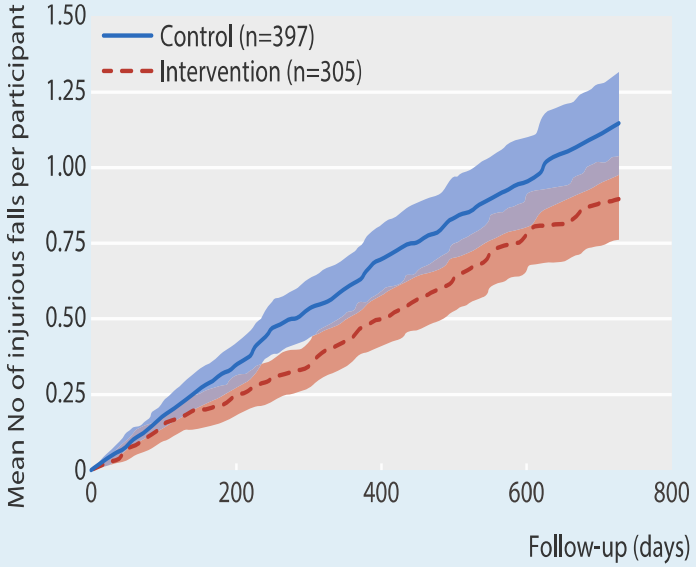


Fig 3 | Mean cumulative function (MCF) for two comparison groups: mean number of injurious falls in women aged 75-85 in two year balance training programme for prevention of fall induced injuries (intervention) or no such programme (control)

BMJ 2015;351

Effects of a Multimodal Exercise Program on Physical Function, Falls, and Injuries in Older Women: A 2-Year Community-Based, Randomized Controlled Trial

Radhika Patil, MSc, PT, Kirsti Uusi-Rasi, PhD,*† Kari Tokola, MSc,* Saija Karinkanta, PhD,* Pekka Kannus, MD, PhD,*‡§ and Harri Sievänen, ScD**

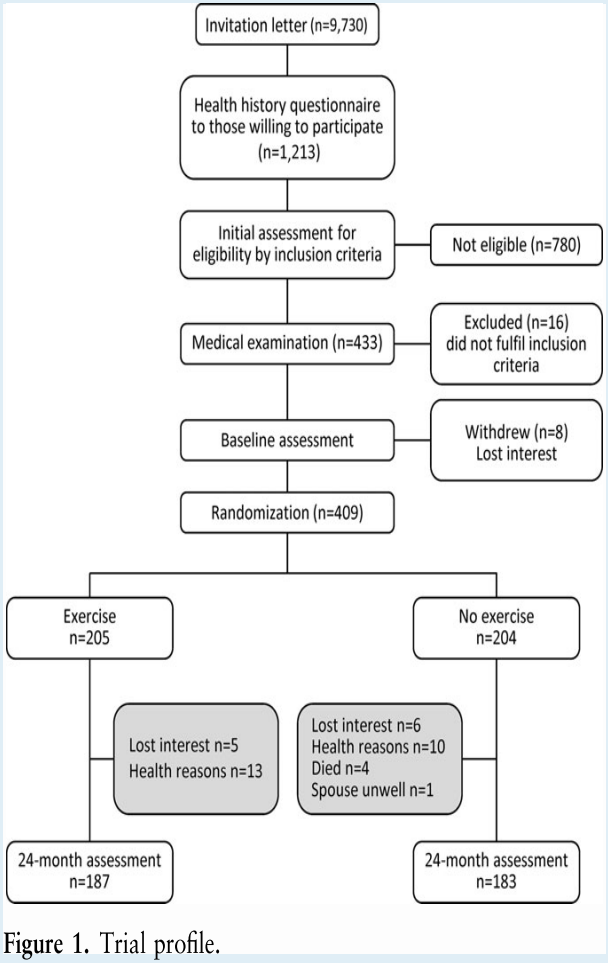


Figure 1. Trial profile.

JAGS 63:1306-1313, 2015

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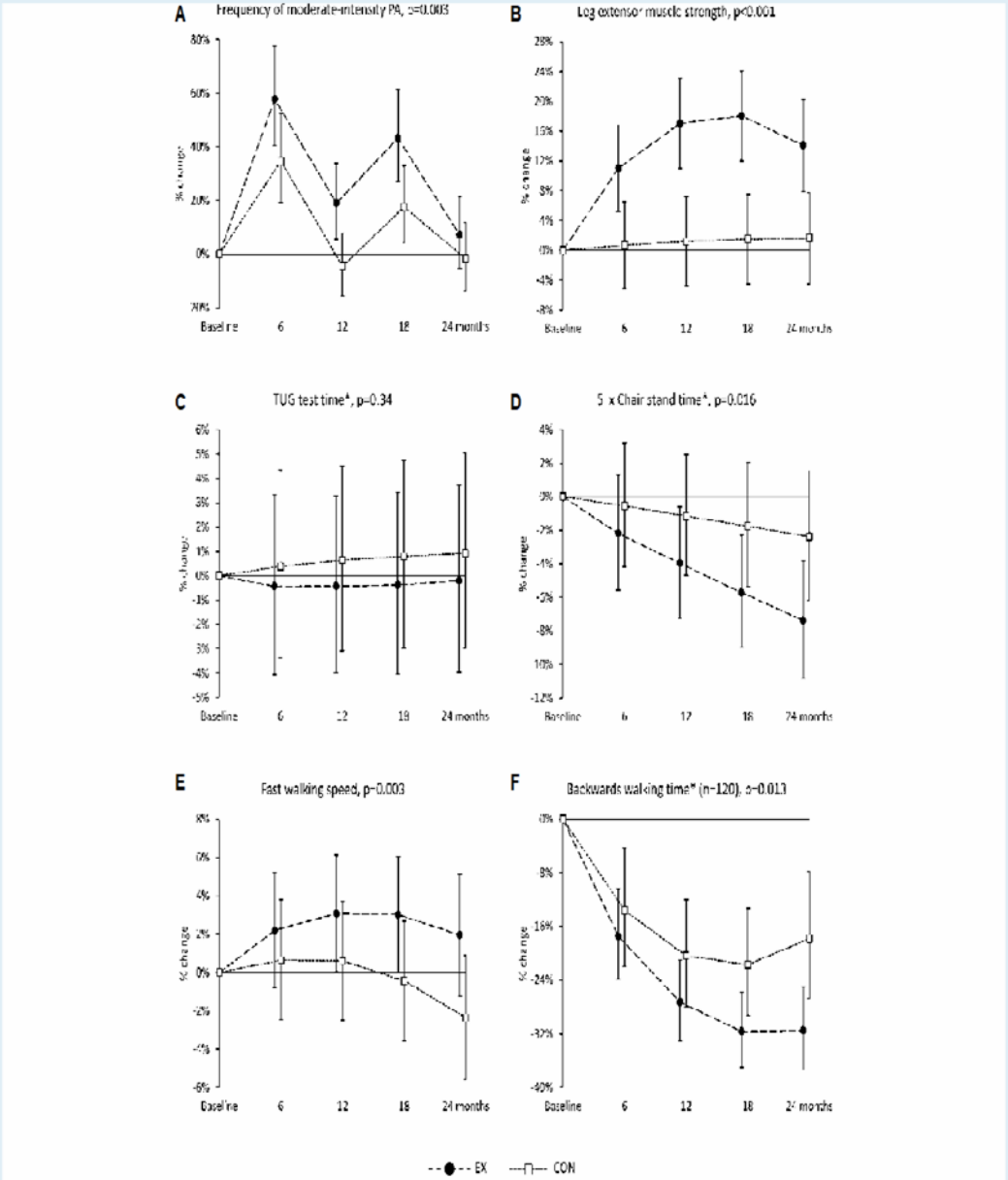

Figure 2. Mean percentage change (95% confidence interval) from baseline for frequency of self-reported physical activity (A) and physical function outcomes: (B) leg extensor muscle strength, (C) Timed Up- and- Go test, (D) 5 times chair stand test, (E) fast walking speed, (F) backward walking time. *Negative change (decreased time) indicates beneficial outcome. EX = exercise group, CON = control group.

Table 3. All Fall-Related Injuries and Medically Attended Fall Injuries According to Group

Injuries	Exercise Group	Control Group
Location, n (%)		
Indoors	75 (31)	60 (27)
Outdoors	152 (63)	156 (70)
Unknown	13 (6)	7 (3)
Fractures, n	8	12
Head and facial injuries, n		
Medically attended	6	12
Not medically attended	22	22
Other injuries (abrasions, bruises, contusions), n		
Medically attended	10	24
Not medically attended	190	152

Gerontology

Gerontology 2013;59:105–113
DOI: [redacted]

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Accepted: September 4, 2012
Published online: October 24, 2012

Effects of Core Instability Strength Training on Trunk Muscle Strength, Spinal Mobility, Dynamic Balance and Functional Mobility in Older Adults

Urs Granacher[a] Andre Lacroix[b] Thomas Muehlbauer[a] Katrin Roettger[b]
Albert Gollhofer[b]

[a]Department of Training and Movement Sciences, University of Potsdam, Potsdam, and [b]Institute of Sport and Sport Science, Albert Ludwigs University Freiburg, Freiburg, Germany

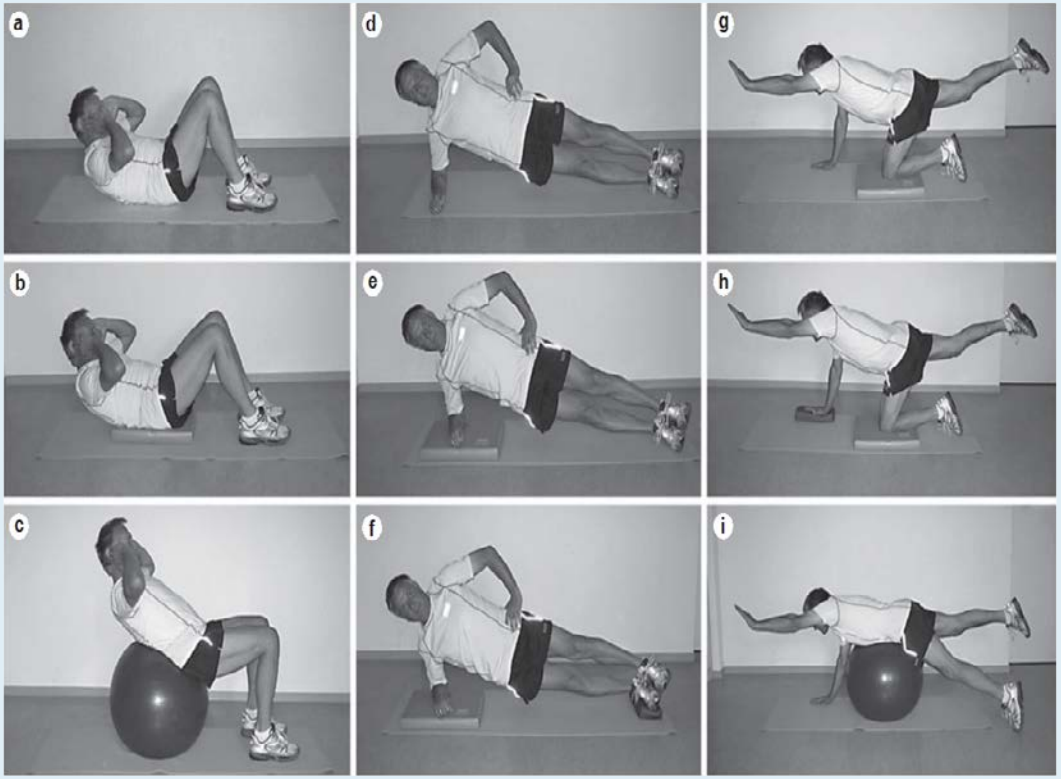


Fig. 1. Participant progressively performing curl up (a–c), side bridge (d–f) and quadruped (g–i) exercises.

Secondary prevention of hip fractures in the Zurich Hip fracture trial (n = 173)

- Home exercise programm: 5 exercises
- Fall reduction: -25% (95%CI:-44%,-1%)
- Rate of fracture: -56% (95%CI:-82% to 9%, p=0.08)
- Better in 3 of 4 functional tests (at least once a week)
- 8% higher knee extensor strength (p=0.02)
- 37% higher grip strength, (p=0.04)
- 39% higher functional mobilitiy performance TUG, (p=0.047)
- 12 month follow up: 9 hip fractures (2 exercise, 7 control)

Bischoff H et al: Arch Intern Med 2010 170(9):813-20

DO-HEALTH
Exercise Programm

- Heben Sie anschliessend das linke Bein und halten das Gleichgewicht auf dem rechten Bein 10 Sekunden lang
- Versuchen Sie das Becken gerade zu halten

Wie oft?

- Wiederholen Sie den Einbeinstand 10 Mal mit jedem Bein abwechselnd zwischen dem rechten und dem linken Bein. Pausieren Sie anschliessend 15 Sekunden.
  Glückwunsch: Übung Nr. 2 ist abgeschlossen!

Übung 5
Beinkräftigung (fortgesetzt)

- Nehmen Sie das rechte Bein wieder von der Stufe herunter
- Das linke Bein sollte auf der Stufe bleiben

- Führen Sie dieses Hinauf- und Hinuntersteigen mit dem rechten Bein 10 Mal aus
- Das linke Bein bleibt dabei immer auf der Stufe
- Steigen Sie dann mit beiden Beinen wieder auf den Boden zurück. Sie befinden jetzt sind Sie wieder in der Ausgangsstellung
- Bitte versuchen Sie den Oberkörper immer aufrecht zu halten
- Führen Sie die Übung mit dem linken Bein durch

Bischoff H et al Arch Intern Med 2010 170(9):813-20

DO-HEALTH - Grant Agreement n° 278588
Start Date: 01/01/2012 - Duration: 66 months
Coordinator: UZH, Prof. Dr. Heike A. Bischoff-Ferrari

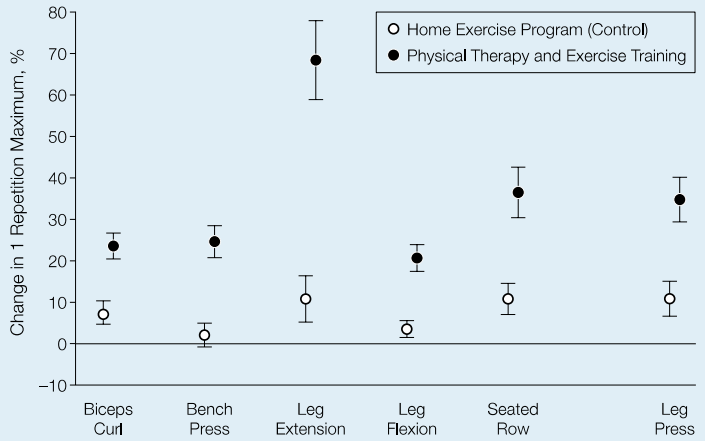
Effects of Extended Outpatient Rehabilitation After Hip Fracture

A Randomized Controlled Trial

Table 1. Baseline Characteristics of Participants Included in the Primary Analysis*

Characteristics	Control Group (n = 44)	Physical Therapy Group (n = 46)	*P* Value
Age, y	81 (8)	80 (7)	.46
Education, y	13 (3)	13 (3)	.92
Female, No. (%)	34 (77)	33 (72)	.55
White race, No. (%)	39 (89)	40 (87)	.81
Married, No. (%)	13 (30)	18 (39)	.34
Living alone, No. (%)	30 (68)	24 (52)	.12
Fracture type, No. (%)			
Subcapital	24 (55)	23 (50)	.45†
Intertrochanteric)	17 (39)	22 (48)	
Other	3 (7)	1 (2)	
Surgical repair type, No. (%)			
Hemiarthroplasty	20 (45)	17 (37)	.41
ORIF	24 (55)	29 (63)	
SBT score	2.7 (2)	2.0 (2)	.15†
GDS score	2.9 (3)	2.5 (2)	.83†
BMI	26 (4)	25 (5)	.27
Body weight, kg	64 (14)	64 (16)	.88
No. of routine medications	3.6 (2)	4.0 (2)	.36†
Charlson comorbidity index score	1.0 (2)	0.6 (1)	.21†
No. of falls in previous 12 mo	1.7 (1)	1.4 (1)	.36†
No. of assistive devices used for ADLs	2.7 (1)	3.1 (2)	.25
Prefracture IADL score	12.6 (1.8)	13.0 (1.5)	.33
Prefracture BADL score	13.5 (0.9)	13.4 (0.9)	.71
Use of assistive device to perform PPT, No. (%)	35 (80)	38 (83)	.71
Time from hip fracture to enrollment, d	103 (30)	99 (36)	.62
Medical history, No. (%)			
High blood pressure	23 (52)	25 (54)	.84
Arthritis	35 (80)	34 (74)	.53
Osteoporosis	13 (30)	16 (35)	.60
Diabetes	4 (9)	3 (7)	.71†
Atrial fibrillation	4 (9)	4 (9)	>.99†
Coronary artery bypass graft surgery	1 (2)	3 (7)	.62†
Congestive heart failure	2 (5)	1 (2)	.61†
Taking medication for osteoporosis ≥12 months prior to screening, No. (%)‡	11 (25)	10 (22)	.72
Using calcium supplements, No. (%)	16 (36)	18 (39)	.79
Serum 25-hydroxyvitamin D level, ng/dL	16.5 (7.2)	17.0 (8.7)	.80

Figure 3. Change in 1-Repetition Maximum Voluntary Strength Values Between Month 3 and Month 6



Data are means (SEs). All group differences were significant ($P<.001$) after adjusting for the 3-month value.

JAMA2004;292:837-846

Original Study

Effects of a Home-Based Physical Rehabilitation Program on Physical Disability After Hip Fracture: A Randomized Controlled Trial

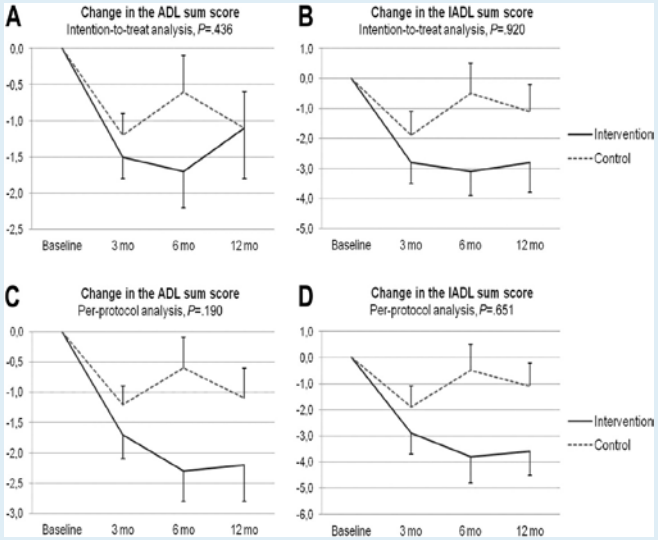
Johanna Edgren PhD [a], Anu Salpakoski MSc [a], Sanna E. Sihvonen PhD [b], Erja Portegijs PhD [a], Mauri Kallinen MD, PhD [c], Marja Arkela PhD [d], Pirkko Jäntti MD, PhD [e], Jukka Vanhatalo MD [d], Mika Pekkonen MD, PhD [f], Taina Rantanen PhD [a], Ari Heinonen PhD [g], Sarianna Sipilä PhD [a,*]

Table 1
Baseline Characteristics of the ProMo Study in the Intervention and Control Groups

	Intervention, n = 40	Control, n = 41	*P*
Age, y, mean (SD)	80.9 (7.7)	79.1 (6.4)	.251*
Gender, women, n (%)	31 (78)	32 (78)	.953†
Chronic diseases, n (%)	3 (2)	3 (2)	.581‡
Time since fracture, d, mean (SD)	62.5	59.0	.379‡
Operation type, n (%)			.917†
Internal fixation	19 (48)	19 (46)	
Arthroplasty	21 (52)	22 (54)	
Offending pain, fractured limb, n (%)	19 (48)	19 (46)	.917†
Use of walking aids outdoors, n (%)	30 (75)	35 (85)	.054†
Berg Balance Scale, total score (range 0–56), mean (SD)	40.5 (10.4)	43.6 (8.5)	.311‡
ABC Scale, total score (range 16–160), mean (SD)	89.5 (32.5)	87.2 (28.9)	.734*

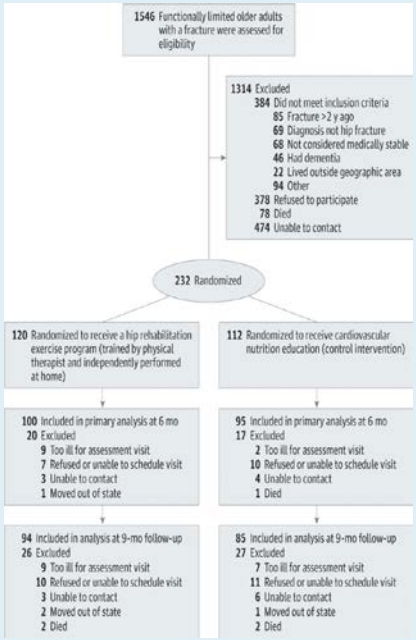
*Independent samples *t* test.
†Pearson χ^2 test.
‡Mann-Whitney *U* test.

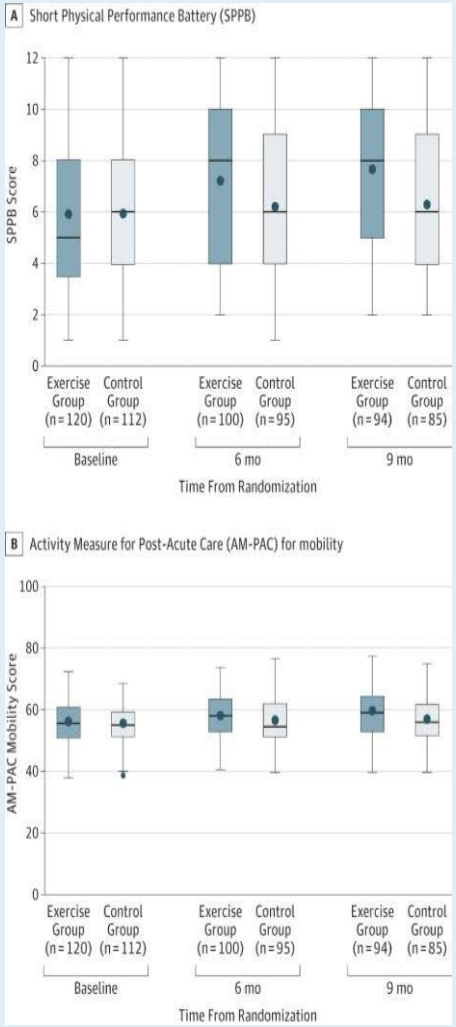
DA 16 (2015) 350.e1–350.e7



Effect of a Home-Based Exercise Program on Functional Recovery Following Rehabilitation After Hip Fracture A Randomized Clinical Trial

Nancy K. Latham, PhD, PT, **Bette Ann Harris, DPT, MS**, **Jonathan F. Bean, MD, MS**, **Timothy Heeren, PhD**, **Christine Goodyear, BS, PT**, **Stacey Zawacki, DrPH, RD**, **Diane M. Heislein, DPT, OCS**, **Jabed Mustafa, MD**, **Poonam Pardasaney, ScD, DPT**, **Marie Giorgetti, PT, MS, NCS**, **Nicole Holt, MPH**, **Lori Goehring, BA**, and **Alan M. Jette, PhD, PT**
Boston University, Boston, Massachusetts (Latham, Heeren, Zawacki, Heislein, Mustafa, Goehring, Jette); MGH Institute of Health Professions, Boston, Massachusetts (Harris, Giorgetti); Harvard Medical School, Boston Massachusetts (Bean); Spaulding Cambridge Outpatient Center, Cambridge Massachusetts (Bean, Holt); Spaulding Rehabilitation Network, Boston Massachusetts (Goodyear); RTI International, Boston Massachusetts (Pardasaney).





Effects of a Supervised versus an Unsupervised Combined Balance and Strength Training Program on Balance and Muscle Power in Healthy Older Adults: A Randomized Controlled Trial

André Lacroix[a] Reto W. Kressig[b] Thomas Muehlbauer[a] Yves J. Gschwind[b]
Barbara Pfenninger[c] Othmar Bruegger[c] Urs Granacher[a]

[a]Division of Training and Movement Sciences, University of Potsdam, Potsdam, Germany; [b]University Center for Medicine of Aging, Felix Platter Hospital, Basel, and [c]Swiss Council for Accident Prevention, Bern, Switzerland

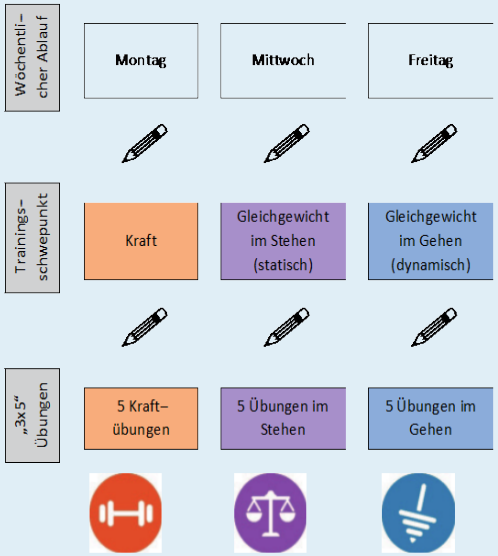
Trainingsprogramm zur Sturzprävention

Das Trainingskonzept „3x5"

Trainingsphase

Gesamtdauer	12 Wochen
Trainingstage pro Woche	3 (z. B. Montag, Mittwoch, Freitag)
Trainingszeit	Freiwählbar. Angeboten für alle die zu einer festen Terminfestlegen (z.B. Mo, Mi, Fr 10:00 – 11:30 Uhr)
Dauer pro Einheit	30 min

Beispiel einer Trainingswoche



DO-HEALTH - Grant Agreement n° 278588
Start Date: 01/01/2012 - Duration: 66 months
Coordinator: UZH, Prof. Dr. Heike A. Bischoff-Ferrari

Internationale Empfehlungen

«Gesundheitswirksam bewegen»

Bewegungsempfehlungen für Erwachsene

Bundesamt für Sport BASPO

Netzwerk Gesundheit und Bewegung Schweiz hepa.ch

«Gesundheitswirksam bewegen»

Basisempfehlungen für Erwachsene

Diese Basisempfehlungen reichen aus, um Gesundheit, Lebensqualität und Leistungsfähigkeit günstig zu beeinflussen.

Gesundheitswirksame Bewegung, Grundlagendokument, BASPO, BAG, Gesundheitsförderung Schweiz, bfu , Suva und Netzwerk Gesundheit und Bewegung Schweiz hepa.ch, 2013

Bundesamt für Sport BASPO 13

Netzwerk Gesundheit und Bewegung Schweiz hepa.ch

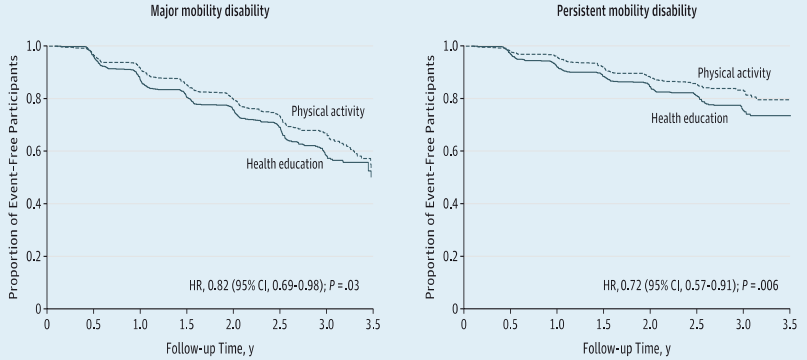
Original Investigation

Effect of Structured Physical Activity on Prevention of Major Mobility Disability in Older Adults
The LIFE Study Randomized Clinical Trial

Marco Pahor, MD; Jack M. Guralnik, MD, PHD; Walter T. Ambrosius, PhD; Steven Blair, PED; Denise E. Bonds, MD; Timothy S. Church, MD, PhD, MPH; Mark A. Espeland, PhD; Roger A. Fielding, PhD; Thomas M. Gill, MD; Erik J. Groessl, PhD; Abby C. King, PhD; Stephen B. Kritchevsky, PhD; Todd M. Manini, PhD; Mary M. McDermott, MD; Michael E. Miller, PhD; Anne B. Newman, MD, MPH; W. Jack Rejeski, PhD; Kaycee M. Sink, MD, MAS; Jeff D. Williamson, MD, MHS; for the LIFE study investigators

- N=424 (70-89)/Physical Performance
- Walking daily (goal 150Min/week)
- 10 Min lower extr. Strength training with
- Ankle weights, 2 sets of 10 repetitions
- 10 Min of balance training and flexibility
- Exercises
- 3-4 sessions a week

Figure 3. Effect of a Moderate Physical Activity Intervention on the Onset of Major Mobility Disability and Persistent Mobility Disability



No. at risk															
Physical activity	818	758	706	646	559	378	182	11	818	761	726	673	579	393	188	12
Health education	817	765	680	617	540	358	162	13	817	762	707	655	567	371	178	10
Events																
Physical activity	0	29	67	115	155	197	224	246	0	18	32	64	88	104	113	120
Health education	0	33	105	155	190	232	277	286	0	25	64	91	118	138	158	162

HR indicates hazard ratio. The graph for major mobility disability was truncated at 3.5 years and the health education group had 4 additional failures between 3.5 and 3.6 years of follow-up. Number of events represents cumulative events and adjusted HRs and *P* values are from proportional hazards regression models defined in the Methods section.

A cluster randomised controlled trial of advice, exercise or multifactorial assessment to prevent falls and fractures in community-dwelling older adults: protocol for the prevention of falls injury trial (PreFIT)

Julie Bruce,[1] Ranjit Lall,[1] Emma J Withers,[1] Susanne Finnegan,[1]
Martin Underwood,[1] Claire Hulme,[2] Ray Sheridan,[3] Dawn A Skelton,[4]

Fracture outcomes by treatment arm

Outcome	Advice	Exercise	MFFP	Total
From randomisation to 18-month follow-up				
Randomised, *n*	3223	3279	3301	9803
Fractures, *n*	133	152	173	458
Unadjusted[a] fracture rate over 18 months (95% CI) per person per 100 years	2.76 (2.76 to 2.76)	3.06 (3.06 to 3.06)	3.50 (3.50 to 3.50)	3.10 (3.10 to 3.10)
Adjusted[b] fracture rate over 18 months (95% CI) per person per 100 years	2.59 (2.53 to 2.67)	3.24 (3.15 to 3.33)	3.50 (3.39 to 3.60)	3.12 (3.06 to 3.17)
Participants with one or more fractures, *n* (%)	110 (3.4)	126 (3.8)	143 (4.3)	379 (3.9)
Total number of person-years of follow-up	4868.5	4981.2	4985.3	14,853.0
Participants with two or more fractures, *n*	17	22	22	61
Fracture episodes, *n*	118	131	153	402
Time to first fracture (months), median (IQR)	8.5 (3.9–14.5)	10.4 (5.1–14.1)	9.1 (4.6–12.9)	9.4 (4.4–13.6)
Time to first fracture, HR[c] (95% CI; *p*-value)				

N=9000
Age: 70-90 years
3 arm: 1. advice 2. advice+ exercise 3. advice with multimodal fall prevention

STUDY PROTOCOL Open Access

Exercise and fall prevention self-management to reduce mobility-related disability and falls after fall-related lower limb fracture in older people: protocol for the RESTORE (Recovery Exercises and STepping On afteR fracturE) randomised controlled trial

Catherine Sherrington[1*], Nicola Fairhall[1], Catherine Kirkham[1], Lindy Clemson[2], Kirsten Howard[3], Constance Vogler[4,5], Jacqueline CT Close[6,7], Anne M Moseley[1], Ian D Cameron[8], Jenson Mak[8,9], David Sonnabend[4] and Stephen R Lord[7]

CONCLUSIONS: No statistically significant intervention impacts on mobility-related disability and falls were detected, but benefits were seen for secondary measures of balance and mobility, fall risk, physical activity, mood, health, and community outings.
TRIAL REGISTRATION: Australian New Zealand Clinical Trials Registry: ACTRN12610000805077

N=500
Age: 70-90years

Adapted Exercise programs according to individual capacity and risk factors

Healthy ager :
Instruction:

(aerobic, strength, balance, coordination)

- Group exercise
- Individual exercise Gym

Prefrail ager:
Instruction and supervision:

(aerobic, balance, strength, coordination)

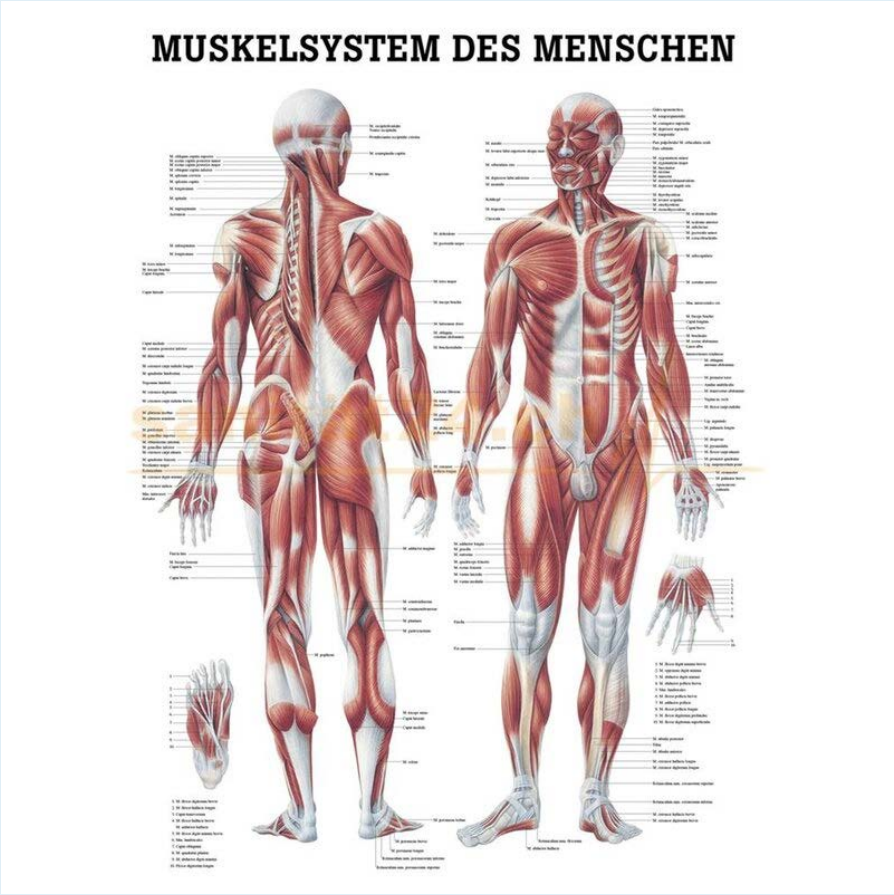
- Group exercise
- Home exercise / Tele- Exercise

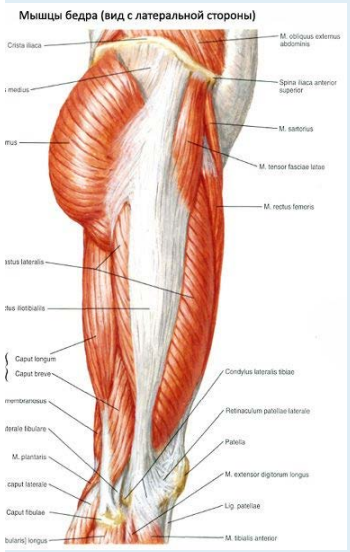
Frail ager:
Instruction, supervision and motivation:

(aerobic, balance, strength, coordination)

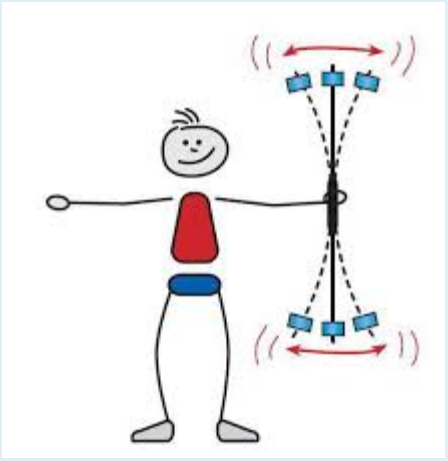
Individual home exercise program / Tele-Exercise

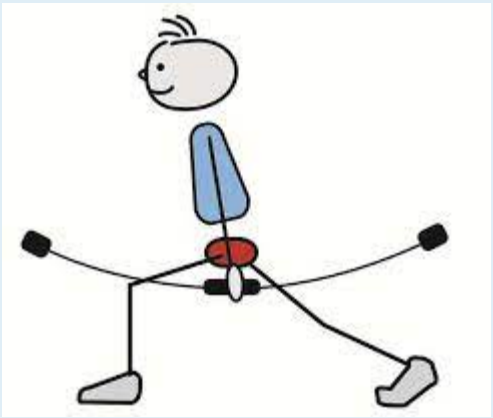
Wichtige Muskelgruppen

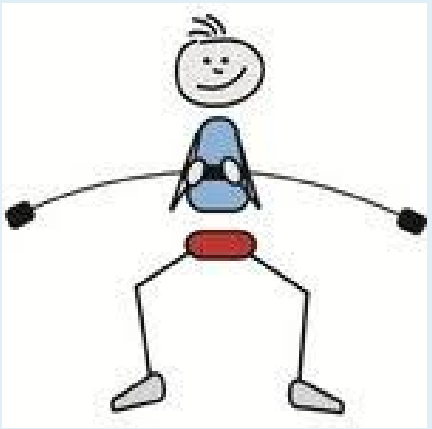




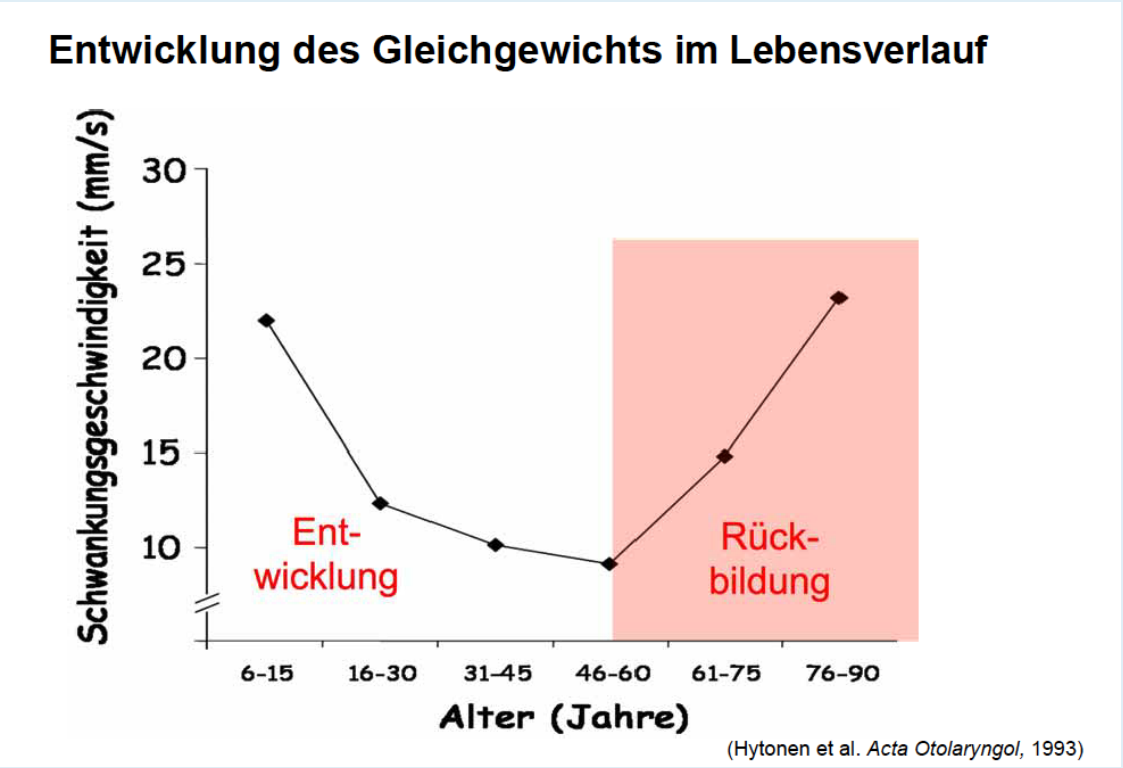
Rumpfmuskulatur: Flexibartraining







Gleichgewicht



Gleichgewichtstraining

Koordinatives Gleichgewichtstraining z.B. mit Sensopro

Gleichgewicht / Koordination

To enhance co-ordination

- Minimise hand support
- Aim to increase time without hand support

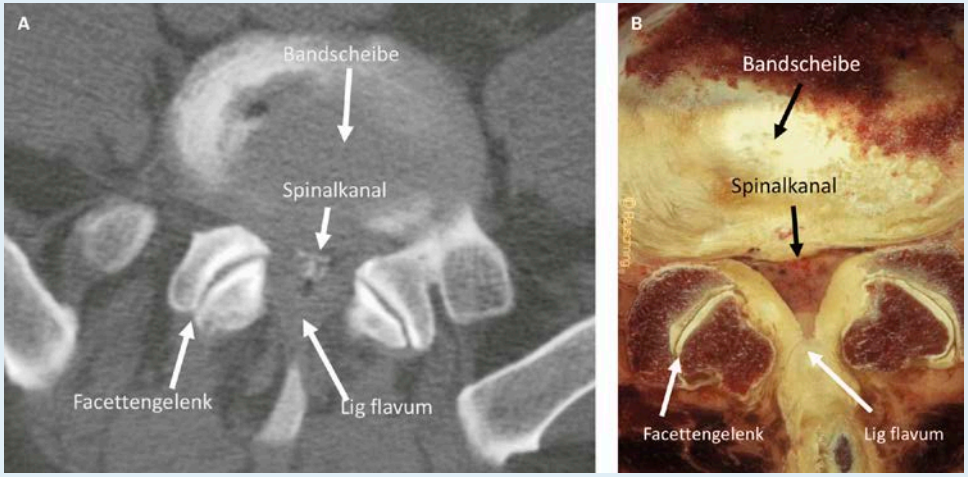
Kraft und Gleichgewichtstraining

To enhance muscle strength

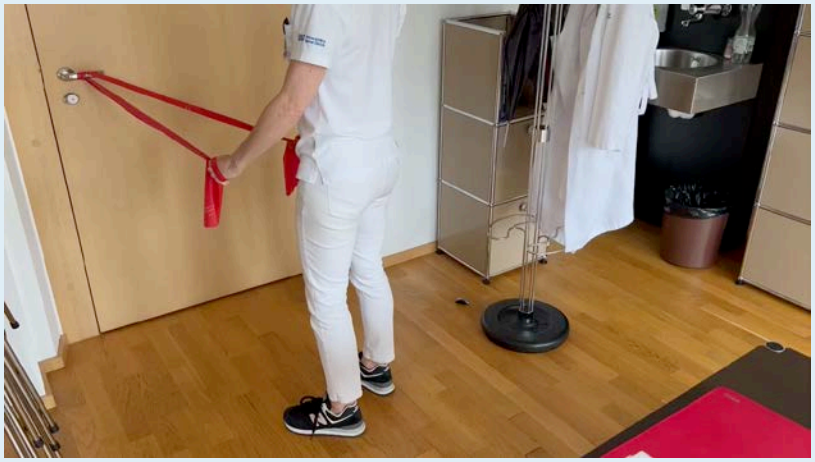
- Aim for an amount of added weight for which the person can just do 2 sets of 10-15 repetitions (ie 10-15 RM).




Sarkopenie-Patient

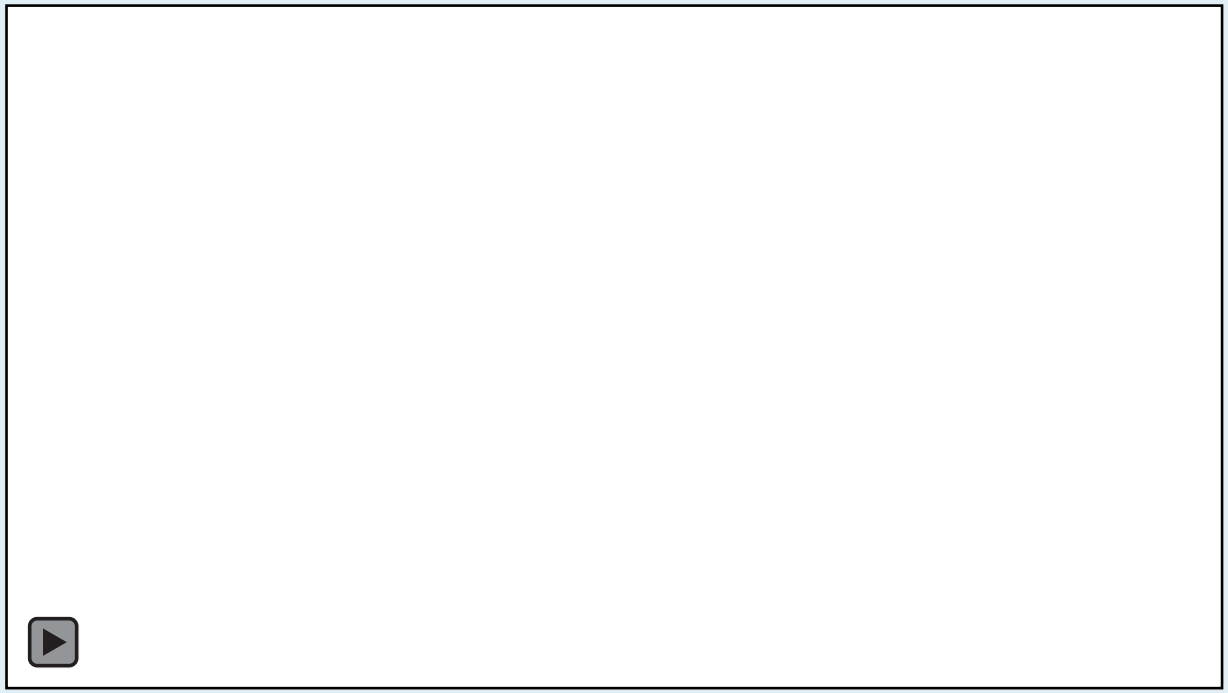

A
Bandscheibe
Spinalkanal
Facettengelenk
Lig flavum
B
Bandscheibe
Spinalkanal
Facettengelenk
Lig flavum

Rumpf-Training 1:
im stehen oder sitzen



Rumpf-Training 2: im Liegen

Rumpftraining 3: im liegen



Bewegung und Koordination

Motivation

Sarcopenia: Medikamentöse Theapie?

Older adults lose 3 to 6 time more muscle mass in bed rest

Per week 10% muscle mass loss
Per week 30% strength decline

Wall BT et al. Ageing Research Reviews 2013

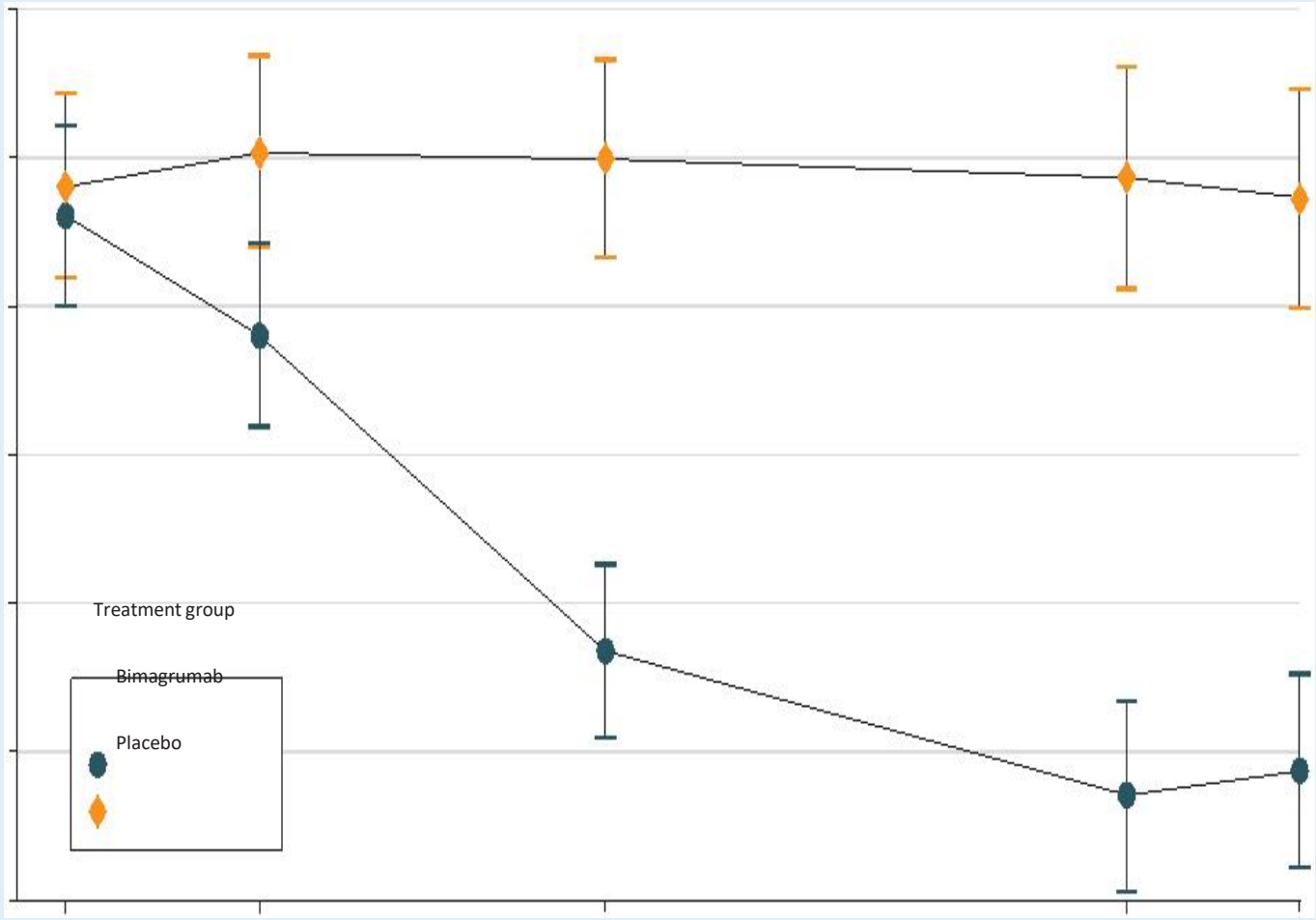
Muskelanabole Therapie

Tabelle 1. Wirkungsmechanismen anaboler Substanzen

Substanz/Hormon	Angriffspunkt	Mechanismus	Kommentar
Wachstumshormon	Insulin-like growth factor-1 (IGF-1) Rezeptor	Steigerung der IGF-1-Synthese, eines der potentesten anabolen Hormone des Menschen	Viele Nebeneffekte, daher obsolet
Testosteron	Androgenrezeptor	Stimuliert Muskelsynthese über anabole Signale.	Gutes Monitoring notwendig
Myostatin-Rezeptor-Antagonist	Myostatinrezeptor	Hemmt Myostatin und steigert indirekt die Muskelsynthese.	Erste Ergebnisse bei älteren Menschen vielversprechend
Metformin	Energiemetabolismus des Myozyten	Hemmt die 5-Andenosin-Monophosphat-aktivierte Proteinkinase, ein Proteinsignal, das zur Abnahme der Muskelproteinsynthese führt.	Bisher keine Studie bei gebrechlichen alten Personen

Safety and pharmacokinetics of bimagrumab in healthy older and obese adults with body composition changes in the older cohort

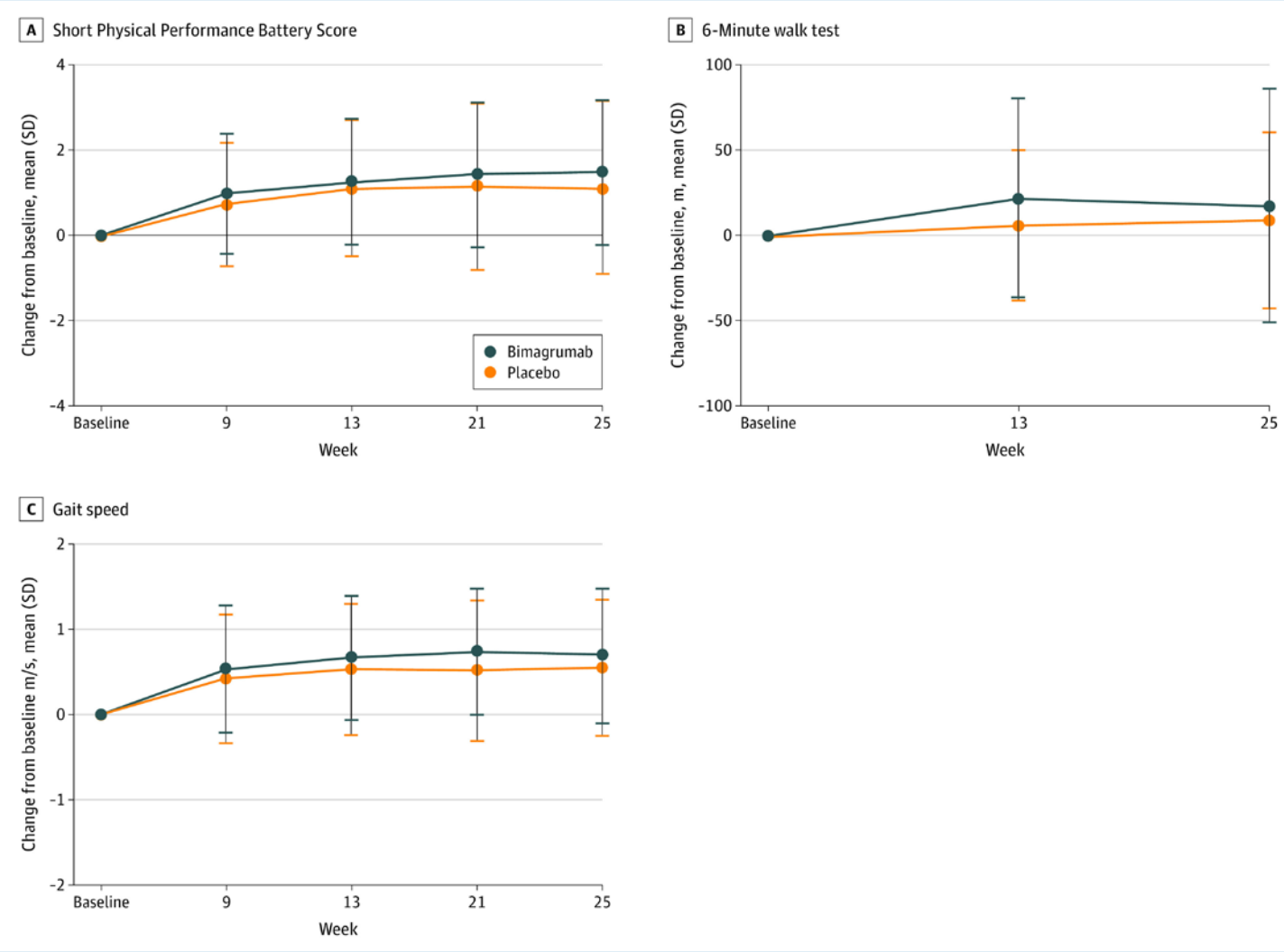
Figure 2. Effect of Bimagrumab on Total Body Fat Mass



JAMA Network Open. 2021;4(1):e2033457. doi:10.1001/jamanetworkopen.2020.33457

JAMA Netw Open. 2020 Oct; 3(10): e2020836.
Published online 2020 Oct 19. doi: 10.1001/jamanetworkopen.2020.20836
PMCID: PMC7573681
PMID: 33074327

Bimagrumab vs Optimized Standard of Care for Treatment of Sarcopenia in Community-Dwelling Older Adults
A Randomized Clinical Trial



Take home message

- Definition Sarkopenie: von der Muskelmasse zur Muskelkraft
- Einfache Messmethoden mit Cut-Offs wie Handkraft, Sit to Stand, SPPB
- Genaue Muskelmassenmessung noch nicht in der Klinik
- Keine medikamentöse Therapie
- Risikobasierte Kombinations-Training zur Stärkung der Muskelkraft, Koordination und Gleichgewicht

Vielen Dank!