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Dansk Selskab for Klinisk Ernæring
Skejby 20. januar 2020

# Muskel- og funktionstab hos ældre patienter

**Charlotte Suetta**

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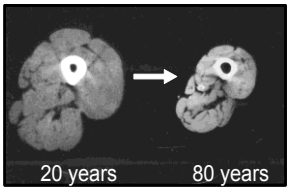
# Sarkopeni




"Muscle loss steals the freedom of the old"
Irvin Rosenberg 1988

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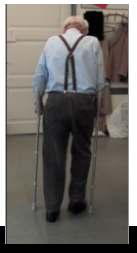
# Fysisk funktion



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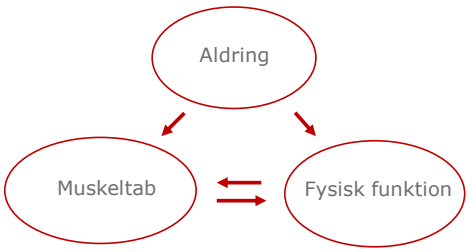


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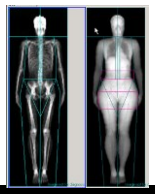
Sarcopenia 1997

Low muscle mass



Baumgartner 1997

Sarcopenia 2018

Muscle failure

Cruz-Jentoft et al. 2018

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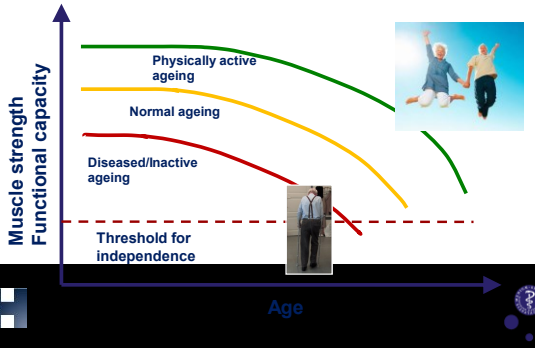
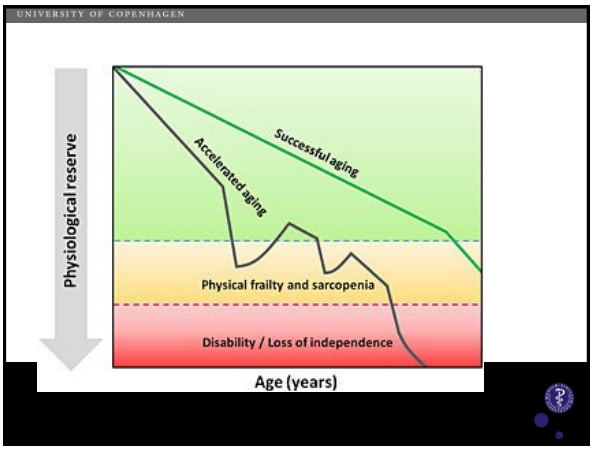
Loss of muscle function with aging

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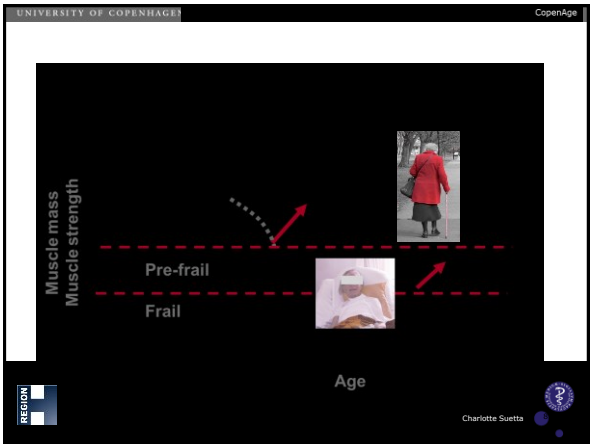
Physiological reserve
Successful aging
Accelerated aging
Physical frailty and sarcopenia
Disability / Loss of independence
Age (years)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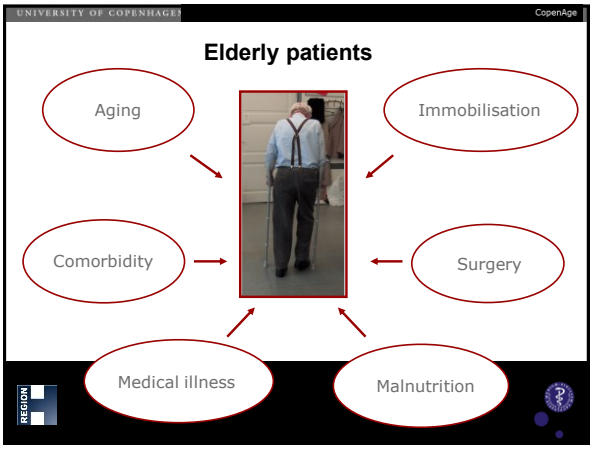
CopenAge
Muscle mass
Muscle strength
Pre-frail
Frail
Age
Charlotte Suetta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CopenAge
Elderly patients
Aging
Immobilisation
Comorbidity
Surgery
Medical illness
Malnutrition

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## Elderly patients arrive sick and often leave disabled from hospital

- About **one-third of patients over 70 years old** and **more than half of patients over 85 leave the hospital more disabled** than when they arrived.
- As a result, many seniors are unable to care for themselves after discharge and need assistance with daily activities such as bathing, dressing or even walking.
- Increasing severity of these functional impairments is associated with increased risk of readmission, morbidity and mortality.

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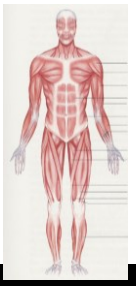
## Why is skeletal muscle important ?

1. Skeletal muscle accounts for ≈40% of our total body mass
2. It is important for metabolic function and acts as a reservoir in catabolic conditions
3. Low muscle mass markedly increases the risk of frailty, morbidity and mortality



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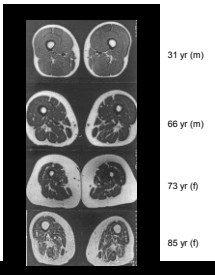
## Loss of muscle mass with aging: sarcopenia

Reduced muscle cross-sectional area (↓ 40% between the age of 20 and 80 yrs)

The decline seems to start in early adulthood and accelerate after the age of 50 years

↑ content of non-contractile tissue such as intramuscular fat and connective tissue



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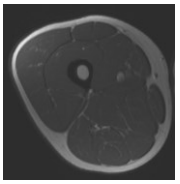
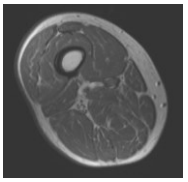
## Muscle CSA in young vs old

Same activity level



23 yrs old male



72 yrs old male

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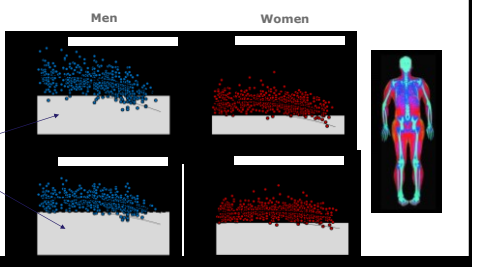
## Appendicular Lean Mass






*Suetta et al., JCSM 2019*

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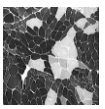
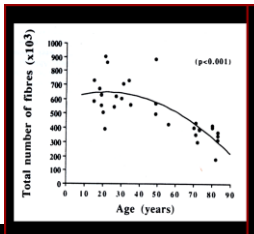
## Reduced muscle mass with ageing
- loss of muscle fibers






Elderly male subjects (70-73 yrs) show ~40% fewer muscle fibers than young subjects (19-37 yrs)
VL muscle, Lexell et al. 1983

Very old male subjects (>80 yrs) ~60% fewer fibers compared to young subjects
VL muscle, Lexell et al. 1988

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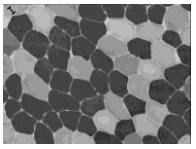
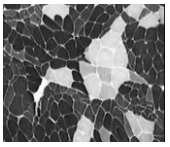
## Changes in muscle mass with aging

22 yr old



87 yr old



Selective loss of type II fibers VL muscle, Lexell et al. 1983

Fibertype grouping Andersen et al 2003

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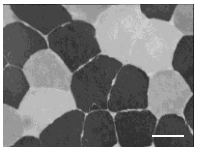
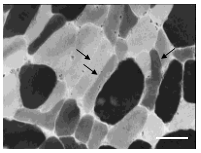
## Change in muscle fiber size and shape

Young subject



Old subject



VL stainings by courtesy JL Andersen CMRC 2004

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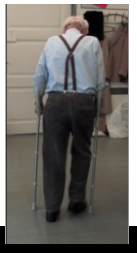
## Har sarkopeni betydning for fysisk funktion



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## Sarcopenia

= muscle mass/ht$^2$ (kg/m$^2$) is 2 SD below reference values for young healthy men and women

Prevalence in 833 men and women:

- 13-24% in persons < 70 yr
- > 50% in persons > 80 yr

Baumgartner 1998

Sarcopenia is significantly associated with a

- 3-4 times greater risk of physical disability
- 2-3 times greater risk of balance abnormality
- 2-3 times greater risk of falls

Baumgartner 1998, 1999

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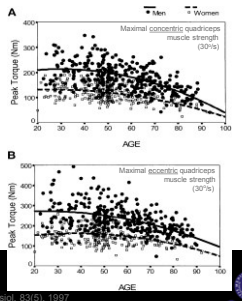
## Decreased Muscular Strength With Aging

**Dynamic muscle strength**

- Decline starting ~50-60 yrs old, decline is accelerated with age (cross-sectional data)
- Substantial differences between men and women
- Substantial individual differences !




Lindle et al, J. Appl. Physiol. 83(5), 1997

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## Relationship between strength and function in 65+ yr old people

- Knee extensor strength and normal gait speed
  (Anianson 1980, Wolfson 1995, Brown 1995, Ferrucci 1997)
- Knee extensor strength and step height in women
  (Aniansson 1980)
- Knee extensor strength and chair rise
  (Skelton 1994, Ferrucci 1997)
- Knee extensor strength and balance in women
  (Ferrucci 1997, Beyer 2007)

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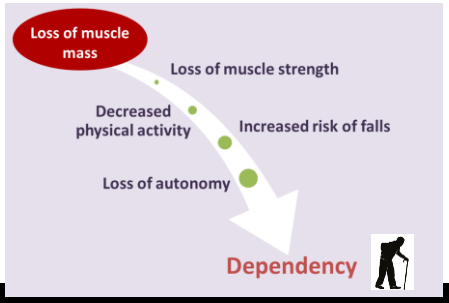
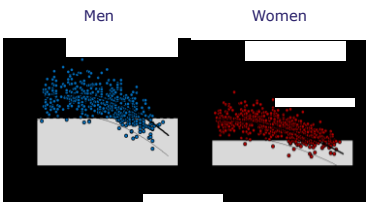





## Hand Grip Strength

Men Women



*Suetta et al., JCSM 2019*



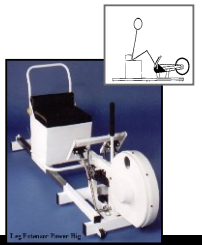
## Decreased Muscular Strength and Power with Aging

Decreased maximal muscle force and contractile power from > 65 years

Loss of strength: 1.5% per year

Loss of power: 3.5% per year

Young & Skelton, Int. J. Sports Med. 15, 1994

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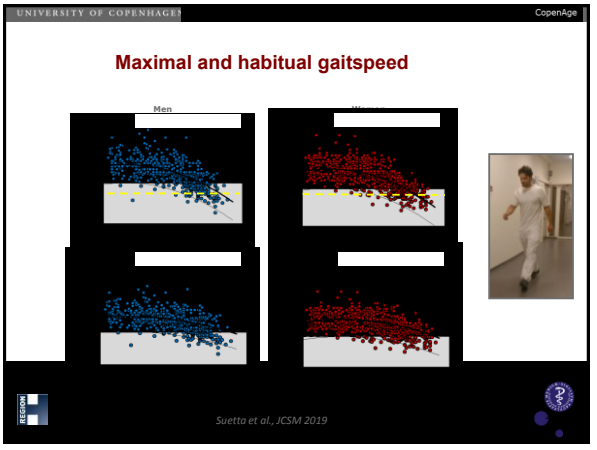
CopenAge
Suetta et al., JCSM 2019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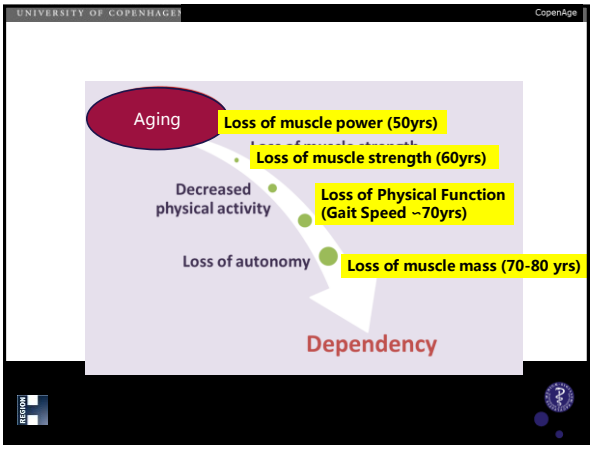
CopenAge
Maximal and habitual gaitspeed
Men
Suetta et al., JCSM 2019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Aging
Loss of muscle power (50yrs)
Loss of muscle strength (60yrs)
Decreased physical activity
Loss of Physical Function (Gait Speed ~70yrs)
Loss of autonomy
Loss of muscle mass (70-80 yrs)
Dependency

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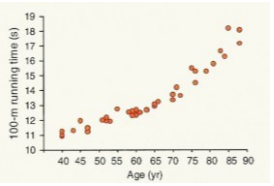
European Championships for Master Athletes
(100 m sprint)




3 best time records in each age group

40 years 88 years

Korhonen MT et al 2002

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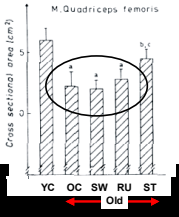
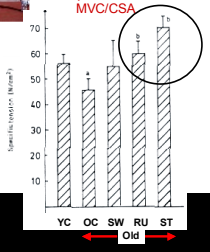
## The effect of lifelong training

Muscle CSA




Specific tension
MVC/CSA

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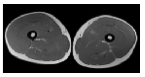
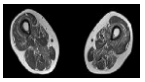
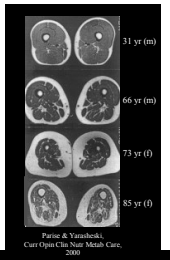
## Effekt af inaktivitet versus alder

Rask 41-årig mand



47-årig mand med SCI






Parise & Yarasheski,
Curr Opin Clin Nutr Metab Care,
2000

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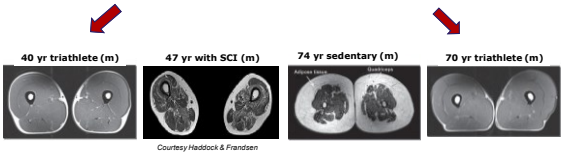
## Inactivity versus ageing

**Chronic exercise preserves lean muscle mass in masters athletes**




Courtesy Haddock & Frandsen

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| Primær sarkopeni | Årsag |
|---|---|
| Aldersrelateret muskeltab | Alder +65 år |
| **Sekundær sarkopeni** | **Årsag** |
| Inaktivitetsrelateret muskeltab | Immobilisering, sengeleje, inaktiv livsstil |
| Sygdomsrelateret muskeltab | Cancer, organsvigt (hjerte, lunge, nyre), infektion, inflammatorisk sygdom, neurologisk sygdom |
| Ernæringsrelateret muskeltab | Fejlernæring, GI-sygdom, malabsorption, dysfagi |

*EWGSOP, Age and Aging 2010*

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*EWGSOP, Age and Aging 2010*

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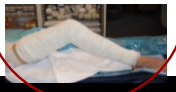
## Disuse

Chronic disuse (pain >1 yr)

14 days immobilisation

Cast



4 days immobilisation

Don-Joy

Suetta

Charlotte

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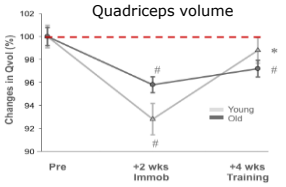
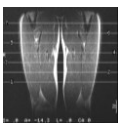
## Changes in muscle size with immobilisation and re-training

Quadriceps volume



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## Disuse

Chronic disuse (pain >1 yr)

14 days immobilisation

Cast

4 days immobilisation

Don-Joy

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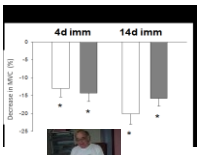
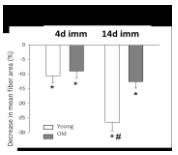
## Changes in maximal muscle strength and myofiber area with 4 days and 14 days of immobilisation





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## 4 days disuse


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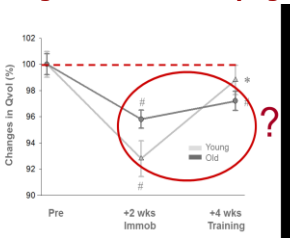
## How is human skeletal muscle re-growth affected by aging

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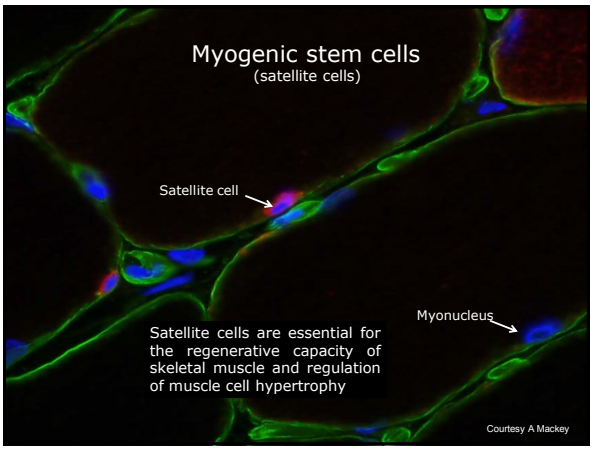
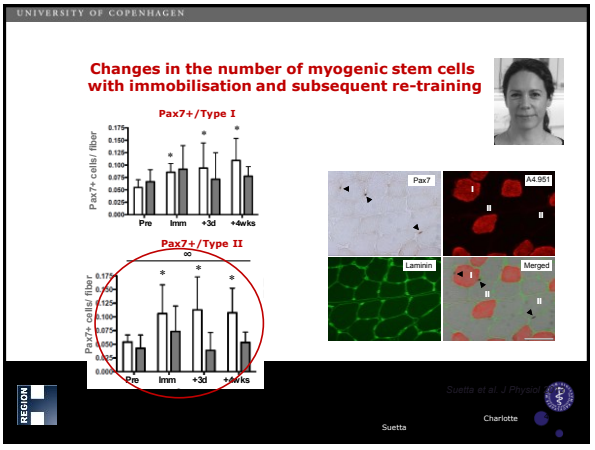

Myogenic stem cells
(satellite cells)
Satellite cell
Myonucleus
Satellite cells are essential for the regenerative capacity of skeletal muscle and regulation of muscle cell hypertrophy
Courtesy A Mackey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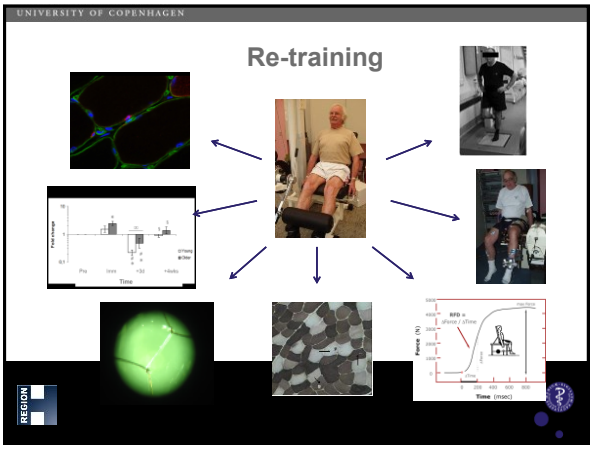
Changes in the number of myogenic stem cells with immobilisation and subsequent re-training
Pax7+/Type I
Pax7+/Type II
Pax7+ cells/ fiber
Pre
Imm
+3d
+4wks
Pax7
A4.951
Laminin
Merged
Suetta et al. J Physiol
Suetta
Charlotte
REGION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Re-training
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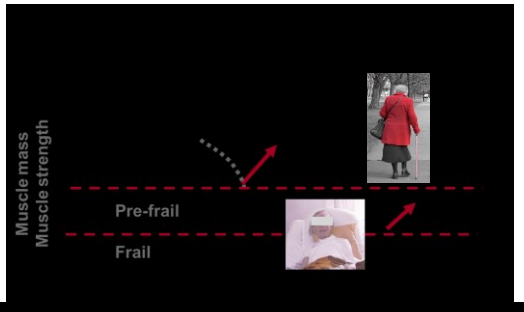


Charlotte Suetta

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**Do frail elderly individuals benefit from resistance training ?**

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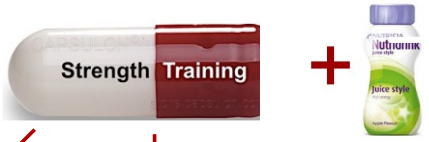
## Treatment




↑ Muscle mass ↑ Muscle strength ↑ Physical function

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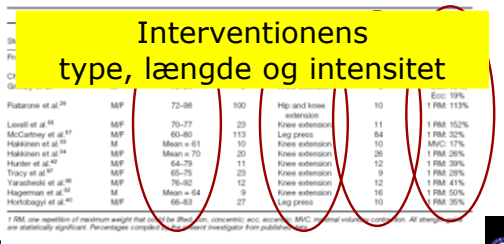
Studies reporting changes in *muscle strength* following strength training in *healthy* elderly individuals




Vandervoort, Muscle & Nerve 25, 2002

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## Implementation of the sarcopenia diagnosis


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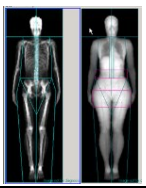
**Sarcopenia 1997**

**Low muscle mass**



Baumgartner 1997

**Sarcopenia 2018**

**Muscle failure**

Cruz-Jentoft et al. 2018

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## September 2016

Journal of Cachexia, Sarcopenia and Muscle 2016; 7: 512–514
Published online 17 October 2016 in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/jcsm.12147

EDITORIAL

### Welcome to the ICD-10 code for sarcopenia

Stefan D. Anker[1], John E. Morley[2]* & Stephan von Haehling[1]

[1]Innovative Clinical Trials, Department of Cardiology and Pneumology, University of Göttingen Medical Centre, Georg-August-University, Göttingen, Germany; [2]Divisions of Geriatric Medicine and Endocrinology, Saint Louis University School of Medicine, St. Louis, MO, USA

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## Definitions of Sarcopenia

| Definition | Function | Muscle mass |
|---|---|---|
| SIG: cachexia-anorexia in chronic wasting disease [3] | Gait speed <0.8 m/s, OR other physical performance test | Low muscle mass (2SD) |
| EWGSOP [4] | Gait speed <0.8 m/s; grip strength 40 kg males, 30 kg females | Low muscle mass (not defined) |
| IWGS Sarcopenia Task Force [5] | Gait speed <1.0 m/s, grip strength | Low appendicular lean mass (<7.23 kg/m$^2$ in men, 5.67 in women) |
| Sarcopenia with limited mobility (SCWD) [6] | 6 min walk <400 m, OR gait speed <1.0 m/s | Low appendicular lean mass/height$^2$ |
| Asian Working Group for Sarcopenia [7] | Gait speed <0.8 m/s; grip strength 26 kg males, 18 kg females | Low appendicular lean mass/height$^2$ |
| Foundation for the National Institutes of Health [8] | Gait speed <0.8 m/s; grip strength 26 kg males, 16 kg females | Appendicular lean mass/BMI |

*EWGSOP* European Working Group of Sarcopenia in Older Persons, *SCWD* Sarcopenia, Cachexia and Wasting Disorders, *IANA* International Association of Nutrition and Aging)

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Suetta Charlotte

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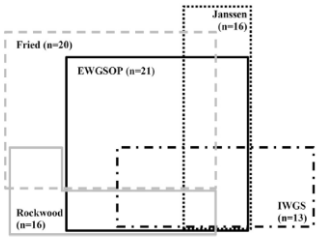


**Fig. 1.** Number of geriatric outpatients identified as having sarcopenia and frailty according to various definitions. Black lines indicate definitions of sarcopenia; gray lines indicate definitions of frailty. A total of 90 outpatients were evaluated in which data were available on all definitions. Sarcopenic outpatients using definitions of EWGSOP: 23.3%, IWGS: 14.4%, Janssen et al[5]: 17.8%. Frail outpatients using definitions of Fried et al[3]: 22.2%, Rockwood et al[10]: 17.8%. Outpatients not having sarcopenia and nonfrail: 47.8% (n = 43). None of the outpatients was classified as having sarcopenia and frailty according to all applied definitions.

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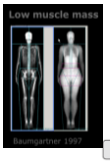
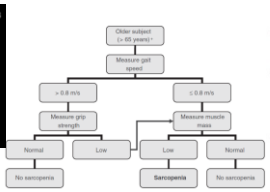
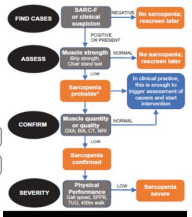
1997 2010 2018

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## Copenhagen Sarcopenia Study

1. 3488 persons from Copenhagen City Heart (ØBUS 5) was invited
2. Reference data for Body Composition, BMD, CoreScan, Muscle strength and Muscle function
1. 1366 persones aged 20-93 years participated (≈40%)
4. Biobank (Vitamin-D, biomarkers of bone- and muscle, cytokines, sex hormones)

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## Copenhagen Sarcopenia Study

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## Cut-off values

**Table 2** Young adult (20–39 years) reference data and cut-points equivalent to *T* scores of −1.0 and −2.0

| | Men ($n$ = 110) | | | Women ($n$ = 172) | | |
|---|---|---|---|---|---|---|
| | Mean ± SD | *T* score = −1.0 | *T* score = −2.0 | Mean ± SD | *T* score = −1.0 | *T* score = −2.0 |
| Age (years) | 30.04 ± 5.15 | | | 29.93 ± 5.22 | | |
| Weight (kg) | 82.99 ± 12.39 | | | 64.35 ± 9.67 | | |
| Height (m) | 1.83 ± 0.07 | | | 1.68 ± 0.07 | | |
| BMI (kg/m$^2$) | 24.77 ± 3.41 | | | 22.71 ± 3.14 | | |
| TLM (kg) | 60.71 ± 6.97 | 53.74 | 46.77 | 42.26 ± 5.28 | 36.98 | 31.70 |
| ALM (kg) | 29.03 ± 3.89 | 25.14 | 21.25 | 18.76 ± 2.77 | 15.99 | 13.22 |
| Relative TLM (kg/m$^2$) | 18.12 ± 1.82 | 16.30 | 14.58 | 14.88 ± 1.37 | 13.51 | 12.14 |
| Relative ALM (kg/m$^2$) | 8.66 ± 1.03 | 7.63 | 6.60 | 6.61 ± 0.79 | 5.82 | 5.03 |
| HG strength (kg) | 52.99 ± 8.44 | 44.55 | 36.11 | 34.83 ± 7.33 | 27.50 | 20.17 |
| LEP (W) | 384.69 ± 78.61 | 306.08 | 227.47 | 232.33 ± 61.34 | 170.99 | 109.65 |
| Habitual GS (m/s) | 1.84 ± 0.25 | 1.59 | 1.34 | 1.63 ± 0.26 | 1.37 | 1.11 |
| Maximal GS (m/s) | 2.81 ± 0.42 | 2.39 | 1.97 | 2.57 ± 0.42 | 2.15 | 1.73 |
| 30 s STS test (n) | 27.26 ± 5.55 | 21.71 | 16.16 | 27.24 ± 6.07 | 21.17 | 15.10 |

ALM, appendicular lean mass; BMI, body mass index; GS, gait speed; HG, handgrip; LEP, leg extensor power; SD, standard deviation; STS, sit-to-stand; TLM, total lean mass.
*T* score = −1.0 corresponds to 1 SD below the young adult reference mean; *T* score = −2.0 corresponds to 2 SD below the young adult reference mean.

*Suetta, Haddock, Alcazar et al., JCSM 2019*

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## September 2016

"If we don't measure it – we can't fix it"
Covinsky, UCSF 2014

EDITORIAL

Welcome to the … sarcopenia

Stefan D. Anker[1], John E. Morley[2*] & Stephan von …

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## Revised guidelines to diagnose Sarcopenia

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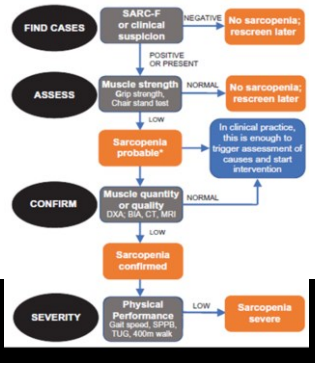


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## EWGSOP (2018) and CSS cut-off values

| Women | EWGSOP-2 | CSS |
|---|---|---|
| **HGS** | **<16 kg** | **<20 kg** |
| Healthy (+65y) | 6,4% | 27% |
| Fallers (+65y) | 21% | 54% |
| **Gaitspeed** | **≤0.8 m/s** | **≤1,1 m/s** |
| Healthy (+65y) | 0,7% | 5,4% |
| Fallers (+65y) | 21% | 51% |

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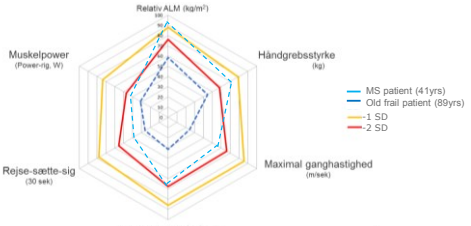
LETTER TO THE EDITOR

*Journal of Cachexia, Sarcopenia and Muscle* (2019)
Published online in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/jcsm.12447

### Is muscle failure a better term than sarcopenia?




Relative værdier (procent af normal), samt -1 SD og -2 SD under normal

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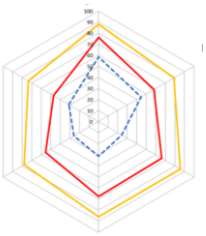
## Summary

1. **Primary (chronic) and secondary (acute) sarcopenia are two different conditions**
2. **Useful to use local reference data and cut-off values**
3. **Assessing muscle domains will enable early identification, individualised treatment *AND***



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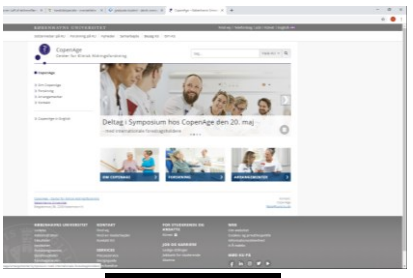


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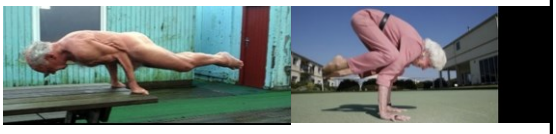

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## EWGSOP-2 Cut-off values

**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$^2$** | **<6.0 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] |

Cruz-Jentoft et al 2019

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## Lean mass

**Table 4** Relative total and appendicular lean mass for men and women by 10 year age groups and for the full age range (20–93 years, displayed as mean ± standard deviation)

| Age group | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | *n* | Relative TLM (kg/m$^2$) | Relative ALM (kg/m$^2$) | *n* | Relative TLM (kg/m$^2$) | Relative ALM (kg/m$^2$) |
| 20–29 | 59 | 18.00 ± 1.84 | 8.58 ± 0.97 | 98 | 14.72 ± 1.33 | 6.55 ± 0.77 |
| 30–39 | 51 | 18.26 ± 1.80 | 8.76 ± 1.11 | 74 | 15.10 ± 1.41 | 6.69 ± 0.82 |
| 40–49 | 83 | 17.85 ± 1.46 | 8.40 ± 0.86 | 96 | 15.31 ± 1.28 | 6.82 ± 0.77 |
| 50–59 | 96 | 18.22 ± 1.75 | 8.56 ± 1.00 | 109 | 15.12 ± 1.61 | 6.75 ± 0.94 |
| 60–69 | 118 | 17.92 ± 1.53 | 8.33 ± 0.87 | 130 | 15.01 ± 1.33 | 6.61 ± 0.75 |
| 70–79 | 127 | 17.08 ± 1.66* | 7.67 ± 0.96* | 151 | 14.78 ± 1.47 | 6.45 ± 0.87 |
| ≥80 | 42 | 16.70 ± 1.36* | 7.39 ± 0.74* | 71 | 14.41 ± 1.35 | 6.11 ± 0.80* |
| All | 576 | 17.72 ± 1.70 | 8.23 ± 1.02 | 729 | 14.93 ± 1.43 | 6.58 ± 0.84 |

ALM, appendicular lean mass; TLM, total lean mass.
*Statistically significant differences compared with the young adult (20–39 years) reference data ($P < 0.05$).

*Suetta, Haddock, Alcazar et al., JCSM 2019*

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## Strength & Power

**Table 5** Handgrip strength and leg extension power for men and women by 10 year age groups and for the full age range (20–93 years, displayed as mean ± standard deviation)

| Age group | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | *n* | Handgrip strength (kg) | Leg extension power (W) | *n* | Handgrip strength (kg) | Leg extension power (W) |
| 20–29 | 38 | 51.59 ± 7.68 | 375.15 ± 78.40 | 60 | 34.88 ± 8.11 | 228.73 ± 49.16 |
| 30–39 | 51 | 54.11 ± 8.87 | 391.37 ± 78.84 | 73 | 34.79 ± 6.67 | 234.46 ± 67.73 |
| 40–49 | 83 | 53.39 ± 8.95 | 385.00 ± 95.88 | 97 | 34.39 ± 5.63 | 232.74 ± 59.30 |
| 50–59 | 95 | 50.26 ± 7.73 | 322.70 ± 83.36* | 108 | 31.83 ± 5.99* | 200.12 ± 55.85* |
| 60–69 | 116 | 47.54 ± 8.31* | 297.19 ± 82.10* | 128 | 28.09 ± 5.81* | 165.37 ± 51.49* |
| 70–79 | 125 | 39.99 ± 7.56* | 221.11 ± 71.27* | 148 | 23.90 ± 5.09* | 129.46 ± 43.97* |
| ≥80 | 43 | 33.73 ± 7.96* | 164.88 ± 72.26* | 71 | 20.30 ± 4.62* | 97.79 ± 36.73* |
| All | 551 | 46.98 ± 10.22 | 299.90 ± 107.56 | 685 | 29.17 ± 7.75 | 176.72 ± 70.61 |

*Statistically significant differences compared with the young adult (20–39 years) reference data ($P < 0.05$).

*Suetta, Haddock, Alcazar et al., JCSM 2019*

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# Gait Speed

**Table 6** Maximal and habitual gait speed for men and women by 10 year age groups and for the full age range (20–93 years, displayed as mean ± standard deviation)

| Age group | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | *n* | Habitual gait speed (m/s) | Maximal gait speed (m/s) | *n* | Habitual gait speed (m/s) | Maximal gait speed (m/s) |
| 20–29 | 40 | 1.84 ± 0.25 | 2.92 ± 0.40 | 60 | 1.63 ± 0.26 | 2.58 ± 0.42 |
| 30–39 | 51 | 1.72 ± 0.26 | 2.72 ± 0.42 | 74 | 1.61 ± 0.26 | 2.55 ± 0.42 |
| 40–49 | 83 | 1.76 ± 0.31 | 2.79 ± 0.49 | 96 | 1.57 ± 0.28 | 2.49 ± 0.44 |
| 50–59 | 96 | 1.68 ± 0.28 | 2.63 ± 0.44 | 109 | 1.57 ± 0.32 | 2.49 ± 0.51 |
| 60–69 | 118 | 1.66 ± 0.25 | 2.43 ± 0.50* | 130 | 1.54 ± 0.34 | 2.19 ± 0.49* |
| 70–79 | 127 | 1.54 ± 0.29* | 2.00 ± 0.42* | 150 | 1.37 ± 0.27* | 1.76 ± 0.39* |
| ≥80 | 42 | 1.30 ± 0.34* | 1.65 ± 0.49* | 72 | 1.15 ± 0.23* | 1.44 ± 0.34* |
| All | 557 | 1.64 ± 0.33 | 2.42 ± 0.59 | 691 | 1.49 ± 0.32 | 2.18 ± 0.59 |

*Statistically significant differences compared with the young adult (20–39 years) reference data ($P < 0.05$).

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*Suetta, Haddock, Alcazar et al., JCSM 2019*

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# Sit-to Stand test

**Table 7** Thirty second sit-to-stand performance for men and women by 10 year age groups and for the full age range (20–93 years, displayed as mean ± standard deviation)

| Age group | Men | | Women | |
|---|---|---|---|---|
| | *n* | 30 s sit-to-stand test (reps) | *n* | 30 s sit-to-stand test (reps) |
| 20–29 | 35 | 26.07 ± 5.34 | 43 | 27.09 ± 5.70 |
| 30–39 | 50 | 28.20 ± 5.58 | 72 | 27.36 ± 6.37 |
| 40–49 | 76 | 26.22 ± 4.98 | 92 | 24.60 ± 6.30 |
| 50–59 | 95 | 23.30 ± 6.05* | 108 | 22.18 ± 6.47* |
| 60–69 | 118 | 19.44 ± 6.39* | 128 | 18.57 ± 5.94* |
| 70–79 | 125 | 16.45 ± 5.00* | 148 | 15.03 ± 4.43* |
| ≥80 | 42 | 13.55 ± 4.37* | 72 | 12.87 ± 3.04* |
| All | 541 | 21.31 ± 7.16 | 664 | 20.30 ± 7.46 |

*Statistically significant differences compared with the young adult (20–39 years) reference data ($P < 0.05$).

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*Suetta, Haddock, Alcazar et al., JCSM 2019*

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17. maj 2018

16. oktober 2018

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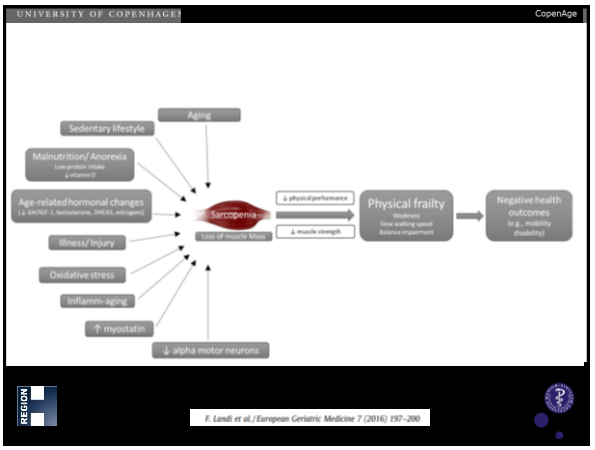
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Aging
Sedentary lifestyle
Malnutrition/ Anorexia
Low protein intake
↓ vitamin D
Age-related hormonal changes
(↓ GH/IGF-1, testosterone, DHEAS, estrogens)
Illness/ Injury
Oxidative stress
Inflamm-aging
↑ myostatin
↓ alpha motor neurons
Sarcopenia
Loss of muscle Mass
↓ physical performance
↓ muscle strength
Physical frailty
Weakness
Slow walking speed
Balance impairment
Negative health outcomes
(e.g., mobility disability)
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F. Landi et al./European Geriatric Medicine 7 (2016) 197–200