“...for wasting which represents old age (sarcopenia) and wasting that is secondary to fever (cachexia) and wasting which is called doalgashi (starvation)”

.........Maimonides (1135-1204)
CAUSES OF WEIGHT LOSS

- Cachexia
- Rhematoid cachexia/sarcopenia
- Anorexia eg nervosa or of aging
- Sarcopenia
- Malabsorption
- Hypermetabolism
- Dehydration

Are these other conditions pre-cachexia?
Bed Rest

Young (30 days)
Old (10 Days)
Old 3 day hospital

Bed Rest leads to 3x rate of muscle loss in 1/3 time

Increased protein Intake stops muscle loss and decreases strength loss
Hospitalization accelerates muscle loss

Old 1.25 protein/kg/day
MacDonald Critchley first described age related wasting of hands and feet.

Irwin Rosenberg was first to use the term Sarcopenia.
SARCOPENIA:
Age Related Loss of Muscle Mass
(poverty of flesh)

Clean and jerk
world weightlifting records
AGING, EXERCISE AND MUSCLE INJURY

CONTRACTION

Mechano Receptors
Titin
Dystroglycan

Muscle Growth Factors

IGF1-Ea
Protein Synthesis/Degradation

Muscle

Satellite Cells
(Mauro, 1961)

MUSCLE INJURY

MUSCLE REGENERATION

FUNCTION

Motor Units

Fiber Number
Type II Fiber Atrophy

Strength
Power
# Prevalence of Sarcopenia

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample Size</th>
<th>Age Range</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baumgartner (1998)</td>
<td>883</td>
<td>61-70</td>
<td>13%</td>
</tr>
<tr>
<td>Melton (2000)</td>
<td>200</td>
<td>80+</td>
<td>50%</td>
</tr>
<tr>
<td>Morley (2001)</td>
<td>199</td>
<td>&lt;70</td>
<td>12%</td>
</tr>
<tr>
<td>Janssen (2002)</td>
<td>8825</td>
<td>80+</td>
<td>7%</td>
</tr>
<tr>
<td>Inuzzi-Sacich (2002)</td>
<td>337</td>
<td>64-92</td>
<td>0.8%</td>
</tr>
<tr>
<td>Gillette-Guyonnet (2003)</td>
<td>1321</td>
<td>76-80</td>
<td>8.9%</td>
</tr>
<tr>
<td>Castillo (2004)</td>
<td>1700</td>
<td>55-98</td>
<td>6%</td>
</tr>
<tr>
<td>Newman (2003)</td>
<td>2984</td>
<td>74.5</td>
<td>12-30%</td>
</tr>
</tbody>
</table>

- 60 – 70 years: 5 – 13%
- 80+ years: 11 – 50%
### Odds Ratios* for Any Disability Associated with Sarcopenia

**SM/Ht\(^2\) (kg/m\(^2\)) Cutpoints established by ROC Analysis**


<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio</th>
<th>% PAR</th>
<th>Cost, billion $</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Women (n = 2,276)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 5.75 kg/m(^2)</td>
<td>3.15 (1.84-5.40)</td>
<td>16.8</td>
<td>4.96</td>
</tr>
<tr>
<td>5.75-6.74 kg/m(^2)</td>
<td>1.46 (1.00-2.15)</td>
<td>9.2</td>
<td>2.70</td>
</tr>
<tr>
<td>&gt; 6.75</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Men (n = 2,223)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 8.50 kg/m(^2)</td>
<td>4.60 (2.07-10.20)</td>
<td>28.7</td>
<td>3.63</td>
</tr>
<tr>
<td>8.50-10.74 kg/m(^2)</td>
<td>3.48 (1.84-6.57)</td>
<td>56.8</td>
<td>7.18</td>
</tr>
<tr>
<td>&gt; 10.75 kg/m(^2)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td></td>
<td></td>
<td>18.4</td>
</tr>
</tbody>
</table>

* Adjusted for age, race, health behaviors, comorbidity, body fat
Muscle Atrophy is not always Sarcopenia

Russell T Hepple
Department of Kinesiology
McGill University
Montreal, Canada

J Applied Physiology, 2012
Old muscle shows fiber size heterogeneity
And fiber grouping

Increase in muscles with MYOSIN HEAVY CHAIN
with aging and denervation
Motor Unit Firing Rate is significantly decreased only in the old-old

McNeil CJ et al, Muscle & Nerve 41:461, 2005

CNTF declines with aging
Old muscles show fiber size variability whereas cancer cells do not (Example: Mouse Muscle)
The age-related loss of muscle strength is weakly associated with the loss of muscle mass.
Relative risk of poor physical performance, functional limitation, or physical disability in older adults with dynapenia (low muscle strength), or sarcopenia (low muscle mass).
Sarcopenia
Loss of muscle mass; not due to cachexia or PVD

Kratopenia
(Thinamopenia)
Loss of force ie strength

Dynapenia
Loss of power; Force X velocity

Frailty
Fatigue
Resistance
Aerobic
Illness
Loss of Weight

Disability
Loss of ADLs

Loss of Weight
Sarcopenia
Kratopenia (Thinamopenia)
Dynapenia
Frailty
Disability

- DEXA
- Bioelectrical impedance
- MRI/CT
- MAMC/Calf Circumference
- Ultrasound

- Isometric (Dynamometry)
- Isotonic

- Walking speed (>1 m/sec)
- Walking distance (6 min)
- Stair climbing

- CHS (Fried) Criteria
- IANA Criteria
- SOF Criteria

- ADLs
- Barthel Index
- Functional Index Measure
ADL’s and Outcome

- Transfer
- Toilet
- Bathe
- Dress
- Eat
- Continence

6-month mortality

6-month Nursing Home

Intact  Lacking
18.9    52.1    8
56.9
**Height** = 1.6 m

**m²** = 3.2

**Lean (Arms + Legs)** = 14.0 kg

**ASM index** = 14.0/3.2 = 4.4 kg/m²

**Regional Fat** = 46.2 %
### Mean (SD) Pretreatment (baseline) and Posttreatment (6 months)

<table>
<thead>
<tr>
<th>Muscle thickness (mm)</th>
<th>Baseline</th>
<th>6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testosterone (n = 15)</td>
<td>15.3 (2.9)</td>
<td>15.7 (2.2)</td>
</tr>
<tr>
<td>Placebo (n = 13)</td>
<td>14.7 (2.1)</td>
<td>13.9 (2.6)</td>
</tr>
<tr>
<td>Treatment effect (95% CI)</td>
<td>1.4 (0.3–2.5)</td>
<td>.015</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fascicle length (mm)</th>
<th>Baseline</th>
<th>6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testosterone (n = 15)</td>
<td>45.1 (7.0)</td>
<td>44.7 (5.8)</td>
</tr>
<tr>
<td>Placebo (n = 13)</td>
<td>48.1 (5.8)</td>
<td>44.9 (6.1)</td>
</tr>
<tr>
<td>Treatment effect (95% CI)</td>
<td>1.9 (−1.2 to 5.0)</td>
<td>.22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pennation angle (°)</th>
<th>Baseline</th>
<th>6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testosterone (n = 15)</td>
<td>23.5 (3.8)</td>
<td>23.3 (4.3)</td>
</tr>
<tr>
<td>Placebo (n = 13)</td>
<td>21.2 (3.4)</td>
<td>20.3 (3.5)</td>
</tr>
<tr>
<td>Treatment effect (95% CI)</td>
<td>1.2 (−1.3 to 3.7)</td>
<td>.32</td>
</tr>
</tbody>
</table>

*Figures are nominal values with standard deviation. Patient numbers are given in parentheses.*

Ultrasound image showing muscle parameters measured.

**Effects of Testosterone on Skeletal Muscle Architecture in Intermediate-Frail and Frail Elderly Men**

Electrical Impedance Myography
## Potential Muscle Biomarkers

<table>
<thead>
<tr>
<th>Biomarker</th>
<th>Aging</th>
<th>Exercise</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatine Kinase</td>
<td>↓</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Aldolase(A)</td>
<td>↓</td>
<td></td>
<td>Correlates with walking speed in old</td>
</tr>
<tr>
<td>CoEnzymeQ</td>
<td>↓</td>
<td></td>
<td>More strongly correlated with FFM</td>
</tr>
<tr>
<td>MLC-1</td>
<td>↓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Troponin T</td>
<td>?</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Creatine (U)</td>
<td></td>
<td></td>
<td>Correlates with muscle mass</td>
</tr>
<tr>
<td>Myoglobin</td>
<td>↑</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Creatinine (U) (/?/Cystatin C)</td>
<td>↓</td>
<td></td>
<td>Correlates with muscle J-shaped curve with function</td>
</tr>
<tr>
<td>N-terminal propeptide III collagen</td>
<td>↓</td>
<td></td>
<td>Increased with testosterone</td>
</tr>
</tbody>
</table>
Sarcopenia with limited Mobility

A position paper from the Society on Sarcopenia, Cachexia and Wasting Disorders Trialist Workshop, Washington DC, December, 2010

JAMDA, June 2011
Sarcopenia with limited mobility

A specific condition with clear loss of muscle mass and a clear target for intervention

- It is a syndrome not a disease

- Definition based on consensus

- It differs from the more general concept of frailty
Sarcopenia with limited mobility: Definition

A person with muscle loss whose walking speed is equal to or less than 1 m/s or who walks less than 400 m during a six minute walk. The person should also have a lean appendicular mass corrected for height squared of more than two standard deviations below that of healthy persons between 20 to 30 years of age of the same ethnic group. Sarcopenia is generally believed to be age-associated and its prevalence increases with age.
Sarcopenia with limited mobility: Exclusions

- Peripheral vascular disease with intermittent claudication
- Diagnosable congenital or acquired muscle disorders eg myotonia dystrophica or inclusion body myositis
- Central nervous system disorders eg stroke, parkinson’s disease, multiple sclerosis
- Peripheral nervous system disorders eg motor neuron disease, spinal cord disease or peripheral neuropathy
- Dementia
- Cachexia
Decreased 6 minute walk distance
Increased dizziness
Sarcopenia with limited mobility: Clinically significant interventions

- An increase in the 6 minute walk of 50 meters
- An increase of gait speed of 0.1 m/sec

NOTE: The 50 meter criteria was used for approval by the FDA of drugs for peripheral vascular disease and...
Sarcopenia with limited mobility: Screening

All persons over 60 years of age who:

- Fall
- Fell their walking speed has decreased
- Had a recent hospitalisation
- Have had prolonged bed rest
- Have problems rising from a chair
- Need to use an assistive device while walking

The 6 minute walk test should be separately reimbursed during a physician visit
Sarcopenia with limited mobility: Conclusion

It is believed that this definition clearly defines a syndrome whose treatment should delay the onset of disability and as such provides a clearly defined entity which can be subjected to therapeutic intervention and for which there is an acceptable defined response which should allow the development of pharmaceutical products that can be approved by regulatory agencies.
# Comparison of Sarcopenia Definitions

<table>
<thead>
<tr>
<th>Definition</th>
<th>Screen</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>IANA Sarcopenia Task Force</td>
<td>Gait Speed &lt;1.0m/s</td>
<td>Low appendicular lean mass (&lt;7.23 kg/m2 in men; 5.67 in women)</td>
</tr>
<tr>
<td>EWGSOP</td>
<td>Gait Speed &lt;0.8m/s</td>
<td>Low muscle mass (not defined)</td>
</tr>
<tr>
<td>SIG: Cachexia-Anorexia in Chronic Wasting Diseases</td>
<td>Gait Speed &lt;0.8m/s, OR Other Physival Performance Measure</td>
<td>Low muscle mass (2SD)</td>
</tr>
<tr>
<td>Sarcopenia with Limited Mobility (SCWD)</td>
<td>6 min walk &lt;400m OR Gait Speed &lt;1.0m/s</td>
<td>Low appendicular lean mass 2SD 20-30 sex ethnicity</td>
</tr>
</tbody>
</table>
Mortality with limited mobility was 4.56 vs 1.80 for ASM alone (p<0.001)
Causes of Limited Mobility

- Muscle Loss
- PVD (intermittent claudication)
- Arthritis
- Stroke
- Spinal stenosis
- Systemic Disease (e.g., CHF, COPD, Anemia)
SARCOPENIC OBESITY
“Fat Frail”

In the New Mexico Aging Process Study we found obese sarcopenia to be longitudinally the best predictor of future disability and mortality.

Epidos Study
Sarcopenic-Obese
Odds of climbing stairs 2.60
Odds of going down stairs 2.35

Morley et al J Clin Med 2001; 137:231-43
### Sarcopenia Definitions Considering Body Size and Fat Mass Are Associated With Mobility Limitations: The Framingham Study

**Table 4.**

<table>
<thead>
<tr>
<th>Sarcopenia</th>
<th>Walk One-Half Mile</th>
<th>Climb Stairs</th>
<th>Heavy House Work</th>
<th>Walk One-Half Mile</th>
<th>Women Climb Stairs</th>
<th>Heavy House Work</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crude</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALM/ht²</td>
<td>1.83 (0.72–4.66)</td>
<td>5.93 (1.29–27.36)</td>
<td>4.68 (2.00–10.99)</td>
<td>0.53 (0.22–1.28)</td>
<td>1.11 (0.24–5.04)</td>
<td>1.54 (0.84–2.83)</td>
</tr>
<tr>
<td>Residuals</td>
<td>2.32 (0.83–6.44)</td>
<td>3.18 (0.62–16.28)</td>
<td>4.47 (1.80–11.09)</td>
<td>1.27 (0.72–2.23)</td>
<td>1.19 (0.37–3.82)</td>
<td>1.90 (1.18–3.08)</td>
</tr>
<tr>
<td>Adjusted*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALM/ht²</td>
<td>3.33 (0.97–11.40)</td>
<td>—</td>
<td>5.96 (1.88–18.86)</td>
<td>0.75 (0.29–1.93)</td>
<td>—</td>
<td>1.89 (0.95–3.76)</td>
</tr>
<tr>
<td>Residuals</td>
<td>1.86 (0.60–5.72)</td>
<td>—</td>
<td>4.30 (1.58–11.72)</td>
<td>1.27 (0.71–2.26)</td>
<td>—</td>
<td>2.11 (1.27–3.51)</td>
</tr>
<tr>
<td><strong>Obesity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neither (referent)</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Obese</td>
<td>1.73 (0.62–4.85)</td>
<td>0.45 (0.04–5.01)</td>
<td>1.48 (0.47–4.68)</td>
<td>—</td>
<td>—</td>
<td>1.42 (0.88–2.30)</td>
</tr>
<tr>
<td>Sarcopenic</td>
<td>2.36 (0.62–8.94)</td>
<td>5.33 (0.85–33.41)</td>
<td>7.83 (2.40–25.56)</td>
<td>—</td>
<td>—</td>
<td>1.98 (0.92–4.28)</td>
</tr>
<tr>
<td>Sarcopenic-obese</td>
<td>2.75 (0.63–12.01)</td>
<td>2.58 (0.22–29.77)</td>
<td>3.33 (0.73–15.19)</td>
<td>—</td>
<td>—</td>
<td>1.71 (0.58–5.08)</td>
</tr>
<tr>
<td><strong>Adjusted†</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Neither (referent)</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Obese</td>
<td>2.01 (0.68–5.97)</td>
<td>—</td>
<td>1.55 (0.48–5.08)</td>
<td>—</td>
<td>—</td>
<td>1.61 (0.96–2.68)</td>
</tr>
<tr>
<td>Sarcopenic</td>
<td>1.74 (0.43–7.00)</td>
<td>—</td>
<td>6.38 (1.85–21.92)</td>
<td>—</td>
<td>—</td>
<td>2.12 (0.94–4.78)</td>
</tr>
<tr>
<td>Sarcopenic-obese</td>
<td>2.46 (0.50–12.06)</td>
<td>—</td>
<td>3.20 (0.63–16.11)</td>
<td>—</td>
<td>—</td>
<td>1.99 (0.63–6.25)</td>
</tr>
</tbody>
</table>
...the flesh is consumed and becomes water,
...the abdomen fills with water, the feet and legs swell, the shoulders, clavicles, chest and thighs melt away
...this illness is fatal...
Cachexia Definition
Society of Sarcopenia, Cachexia and Wasting Disorders

Cachexia, is a complex metabolic syndrome associated with underlying illness and characterized by loss of muscle with or without loss of fat mass. The prominent clinical feature of cachexia is weight loss in adults (corrected for fluid retention) or growth failure in children (excluding endocrine disorders). Anorexia, inflammation, insulin resistance and increased muscle protein breakdown are frequently associated with cachexia. Cachexia is distinct from starvation, age-related loss of muscle mass, primary depression, malabsorption and hyperthyroidism.
Cachexia Definition
Saini et al, Cytokine Growth Factor Review 2006: 17:475

Often misdiagnosed as a condition simply of weight loss, cachexia is a highly complex metabolic disorder involving features of anorexia, anemia, lipolysis and insulin resistance. A significant loss of lean body mass arises from such conditions, resulting in wasting of skeletal muscle. Unlike starvation, the weight loss arises equally from loss of muscle and fat.
BODY COMPOSITION ALTERATIONS IN CARDIAC CACHEXIA

Loss of lean tissue (i.e. skeletal muscle)
Decreased fat tissue mass
Reduced bone mass (i.e., osteoporosis)

Anker S et al. Am J Cardiol 1999;83:612
Jankowska E et al. 2007 submitted

Cardiac cachexia in HF =
general tissue wasting
## Cachexia Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>EPCRC</th>
<th>SIG-ESPEN</th>
<th>SCWD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight loss</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Muscle loss</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Fat loss</td>
<td>-</td>
<td>+</td>
<td>+/-</td>
</tr>
<tr>
<td>Inflammation</td>
<td>+/-</td>
<td>+</td>
<td>+/-</td>
</tr>
<tr>
<td>Insulin Resistance</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Anemia</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Anorexia</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Fatigue</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Reversed with nutrition</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Body composition and survival in CHF

Assessed using DEXA
investigated in:
- Verona / IT
- Wroclaw / PL
- London, UK

498 CHF patients
62±12 years, 92% male
106 deaths during FU

Mortality reduction per
- % fat mass: 6%***
- kg fat mass: 5%***

Q1: 4-21 14%
Q2: 21-25 7% RR 0.65
Q3: 25-30 6% RR 0.64
Q4: >30 3% RR 0.28

12-month mortality

*** p<0.0001
Muscle mass and function and exercise intolerance in HF

- In HF muscle weakness correlates with exercise intolerance
- Muscle weakness in HF occurs as a result of loss of muscle bulk
- Muscular atrophy becomes a major determinant of exercise capacity

Harrington D et al.; JACC 1997
CYTOKINES AND CACHEXIA
CYTOKINES AND CACHEXIA

- TNF
- IL-1
- IL-6

- Anorexia
- Decreased Memory
- Sickness Behavior
- Gastric emptying
- Decreased Voluntary Energy Utilization
- Increased RMR
- Epinephrine
- Decreased Memory
- Insulin Resistance
- Cortisol
- Glucose
- Hyperlipidemia
- LPL
- TRAIL
- CRP
- SAP
- Free Fatty Acids
- Triglycerides
- Intestinal Motility
CYTOKINES AND CACHEXIA

- Immunomodulation
- Anemia
- IL-1
- IL-2
- IL-6
- TNFα

- FRAILTY
- IMPAIRED FUNCTION
- INCREASED MORTALITY
- ANOREXIA
- COGNITIVE DECLINE
- SICKNESS BEHAVIOR
- OSTEOOPENIA
- ALBUMIN SYNTHESIS
- MUSCLE WASTING
- LOSS OF NITROGEN
- ATHEROSCLEROSIS
- EXTRAVASATION OF ALBUMIN INTO EXTRAVASCULAR SPACE
Anorexia Independently Predicts Mortality

Hazard Ratio 2.9 (1.1-7.4)

Cornali et al JAGS 53 354, 2005
Figure 4 Changes in FFM following energy restriction combined with exercise. Data are plotted in descending order from largest to smallest loss in body weight for (a) absolute change in FFM and (b) percent of weight loss as FFM ([Δ FFM/Δ body weight] × 100 = % weight loss as FFM), indicates resistance exercise was prescribed in the intervention. Data presented as mean (± SD when applicable).

Figure 3 Changes in FFM following energy restriction. Data are plotted in descending order from largest to smallest loss in body weight for (a) absolute change in FFM and (b) percent of weight loss as FFM ([Δ FFM/Δ body weight] × 100 = % weight loss as FFM). Data presented as mean (± SD when applicable).
1) **My appetite is**
1. Very poor
2. Poor
3. Average
4. Good
5. Very good

2) **When I eat, I feel full after**
1. Eating only a few mouthfuls
2. Eating about a third of a plateful
3. Eating over half a plateful
4. Eating most of the food
5. Hardly ever

3) **Food tastes**
1. Very bad
2. Bad
3. Average
4. Good
5. Very good

4) **Normally I eat**
1. Less than one full meal a day
2. One meal a day
3. Two meals a day
4. Three meals a day
5. More than three meals a day, including snacks

< 15 predicts significant weight loss within 6 months
Mini-CNAQ: 5% weight loss

Area Under Curve = 0.85, P < .001

Area Under Curve = 0.87, P < .001

Area Under Curve = 0.84, P < .001
### SNAQ

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5% weight loss</td>
<td>81.3</td>
<td>76.4</td>
</tr>
<tr>
<td>10% weight loss</td>
<td>88.2</td>
<td>83.5</td>
</tr>
</tbody>
</table>
DECLINE IN FOOD INTAKE OVER LIFESPAN (NHANES)

**MALES**

**FEMALES**

“... habeoque senectuti magnam gratiam, quae mihi sermonis aviditatem auxit, potionis et cibi sustulit.”

*Cicero*

*Cato Maior De Senectute, XIV, 46*
Anorexia of Aging

- Smell
- Taste
- Opioids
- Nitric oxide
- NPY
- Testosterone
- Fat Mass
- Leptin
- TNFα
- Cholesystokinin
- Vagus
- Adaptive Relaxation
- Antral stretch occurs earlier
- Decreased rate of gastric emptying

Decreased Food Intake male > female

## Common Causes of Undernutrition in Medical Outpatients

<table>
<thead>
<tr>
<th></th>
<th>Older (%)</th>
<th>Young (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression</td>
<td>30</td>
<td>15</td>
</tr>
<tr>
<td>Cancer</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Therapeutic diet</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Oropharyngeal disease</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Intentional</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Chronic pain</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Misc</td>
<td>43</td>
<td>36</td>
</tr>
</tbody>
</table>

*Wilson MMG Am J Med. 1998;104:56*
## Causes of Weight Loss in Nursing Home Residents

*Morley & Kraenzle JAGS 1994:42:6*

<table>
<thead>
<tr>
<th>Cause</th>
<th>Short stay &lt;6 months</th>
<th>Long stay &gt;6 months</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression</td>
<td>60</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Swallowing disorder</td>
<td></td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Cancer</td>
<td></td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Wandering</td>
<td>20</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Medications</td>
<td>20</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Psychotropic drugs</td>
<td>20</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Tardive dyskinesia</td>
<td></td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>COPD</td>
<td></td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Dehydration</td>
<td>20</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Dementia</td>
<td></td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Obsessive Compulsive</td>
<td></td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Paranoia</td>
<td></td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Gallstones</td>
<td></td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Unknown</td>
<td>0</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>
COMPARISON OF ANOREXIA, SARCOPENIA AND CACHEXIA

<table>
<thead>
<tr>
<th></th>
<th>Anorexia</th>
<th>Sarcopenia</th>
<th>Cachexia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body mass</strong></td>
<td>--</td>
<td>-</td>
<td>---</td>
</tr>
<tr>
<td><strong>Fat free mass</strong></td>
<td>-</td>
<td>--</td>
<td>---</td>
</tr>
<tr>
<td><strong>Body fat</strong></td>
<td>---</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td><strong>RMR</strong></td>
<td>-</td>
<td>-</td>
<td>++</td>
</tr>
<tr>
<td><strong>Physical activity</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Food intake</strong></td>
<td>---</td>
<td>0</td>
<td>--</td>
</tr>
</tbody>
</table>
### COMPARISON OF ANOREXIA, SARCOPENIA AND CACHEXIA

<table>
<thead>
<tr>
<th></th>
<th>Anorexia</th>
<th>Sarcopenia</th>
<th>Cachexia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proteolysis</td>
<td>-</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Cortisol</td>
<td>+/-</td>
<td>+/-</td>
<td>++</td>
</tr>
<tr>
<td>Trigyc.</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Cytokines</td>
<td>+/-</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Anemia</td>
<td>+</td>
<td>0</td>
<td>+++</td>
</tr>
<tr>
<td>Insulin Resistance</td>
<td>0</td>
<td>0</td>
<td>+</td>
</tr>
</tbody>
</table>
Inclusion Body Myositis

A slow degenerative, inflammatory muscle disease in persons over 50 years of age

Inclusion body myositis.
Greenberg, Steven

Current Opinion in Rheumatology. 23(6):574-578, November 2011.
DOI: 10.1097/BOR.0b013e32834b53cc
MYOPENIA

CONGENITAL

- Sarcopenia
- Cachexia
- Protein energy undernutrition
- Hyperthyroidism
- PVD
- Inclusion Body Myositis

ACQUIRED
Similarities in Acquired Factors Related to Postmenopausal Osteoporosis and Sarcopenia

Joonas Sirola\textsuperscript{1,2} and Heikki Kröger\textsuperscript{1,2}
FRAILTY

Cardiovascular Health Study
- Unintentional weight loss
- Poor grip strength
- Reduced energy level
- Slow walking speed
- Low level of physical activity

Study of Osteoporotic Fractures
- Weight loss
- Inability to raise from chair 5 times without using arms
- Reduced energy level
Rockwood Deficit Scale
10 year outcomes
Deficits added $>0.25 = Frail$
FRAILTY (IANA)

- Fatigue
- Resistance (Climb 1 flight stairs)
- Aerobic (Walk one block)
- Illnesses
- Loss of weight
Kaplan-Meier survival curves showing association between FRAIL scale at W2 and subsequent all-cause mortality. 4 to 8 year follow up

Hyde Z et al. JCEM 2010;95:3165-3172
The African American Health Project

Developed at SLU by DK Miller

998 AA aged 49 to 65 years

Recruited between September 2000 and July 2001

Wave 10 repeated 9 years later

Population has dysphoric symptoms above and health related quality of life and disability below the USA national average
### Outcome Measures According to Baseline Frail Status
(All significant except for Gait Speed)

<table>
<thead>
<tr>
<th></th>
<th>Healthy</th>
<th>Prefrail</th>
<th>Frail</th>
</tr>
</thead>
<tbody>
<tr>
<td>IADLs</td>
<td>0.08</td>
<td>0.49</td>
<td>1.47</td>
</tr>
<tr>
<td>SPPB</td>
<td>9.3</td>
<td>8.3</td>
<td>6.8</td>
</tr>
<tr>
<td>Gait Speed</td>
<td>0.84 m/sec</td>
<td>0.79</td>
<td>0.74</td>
</tr>
<tr>
<td>Injurious Falls</td>
<td>3.6%</td>
<td>3.0%</td>
<td>5.3%</td>
</tr>
<tr>
<td>One Leg Stand</td>
<td>22.17 sec</td>
<td>18.62</td>
<td>12.25</td>
</tr>
<tr>
<td>Grip Strength</td>
<td>39.0 kg</td>
<td>33.0</td>
<td>28.7</td>
</tr>
<tr>
<td>Fall Scale</td>
<td>98.7</td>
<td>96.0</td>
<td>92.9</td>
</tr>
</tbody>
</table>
Prevalence of Frailty by Different Scales
Prevalence of Frailty
Excluding baseline ADL deficits
AAH Study: Mortality 9 Years After Baseline

Frail Category

- FRAIL: 38.50%
- SOF: 25.90%
- CHS: 15.40%

Pre-Frail Category

- Rockwood: 39.40%
- 23.20%
- 24.20%
- 20.70%
- 19.70%
AAH Study: 1 or More ADLs 9 Years After Baseline

Frail Category

Pre-Frail Category

FRAIL: 85.70%
SOF: 15.80%
CHS: 50.00%
Rockwood: 53.50%
FRAlL: 22.90%
SOF: 27.80%
CHS: 22.90%
Rockwood: 18.30%
## Frail Scales & IADLs

<table>
<thead>
<tr>
<th></th>
<th>Frial Scale</th>
<th>Pre-Frail Scale</th>
<th>Robust Scale</th>
<th>Frail vs. Robust</th>
<th>Pre-Frail vs. Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± Standard Deviation</td>
<td>F-Value</td>
<td>P-Value</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FRAIL Scale</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IADLs at Baseline</td>
<td>3.1 ± 2.1</td>
<td>1.1 ± 1.6</td>
<td>0.1 ± 0.4</td>
<td>248.3***</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>IADLs 3 years later</td>
<td>2.7 ± 2.0</td>
<td>1.4 ± 1.9</td>
<td>0.3 ± 0.8</td>
<td>16.9***</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>IADLs 9 years later</td>
<td>2.6 ± 2.3</td>
<td>1.4 ± 2.1</td>
<td>0.5 ± 1.3</td>
<td>3.6*</td>
<td>.037</td>
</tr>
<tr>
<td><strong>SOF Scale</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IADLs at Baseline</td>
<td>2.6 ± 2.2</td>
<td>1.0 ± 1.6</td>
<td>0.2 ± 0.8</td>
<td>151.8***</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>IADLs 3 years later</td>
<td>2.3 ± 2.2</td>
<td>1.3 ± 1.9</td>
<td>0.4 ± 1.1</td>
<td>8.6***</td>
<td>.003</td>
</tr>
<tr>
<td>IADLs at year 9**</td>
<td>2.2 ± 2.3</td>
<td>1.5 ± 2.2</td>
<td>0.6 ± 1.3</td>
<td>5.5**</td>
<td>.058</td>
</tr>
<tr>
<td><strong>Fried Scale</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IADLs at Baseline</td>
<td>1.6 ± 2.1</td>
<td>0.7 ± 1.3</td>
<td>0.1 ± 0.4</td>
<td>24.3***</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>IADLs 3 years later</td>
<td>2.0 ± 2.0</td>
<td>0.9 ± 1.6</td>
<td>0.3 ± 0.7</td>
<td>4.0*</td>
<td>.013</td>
</tr>
<tr>
<td>IADLs at year 9**</td>
<td>1.2 ± 1.6</td>
<td>0.9 ± 1.5</td>
<td>0.5 ± 1.2</td>
<td>0.1</td>
<td>---</td>
</tr>
<tr>
<td><strong>Rockwood Scale</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IADLs at Baseline</td>
<td>2.5 ± 2.0</td>
<td>0.2 ± 0.6</td>
<td>0.0 ± 0.1</td>
<td>424.4</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>IADLs 3 years later</td>
<td>2.6 ± 2.1</td>
<td>0.4 ± 1.0</td>
<td>0.1 ± 0.6</td>
<td>36.9***</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>IADLs at year 9**</td>
<td>2.6 ± 2.4</td>
<td>0.7 ± 1.5</td>
<td>0.2 ± 0.9</td>
<td>20.9***</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

*§* IADLs indicate Instrumental Activities of Daily Living.
Hong Kong Study
4000 participants; 4 year follow up
Woo et al

<table>
<thead>
<tr>
<th></th>
<th>Mortality</th>
<th>ADL Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robust</td>
<td>16%</td>
<td>Robust</td>
</tr>
<tr>
<td>Prefrail</td>
<td>22%</td>
<td>Prefrail</td>
</tr>
<tr>
<td>Frail</td>
<td>44%</td>
<td>Frail</td>
</tr>
</tbody>
</table>
### Specificity of Scales in Hong Kong Study

<table>
<thead>
<tr>
<th></th>
<th>MALE</th>
<th>MALE</th>
<th>FEMALE</th>
<th>FEMALE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MORTALITY</td>
<td>Physical Limit</td>
<td>MORTALITY</td>
<td>Physical Limit</td>
</tr>
<tr>
<td>Rockwood</td>
<td>96.4%</td>
<td>98.4%</td>
<td>93.8%</td>
<td>98%</td>
</tr>
<tr>
<td>CHS</td>
<td>99.2%</td>
<td>100%</td>
<td>99.4%</td>
<td>99.9%</td>
</tr>
<tr>
<td>FRAIL</td>
<td>99.1%</td>
<td>99.4%</td>
<td>99.9%</td>
<td>100%</td>
</tr>
<tr>
<td>Hubbard</td>
<td>98%</td>
<td>99.6%</td>
<td>96.1%</td>
<td>95.1%</td>
</tr>
</tbody>
</table>

All had poor Sensitivity
- Fatigue Syndrome (CFS; myalgic encephalitis)
- Anemia
- Treatment excess eg hypotension, chemotherapy
- Illnesses eg vitamin B12 deficiency, heart failure, renal failure, cancer
- Gulf War Syndrome (? toxin exposure)
- Unhappy (Depression)
- Endocrine (Hypothyroid, Addison’s, Diabetes mellitus)
- Sleep Disorders (Sleep apnea, restless legs, insomnia)

**FRAILTY (IANA)**

- Resistance and balance exercises
- Aerobic Exercise
- Aerobic (Walk one block)

**Fatigue**

- Resistance (Climb 1 flight stairs)

**Loss of weight**

**Illnesses**

- Reduce polypharmacy
Causes of Weight Loss

Medications
Emotional (depression)
Alcoholism, anorexia tardive, abuse (elder)
Late life paranoia
Swallowing problems

Oral problems
Nosocomial infections, no money (poverty)

Wandering/dementia
Hyperthyroidism, hypercalcemia, hypoadrenalism
Enteric problems (malabsorption)
Eating problems (eg. Tremor)
Low salt, low cholesterol diet
Shopping and meal preparation problems, Stones (cholecystitis)

PsychoSocial Frailty
Environment Modulates Longevity
East Germans rapidly developed a survival equivalent to West Germans
Stressful Social Events increase Mortality in oldest-old males in Hong Kong
Frailty Cascade

**PSYCHOLOGICAL**
- Depression
- Cognition
- Anxiety
- Fear of Falling
- Fatigue
- Health Perception

**SOCIAL**
- Environment
- Income
- Support System
- Health Literacy
- Activity

**BIOLOGICAL**
- Genetics
- Muscle
- Hormones
- Cytokines
- Disease
- Deficits

**FRAILTY**
- Functional Deficit (IADLs/ADLs)
- Hospitalisation
- Nursing Home
- Death
SOCIAL frail scale items in AAH

Scores range from 0-6. Scores are categorized as healthy (0-1), pre-frail (2-3), and frail (4-6).

**Sadness:** “During the past week I felt sad.” 0 = Rarely or none of the time, 1 = Some or a little of the time, 2 = Occasionally or a moderate amount of the time, 3 = Most of all of the time. [Response of 2 or 3 is scored as 1 and all others as 0.]

**Outside activity:** “In the spring, summer, and fall, how much do you go outside during daylight?” 0 = Never, 1 = Less than 1 hour a week, 2 = Between 1 hour a week and 1 hour a day, 3 = More than 1 hour a day. [Response of 0 scored as 1 and all others as 0.]

**Cognition:** “I am going to name 3 objects. After I have said all 3 objects, I want you to repeat them. Remember what they are because I am going to ask you to name them again in a few minutes. [Delay]...Now what were the 3 objects that I asked you to remember?” [0-2 correct responses scored as 1 and 3 correct responses scored as 0.]

**Income adequacy:** “When you consider your household income from all sources today, would you say that you are comfortable (1), have just enough to make ends meet (2), or do not have enough to make ends meet (3)?” [Responses of 2 or 3 scored as 1 and 3 scored as 0.]

**Attachment to neighborhood:** “When you think of your attachment to this neighborhood, are you very strongly attached (1), strongly attached (2), undecided (3), not strongly attached (4), or not at all attached (5)?” [Responses of 4 or 5 scored as 1 and all others as 0.]

**Lethargy:** “How much of the time during the past 4 weeks did you feel tired?” 1 = All of the time, 2 = Most of the time, 3 = some of the time, 4 = A little of the time, 5 = None of the time. [Response of 1 or 2 scored as 1 and all others as 0.]
**CROSS-SECTIONAL:** SOCIAL Frail Wave 1 & FRAIL Wave 1 Overlap (N=955)

<table>
<thead>
<tr>
<th>SOCIAL FRAIL</th>
<th>FRAIL</th>
<th>Healthy</th>
<th>Pre-Frail</th>
<th>Frail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>310 (32.5%)</td>
<td>132 (13.8%)</td>
<td>2 (0.2%)</td>
<td></td>
</tr>
<tr>
<td>Pre-Frail</td>
<td>147 (15.4%)</td>
<td>231 (24.2%)</td>
<td>27 (2.8%)</td>
<td></td>
</tr>
<tr>
<td>Frail</td>
<td>21 (2.2%)</td>
<td>67 (7.0%)</td>
<td>18 (1.9%)</td>
<td></td>
</tr>
</tbody>
</table>

- If frail on the SOCIAL Frail:
  - 38% frail (18/47) frail on FRAIL
  - 96% (45/47) frail or pre-frail on FRAIL

**LONGITUDINAL:** SOCIAL Frail Wave 1 & FRAIL Wave 10 Overlap (N=520)

<table>
<thead>
<tr>
<th>SOCIAL FRAIL</th>
<th>FRAIL</th>
<th>Healthy</th>
<th>Pre-Frail</th>
<th>Frail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>167 (32.1%)</td>
<td>84 (16.2%)</td>
<td>7 (1.3%)</td>
<td></td>
</tr>
<tr>
<td>Pre-Frail</td>
<td>91 (17.5%)</td>
<td>78 (15.0%)</td>
<td>11 (2.1%)</td>
<td></td>
</tr>
<tr>
<td>Frail</td>
<td>26 (5%)</td>
<td>46 (8.8%)</td>
<td>10 (1.9%)</td>
<td></td>
</tr>
</tbody>
</table>

- If frail on the SOCIAL Frail:
  - 35% frail (10/28) frail on FRAIL
  - 75% (21/28) frail or pre-frail on FRAIL
**SOCIAL Cross-Sectional Results**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Robust (n=492)</th>
<th>Pre-Frail (N=444)</th>
<th>Frail (n=53)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ADL disabilities</strong></td>
<td>0.37±1.0</td>
<td>0.98±1.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.08±2.2&lt;sup&gt;d&lt;/sup&gt;</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>IADLs disabilities</strong></td>
<td>0.42±1.1</td>
<td>1.14±1.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.58±2.2&lt;sup&gt;d&lt;/sup&gt;</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Short Physical Performance Battery</strong></td>
<td>8.76±2.7</td>
<td>7.44±3.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.36±4.0&lt;sup&gt;d&lt;/sup&gt;</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Lower Body Functional Limitations</strong></td>
<td>1.09±1.5</td>
<td>2.04±1.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.56±1.6&lt;sup&gt;d&lt;/sup&gt;</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>One-Leg Stand</strong></td>
<td>20.92±10.9</td>
<td>18.50±11.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>13.64±10.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Grip Strength</strong></td>
<td>37.01±12.7</td>
<td>32.74±13.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>33.39±14.3</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Physician visits past year</strong></td>
<td>4.19±4.4</td>
<td>5.32±5.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.41±5.6</td>
<td>.002</td>
</tr>
<tr>
<td><strong>Binary Logistic Regression</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Odds Ratio</strong></td>
<td></td>
<td>95% CI</td>
<td>P-Value</td>
<td></td>
</tr>
<tr>
<td><strong>Hospitalized overnight past 2 years</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Pre-frail</td>
<td>1.38</td>
<td>1.01-1.89</td>
<td>.042</td>
<td></td>
</tr>
<tr>
<td>Frail</td>
<td>2.75</td>
<td>1.51-5.00</td>
<td>&lt;.001</td>
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</tbody>
</table>
## SOCIAL
Longitudinal Outcomes at 9 years

### Univariate Analysis of Variance*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Robust (n=318)</th>
<th>Pre-Frail (n=231)</th>
<th>Frail (n=29)</th>
<th>P-Value</th>
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</thead>
<tbody>
<tr>
<td>ADL disabilities</td>
<td>0.58±1.5</td>
<td>1.00±1.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.86±2.5&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>IADL disabilities</td>
<td>0.77±1.6</td>
<td>1.26±2.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.64±2.7&lt;sup&gt;d&lt;/sup&gt;</td>
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<tr>
<td>Short Physical Performance Battery</td>
<td>8.44±2.8</td>
<td>7.28±3.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.53±4.03&lt;sup&gt;d&lt;/sup&gt;</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Lower Body Functional Limitations</td>
<td>1.51±1.7</td>
<td>2.30±1.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.46±1.7&lt;sup&gt;d&lt;/sup&gt;</td>
<td>&lt;.001</td>
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<tr>
<td>One-Leg Stand</td>
<td>17.90±11.6</td>
<td>11.91±10.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11.79±10.1</td>
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<tr>
<td>Grip Strength</td>
<td>33.41±12.2</td>
<td>29.11±10.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>27.85±10.0</td>
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<td>Mortality</td>
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<tr>
<td>Pre-frail</td>
<td>2.30</td>
<td>1.57-3.37</td>
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<tr>
<td>Frail</td>
<td>2.46</td>
<td>1.14-5.30</td>
<td>.022</td>
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</tbody>
</table>
Conclusions

- Sarcopenia is histologically different from cachexia with a different set of causes.
- Sarcopenic individuals do not loose fat
- Sarcopenia should not be used for muscle wasting due to diseases
- Limited mobility has many causes other than sarcopenia.
- All persons with sarcopenia do not have limited mobility
Conclusions

- Sarcopenic obesity has worse outcomes than sarcopenia
- Frailty is a multifactorial geriatric syndrome that predicts disability and mortality
- The IANA FRAIL screen is a rapid validated screen for use in physicians office practice