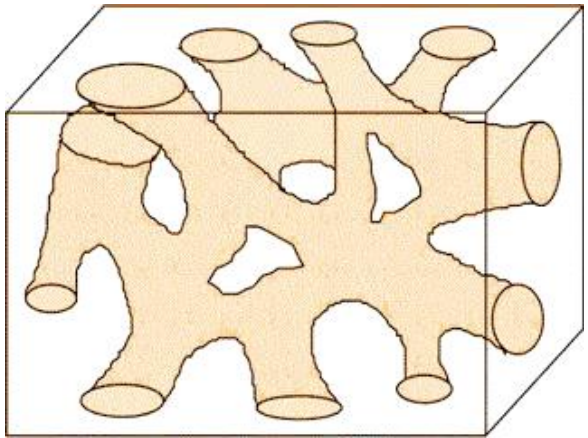
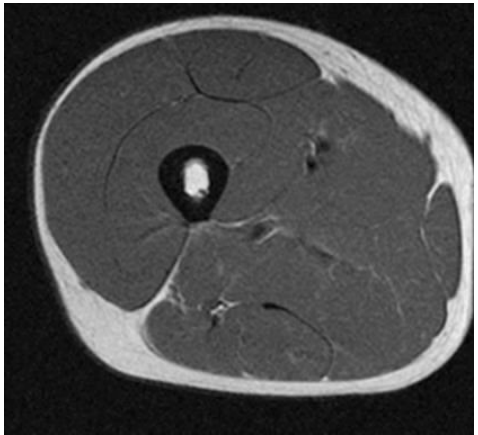
Osteoporosis and Soft Tissue (Muscle/Fat) Disorders

Clinical phenotypes and targeting

Bruce R. Troen, M.D.

Division of Geriatrics and Palliative Medicine
University at Buffalo
VA Western NY Healthcare System





Disclosures

None

Fracture Facts

- By 90 years, 1/3 of women and 1/6 of men suffer hip fractures.
- Age is the most important risk factor for osteoporotic fracture.
- Most hip fractures occur with T-scores better than -2.5.
- More than 1/3 of NH residents have suffered a fracture - ⇑5-fold vs. community-dwellers
- Prior fractures predict future fractures.
- Clinical risk factors, including falls and vitamin D status, are critical to predicting fracture risk.

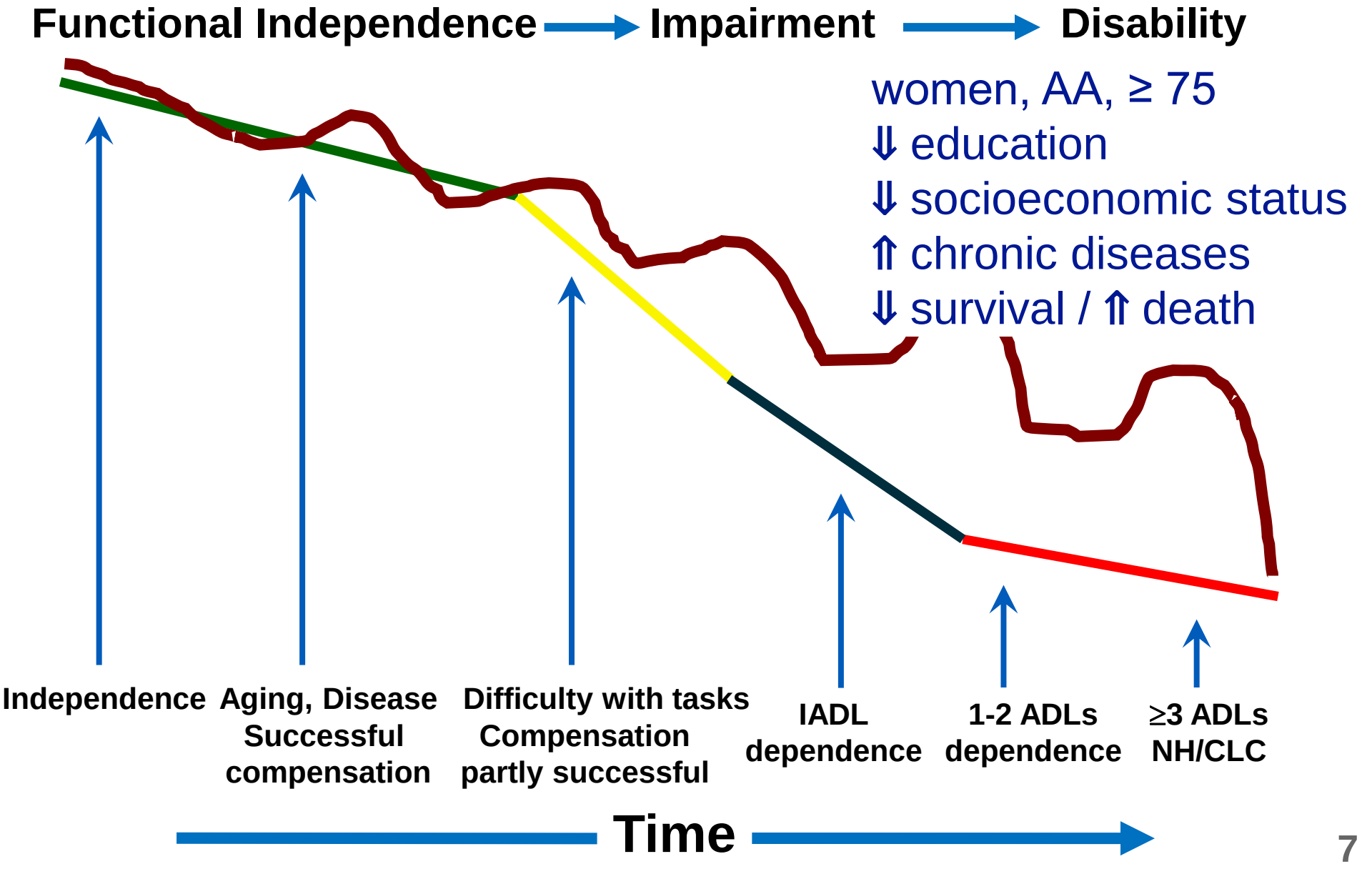
Strength and Balance

- Major confounders are disuse and disease
- Muscle mass, strength ↓; modifiable by training – at best ~15% ↓ by 80; fast twitch type 2 ↓↓
- Sarcopenia >50% ↓ common, NOT purely aging
- Strength, cerebellar integrity, hearing and vision all play a role in balance
- Vestibular portion of 8th CN – degeneration of otoconia (otolith granules) – multiple diseases, 8th N sensitivity to drugs are confounders
- Single stance a powerful discriminator

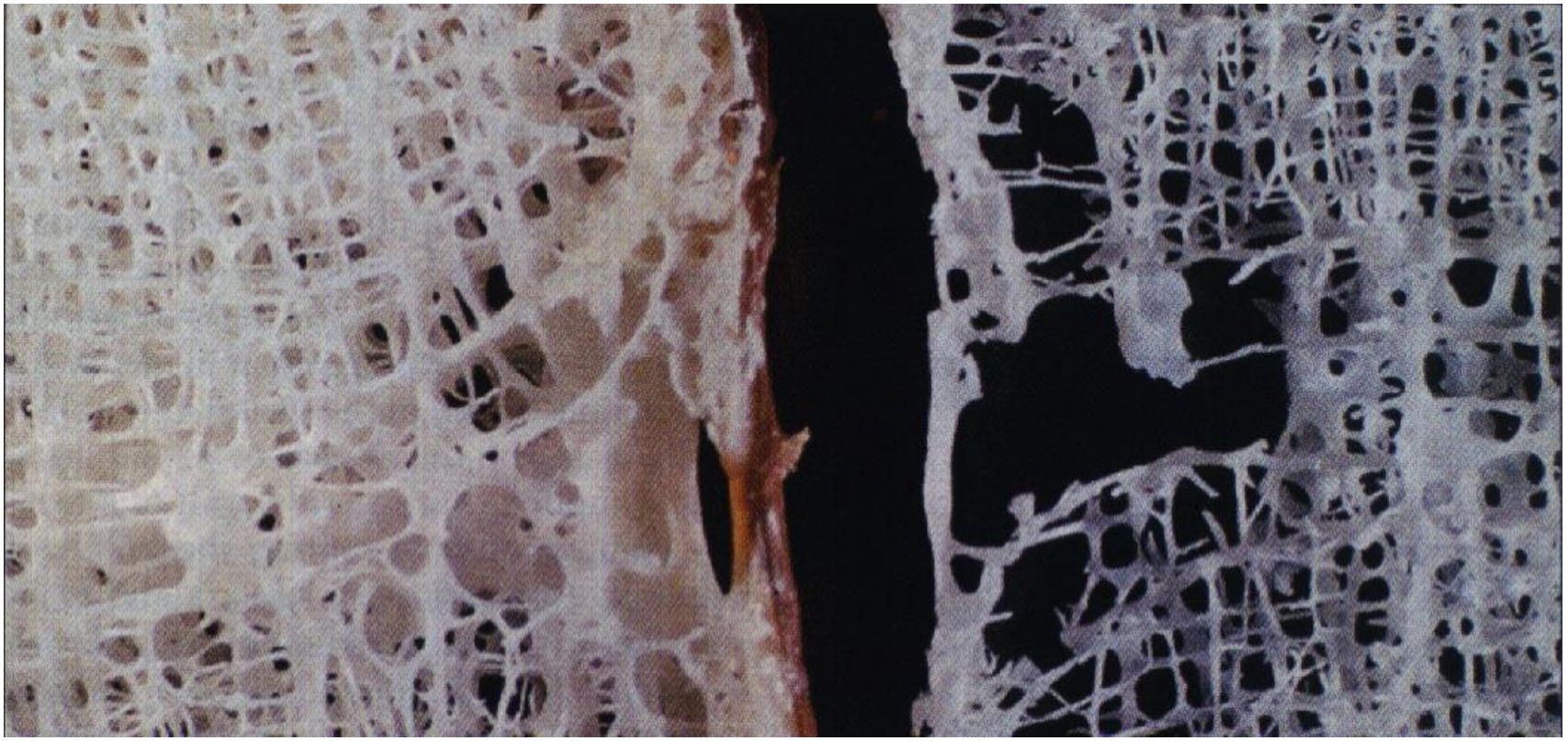
Falls Facts

- 1/3 adults ≥ 65 each year, but less than half talk to their healthcare providers about it
- Direct medical costs of falls estimated > $30 billion
- Injuries ⇑ 4-fold ≥ 85 vs 65 to 74
- LTC ≥ 1 year ⇑ 4-5-fold ≥ 75 vs 65 to 74
- Women ⇑ injuries and fractures 2x men
- Over 90% of hip fractures due to falls
- 82% of fall deaths are among people ≥ 65
- Men ⇑ deaths

Trajectory of functional ability

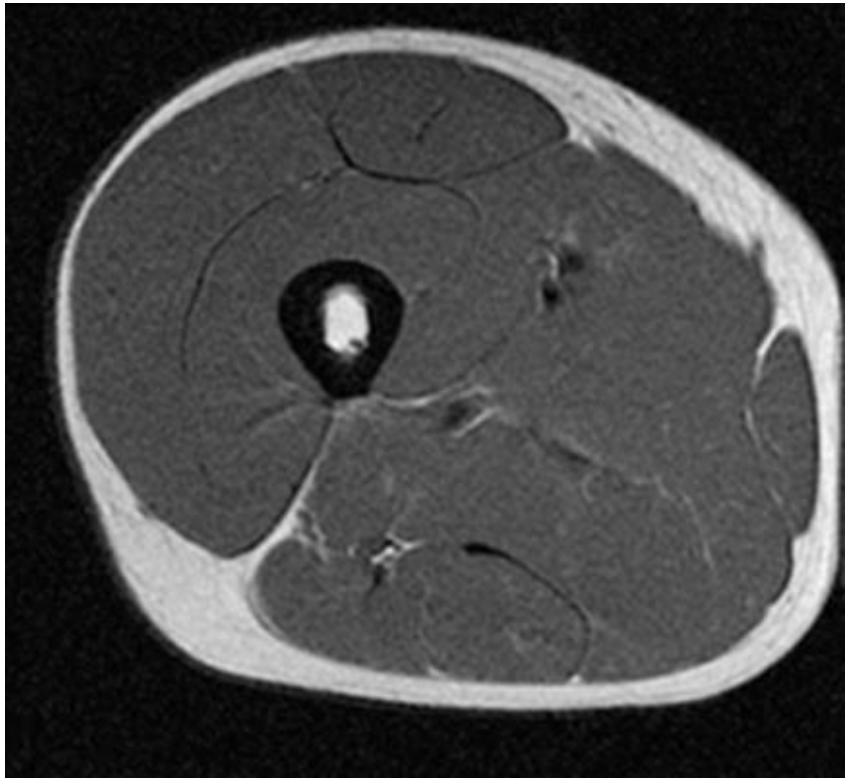


Normal bone Osteoporosis

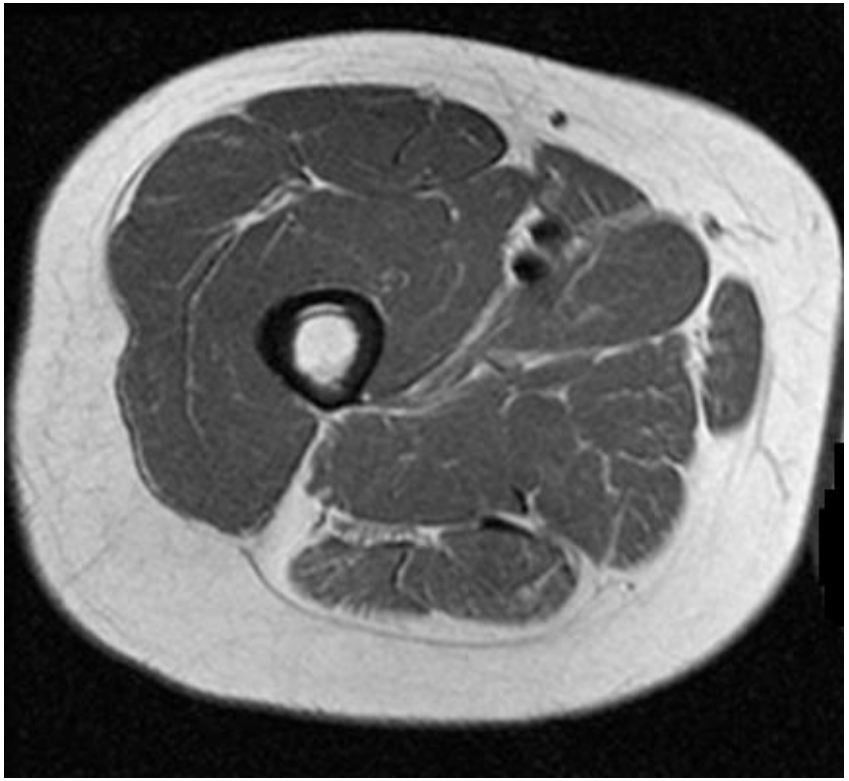


Osteoporosis is a disease characterized by low bone mass, microarchitectural deterioration of bone tissue leading to enhanced bone fragility, and a consequent increase in fracture risk.

Young quad

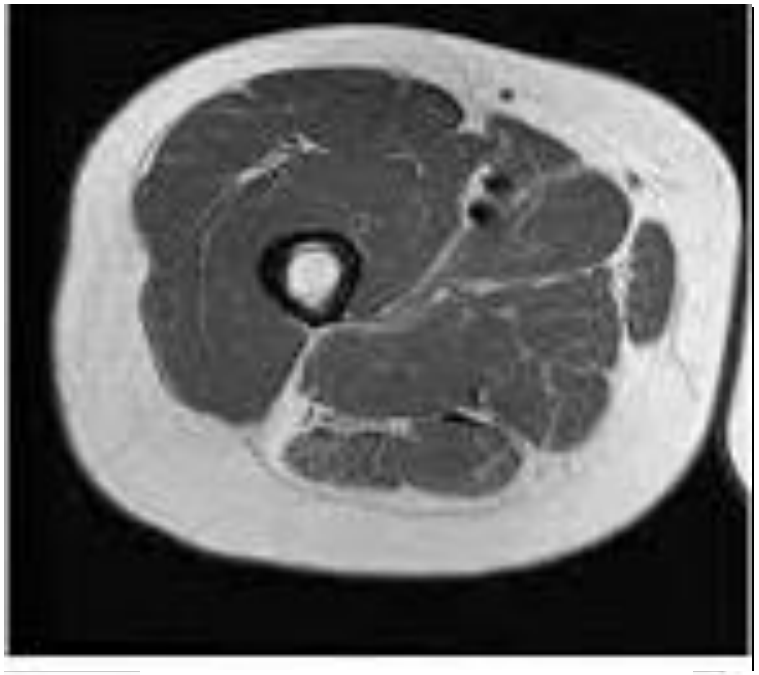


Old quad



Sarcopenia

- **Hallmarks:**
  Loss of muscle mass
  Fat infiltration
  Smaller fast twitch fibers
- **Prevalence with aging:**
  Everyone!
- **Consequences:**
  Poor muscle function
  Falls and fractures
  Loss of independence
  FRAILTY



63 year old

- Best known intervention: **Exercise**
  → **YET** only **12%** over the age of 65 participate!

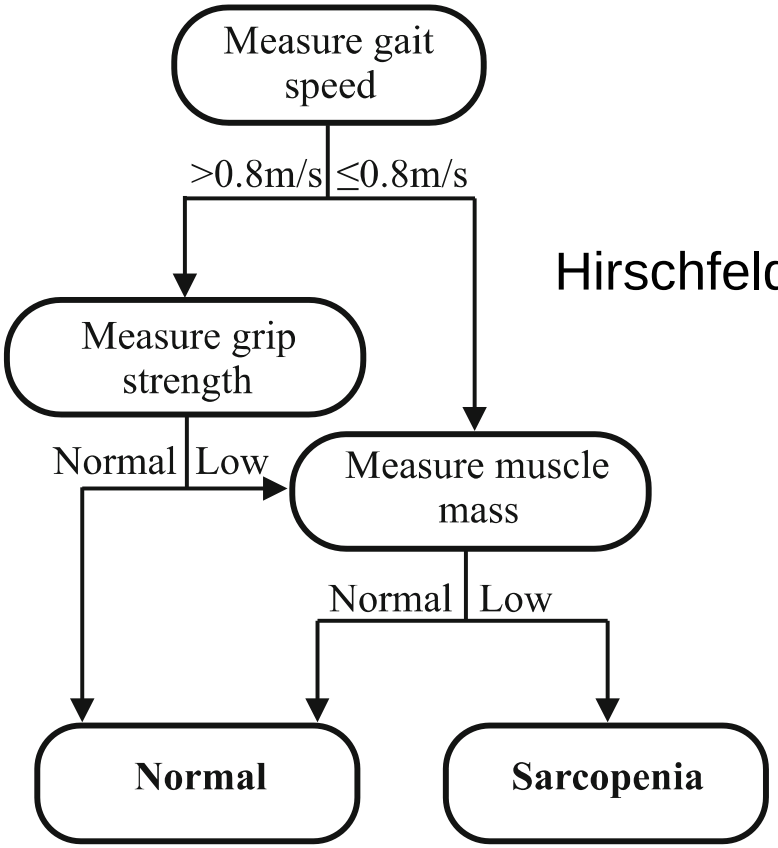
SARC-F Screen for Sarcopenia

Component	Question
Strength	How much difficulty do you have in lifting and carrying 10 pounds?
Scoring: None = 0 Some = 1 A lot or unable = 2	
Assistance in Walking	How much difficulty do you have walking across a room?
Scoring: None = 0 Some = 1 A lot , use aids or unable = 2	
Rise from a Chair	How much difficulty do you have transferring from a chair or bed?
Scoring: None = 0 Some = 1 A lot or unable without help = 2	
Climb stairs	How much difficulty do you have climbing a flight of ten stairs?
Scoring: None = 0 Some = 1 A lot or unable = 2	
Falls	How many times have you fallen in the last year?
Scoring: None = 0 1-3 Falls = 1 4 or more falls = 2	

Total score of 4 or more indicates Sarcopenia

Malmstrom, J Frailty Aging 2013

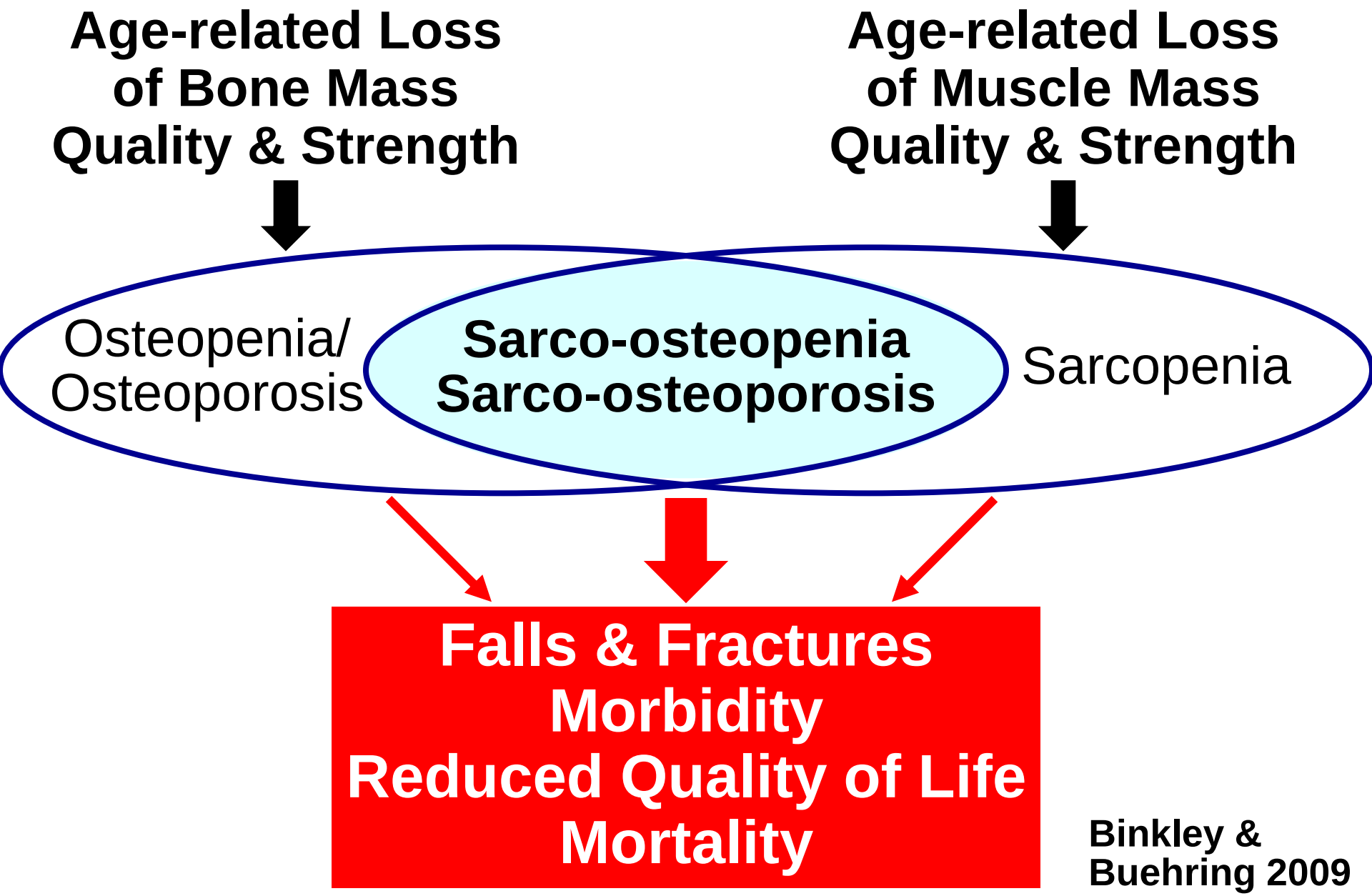
EWGSOP modified algorithm for screening and classification of sarcopenia



Hirschfeld et al. Osteo Int 2017

Stage	Muscle mass	Muscle strength	Physical performance
Pre-sarcopenia	Low	Normal	Normal
Sarcopenia	Low	One of them low	
Severe sarcopenia	Low	Low	Low

Sarco-Osteoporosis

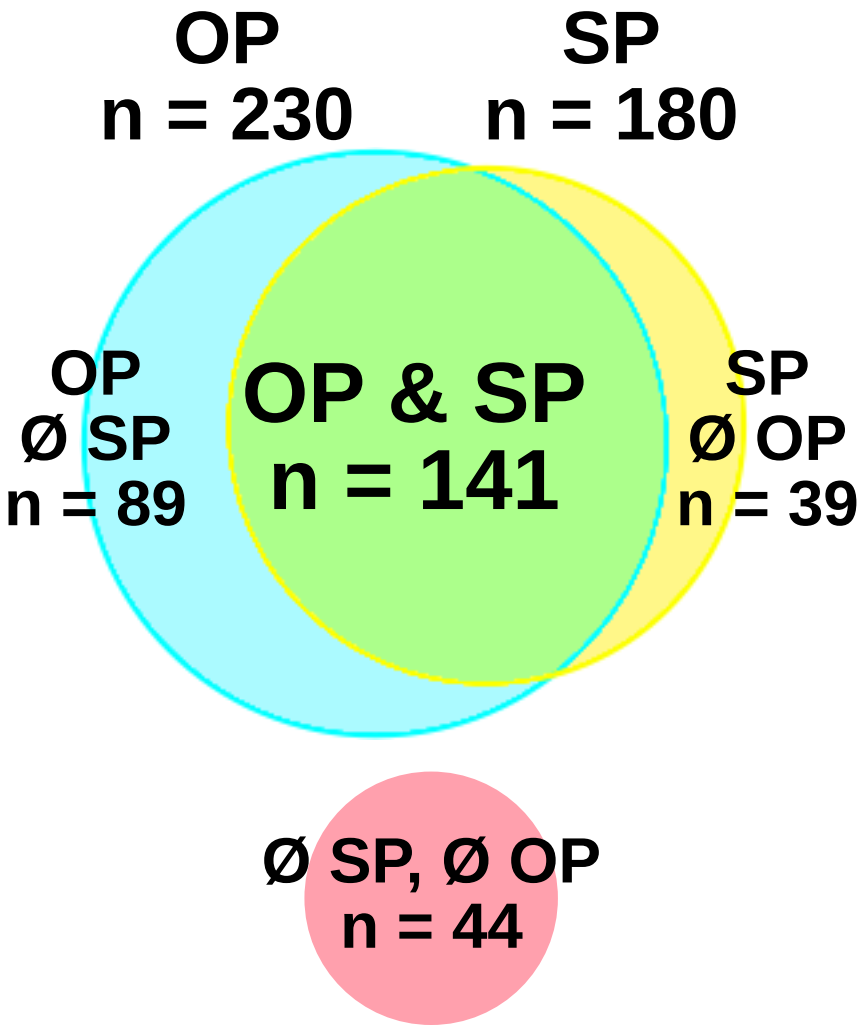


Binkley & Buehring 2009

Hip Fx Pts Often Have Sarcopenia and Osteoporosis by DXA

313 white women: hip fracture
Sarcopenia: ALM/Ht^2 < 5.45
Osteoporosis: Femur T-score ≤ -2.5

"Data supports… preventive strategies and treatment options for sarcopenia and osteoporosis targeting both bone and muscle…"



Adapted from Di Monaco 2010

Frailty Facts

- 7-10 % ≥ 65, 40-50 % ≥ 85
- ⇑ women, African Americans, less educated, poor
- Co-existing chronic diseases: including arthritis, hypertension, and diabetes
- Death ⇑ 6-fold vs non-frail
- Falls, fractures, functional decline, disability, loss of independence, hospitalization, mortality

Frailty Syndrome

1- Weight loss: >10 lb unintentionally prior year

2- Weakness: grip strength lowest 20% (by gender and body mass index)

3- Exhaustion: self report of exhaustion (CED-Depression Scale)

4- Slowness: walking time/15 feet slowest 20% (by gender and height)

5- Low activity: Kcal/week lowest 20% (Minnesota Leisure Time activity questionnaire)

Frailty: ≥ 3 criteria

Prefrailty: 1 or 2 criteria

Fried et al. Journal of Gerontology 2001

FRAIL Scale

Fatigue / **R**esistance (1 flight of stairs) / **A**mbulation (one block) / **I**llnesses / **L**oss of weight

Fatigue: "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. Responses of "1" or "2" are scored as 1 and all others as 0. Baseline prevalence = 20.1%.

Resistance: "By yourself and not using aids, do you have any difficulty walking up 10 steps without resting?" 1 = Yes, 0 = No. Baseline prevalence = 25.5%.

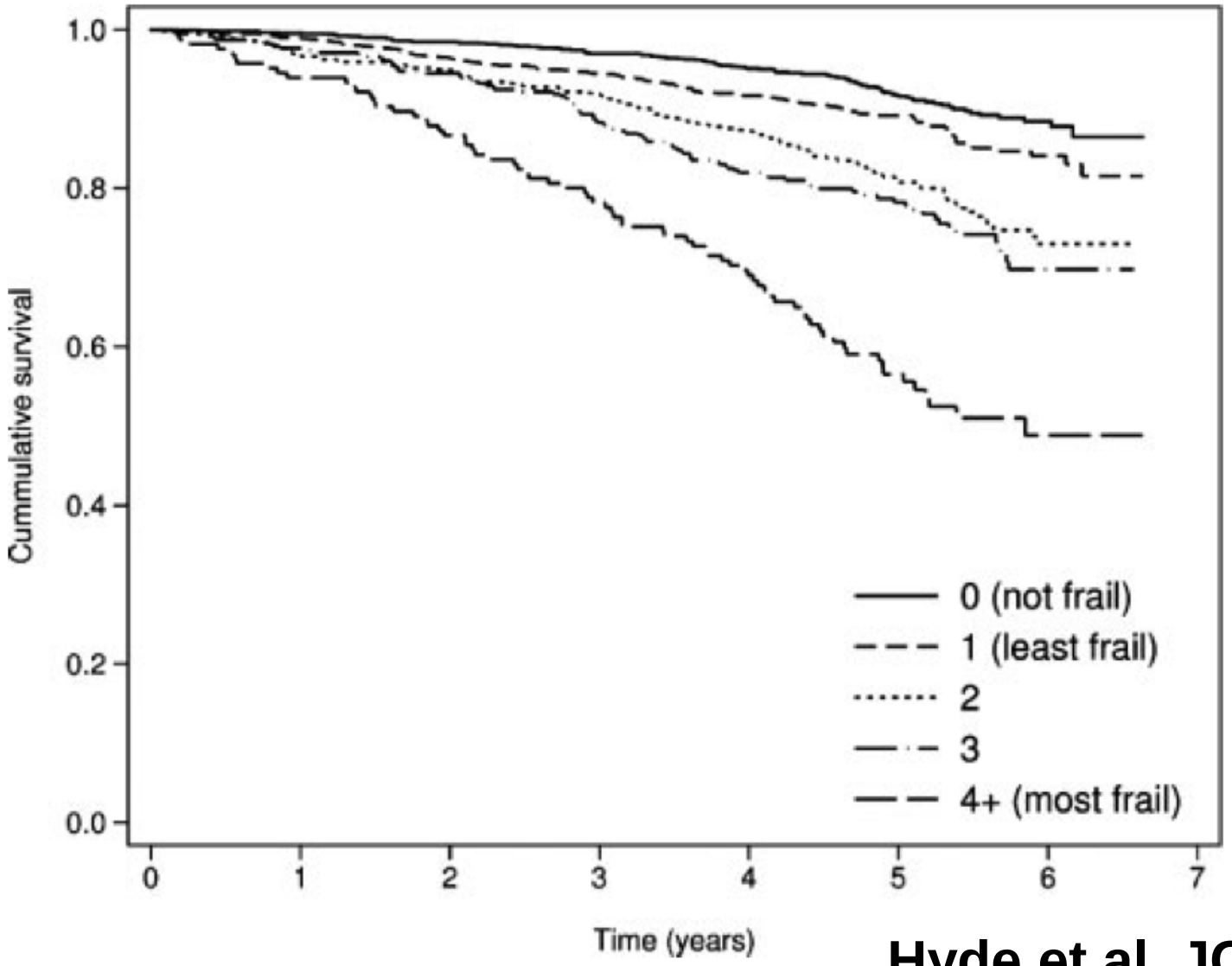
Ambulation: By yourself and not using aids, do you have any difficulty walking several hundred yards?" 1 = Yes, 0 = No. Baseline prevalence = 27.7%.

Illnesse: For 11 illnesses, participants are asked, "Did a doctor ever tell you that you have [illness]?" 1 = Yes, 0 = No. The total illnesses (0-11) are recoded as 0-4 = 0 and 5-11 = 1. The illnesses include hypertension, diabetes, cancer (other than a minor skin cancer), chronic lung disease, heart attack, congestive heart failure, angina, asthma, arthritis, stroke, and kidney disease. Baseline prevalence = 2.1%.

Loss of weight: "How much do you weigh with your clothes on but without shoes? [current weight]" "One year ago in (MO, YR), how much did you weigh without your shoes and with your clothes on? [weight 1 year ago]" Percent weight change is computed as: [[weight 1 year ago - current weight] / weight 1 year ago]] * 100. Percent change > 5 (representing a 5% loss of weight) is scored as 1 and < 5 as 0. Baseline prevalence = 21.0%.

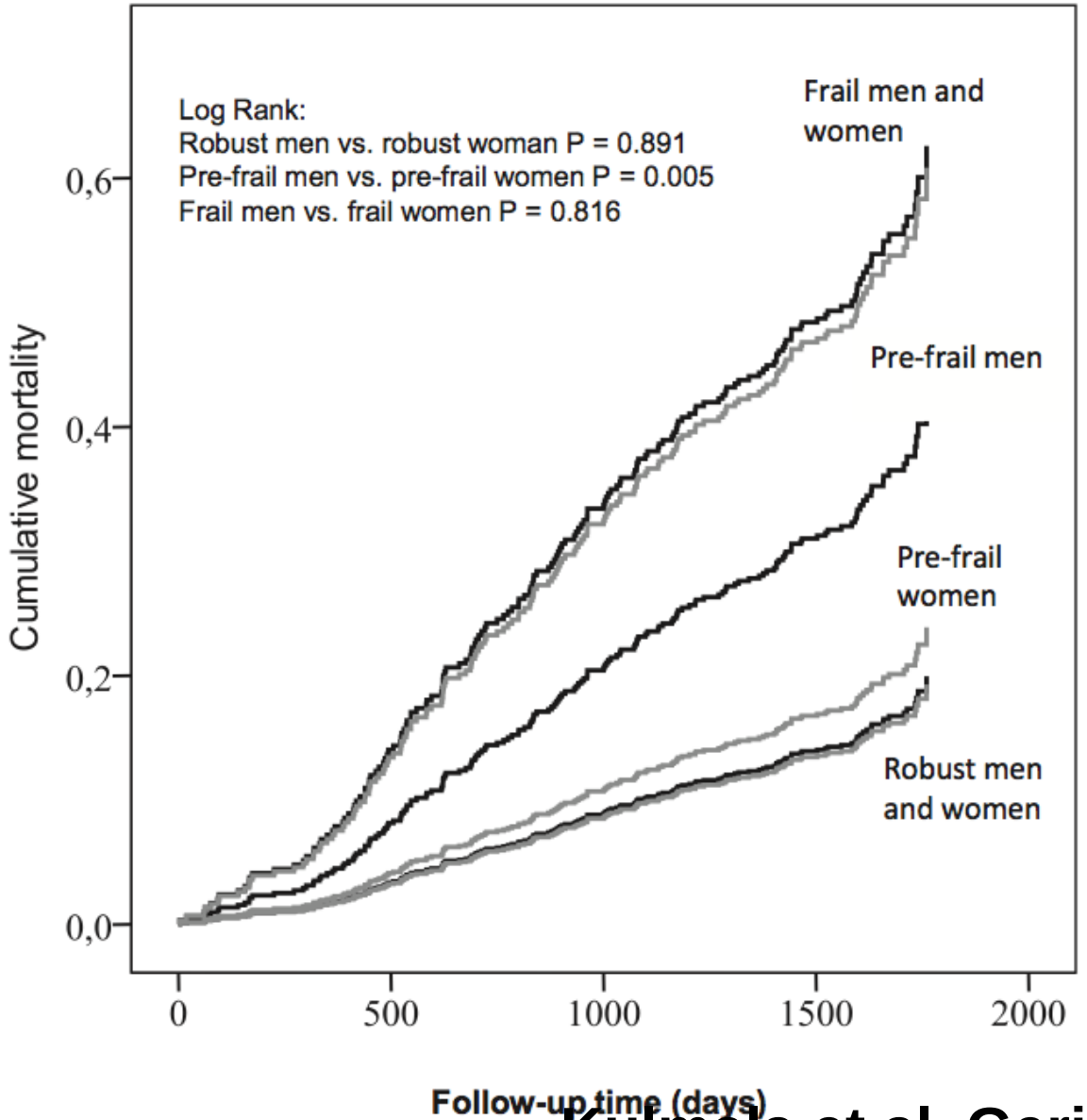
⇑Frailty ∝ ⇑Mortality

FRAIL scale: Fatigue, Resistance, Ambulation, Illnesses, Loss of weight



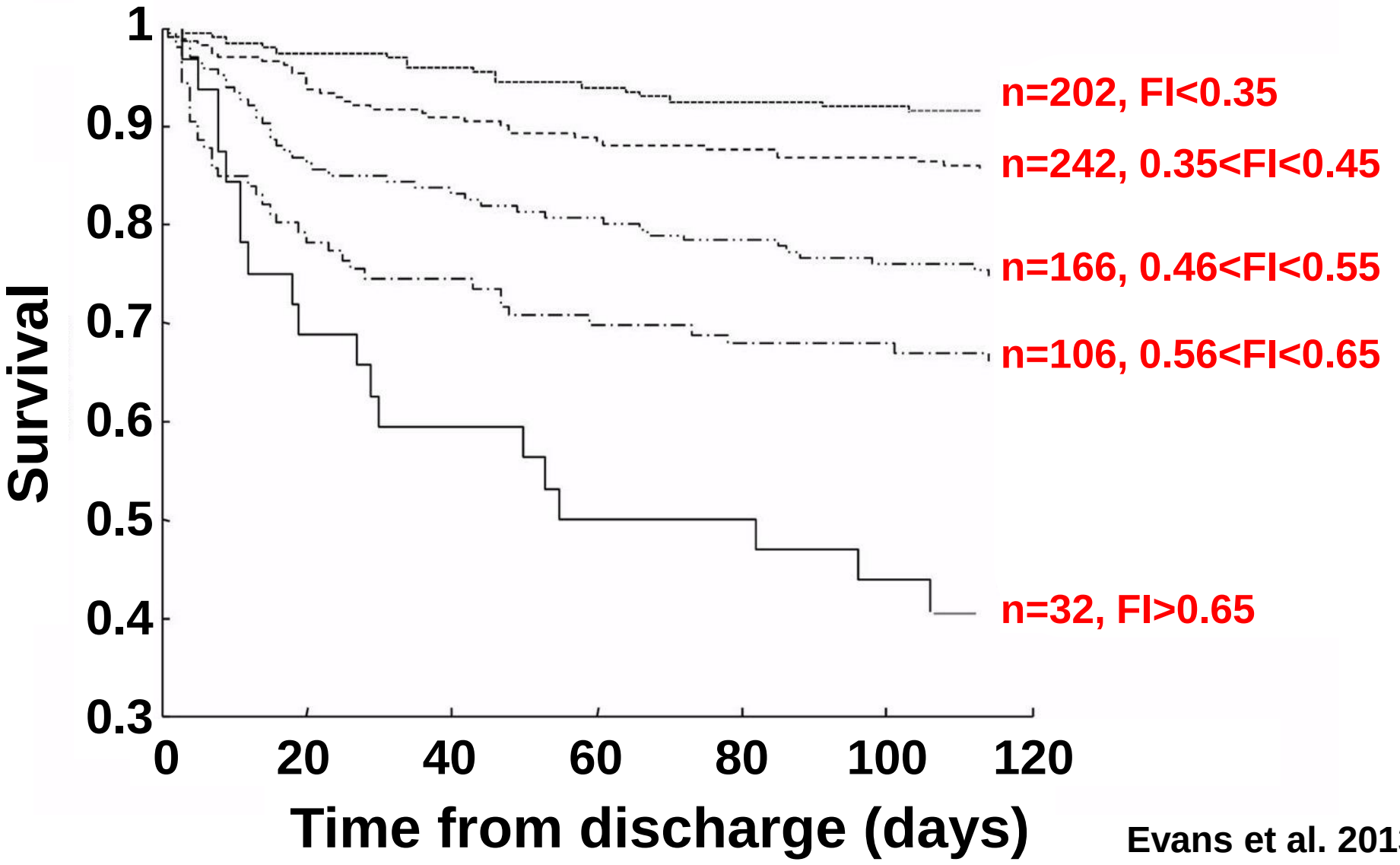
Hyde et al. JCEM 2010

⇑Frailty ∝ ⇑Mortality



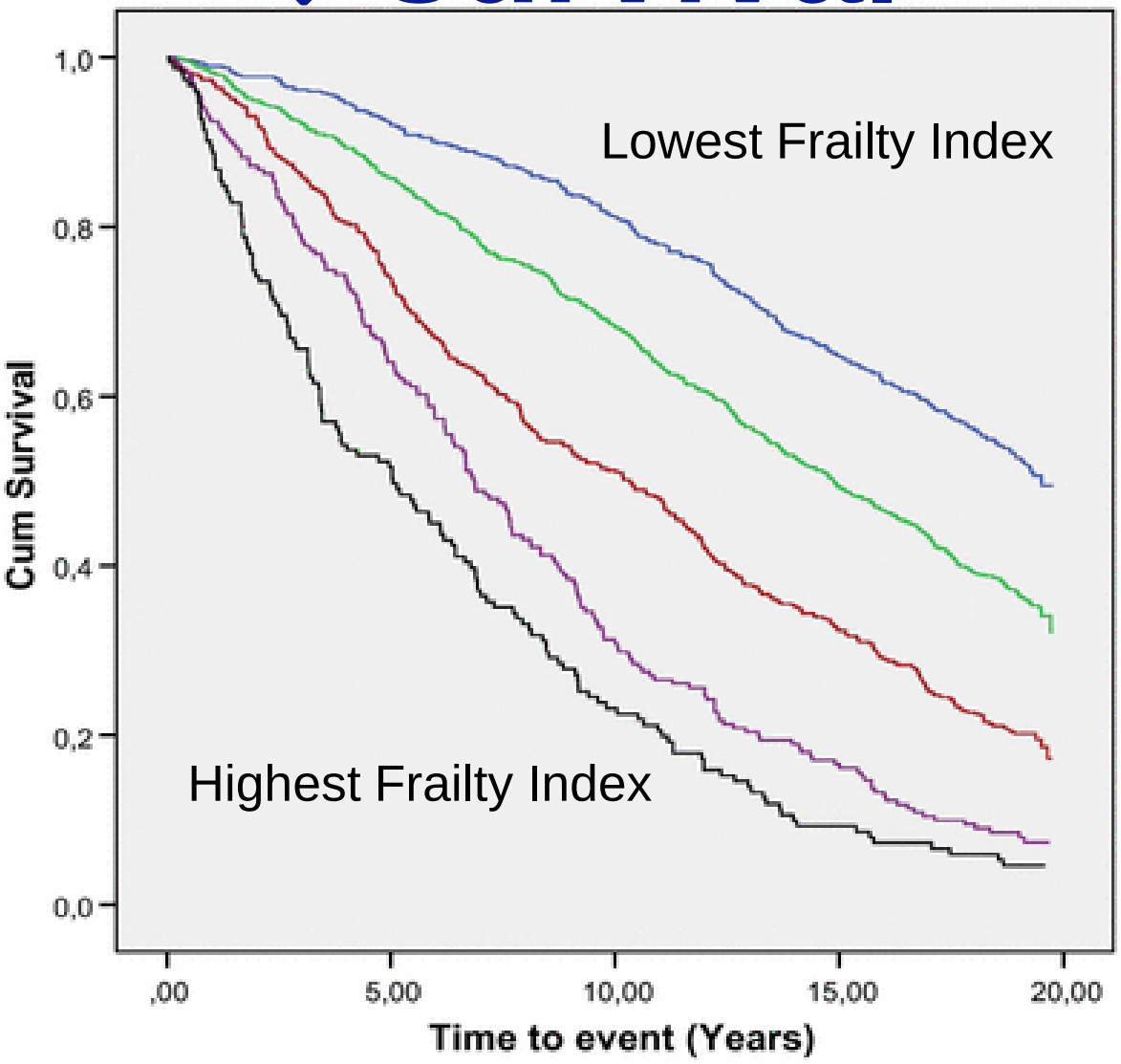
Kulmala et al. Geri Geront 2014

Increased frailty index (FI-CGA) predicts decreased survival



Evans et al. 2013

Increased frailty index ∝ ⇓ survival



Hoogendijk et al Aging Clin Exp Res. 2017

Clinical Frailty Scale

1. Very Fit

2. Well

3. Managing Well

4. Vulnerable

5. Mildly Frail

6. Moderately Frail

7. Severely Frail

8. Very Severely Frail

9. Terminally Ill

Where dementia is present, the degree of frailty usually corresponds to the degree of dementia:

- **Mild dementia** – includes forgetting the details of a recent event, though still remembering the event itself, repeating the same question/story and social withdrawal.
- **Moderate dementia** – recent memory is very impaired, even though they seemingly can remember their past life events well. They can do personal care with prompting.
- **Severe dementia** – they cannot do personal care without help.

K. Rockwood et al. A global clinical measure of fitness and frailty in elderly people. CMAJ 2005;173:489–495

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Geriatric Medicine Research, Dalhousie University, Halifax, Canada

Gerontopole Frailty Screening Tool

	YES	*NO*	*Do not know*
Does your patient live alone?	☐	☐	☐
Has your patient involuntarily lost weight in the last 3 months?	☐	☐	☐
Has your patient been more fatigued in the last 3 months?	☐	☐	☐
Has your patient experienced increased mobility difficulties in the last 3 months?	☐	☐	☐
Has your patient complained of memory problems?	☐	☐	☐
Does your patient present slow gait speed (i.e., >4 seconds to walk 4 meters)?	☐	☐	☐

If you have answered YES to one or more of these questions:

Do you think your patient is frail?	***YES*** ☐	***NO*** ☐
If ***YES***, is your patient willing to be assessed for his/her frailty status at the Frailty Clinic?	***YES*** ☐	***NO*** ☐

Vellas et al. J Nutr Health Aging 2013

Screening / Assessment

- Osteopenia / Osteoporosis
  - Clinical factors, biomarkers, DXA, US
- Sarcopenia
  - Sarc-F, Gerontopole, biomarkers (infl/metab), DXA, US, ADP, BIA, D3-cr
- Frailty
  - Fried, FRAIL, CFS, Frailty Index, Tilburg, Edmonton

Closing the barn door after the horse has bolted?

Management of osteosarcopenic obesity & frailty

- Early Identification (pre- & pre-pre-?)
  - Risk factors / calculators, Questionnaire, Biomarkers, DXA
- Prevention
  - Lifestyle, Exercise, Nutrition, Environment, ?Social Support, ?Pharmacologic
- Treatment
  - PT, OT, Protein, Environment, Social Support, ?Pharmacologic

IAGG Recommendations for Frailty

Physical frailty can potentially be prevented or treated with specific modalities, such as exercise, protein-calorie supplementation, vitamin D, and reduction of polypharmacy.

Future Goals

- Knowledge Gaps
  - Genetics / Race / Gender
  - Social & Cultural Supports
  - Biology / physiology (?unifying or multi-layered or both)
- Research Opportunities
  - Predictive biomarkers
  - Interventions – targeted, multifactorial
  - Nutrition
  - Exercise modalities
- Implementation