Frailty: Are we able to identify the older adult who is frail? A discussion on methods and limitations'

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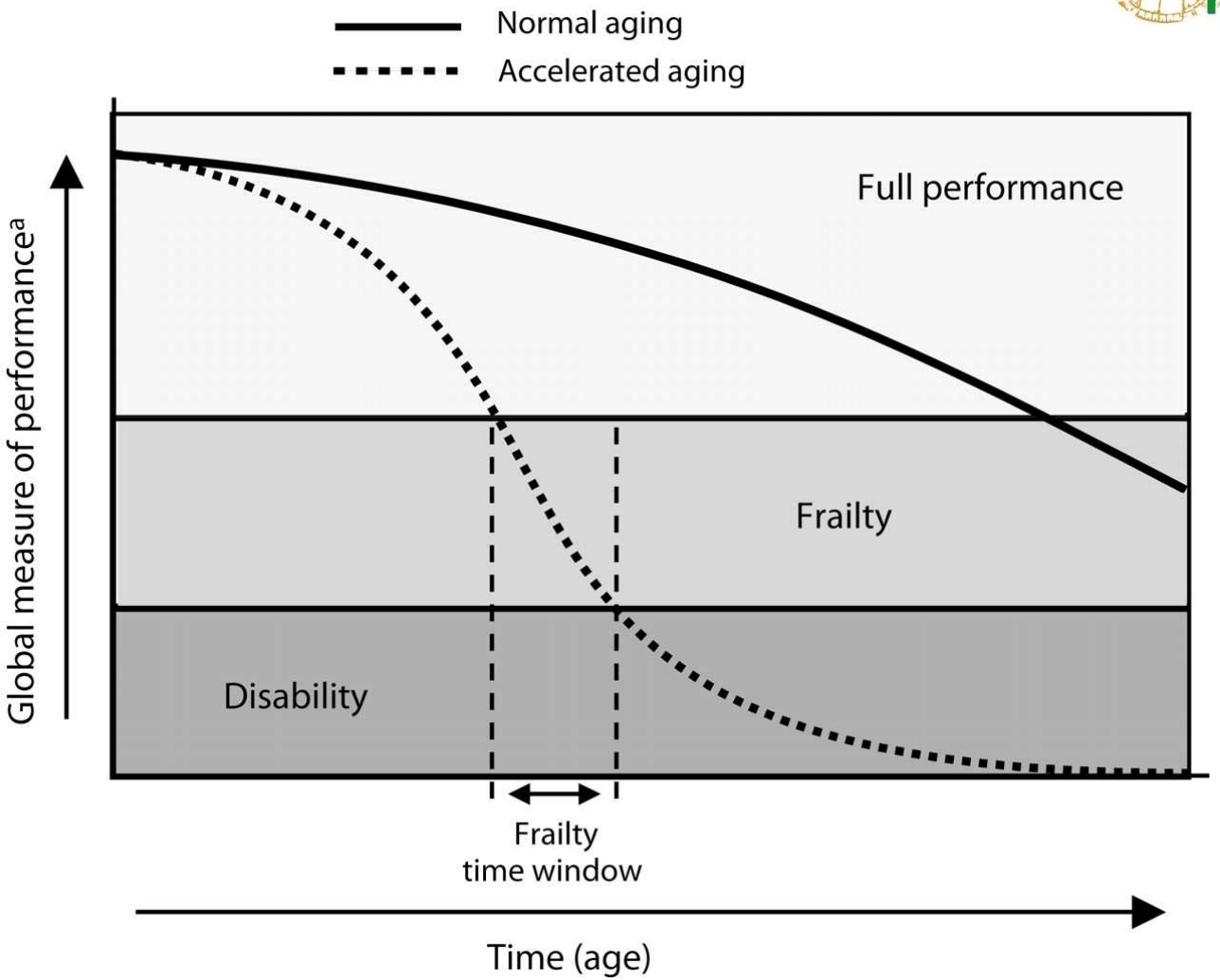
Frailty

- Foundation in observation by clinicians dealing with older adults
- Is felt by majority of health care workers, professionals and researchers to be useful concept
- Is topic receiving increasing increased research support and publication
- Only consensus is state of vulnerability and multi-factorial
- However concerns exist

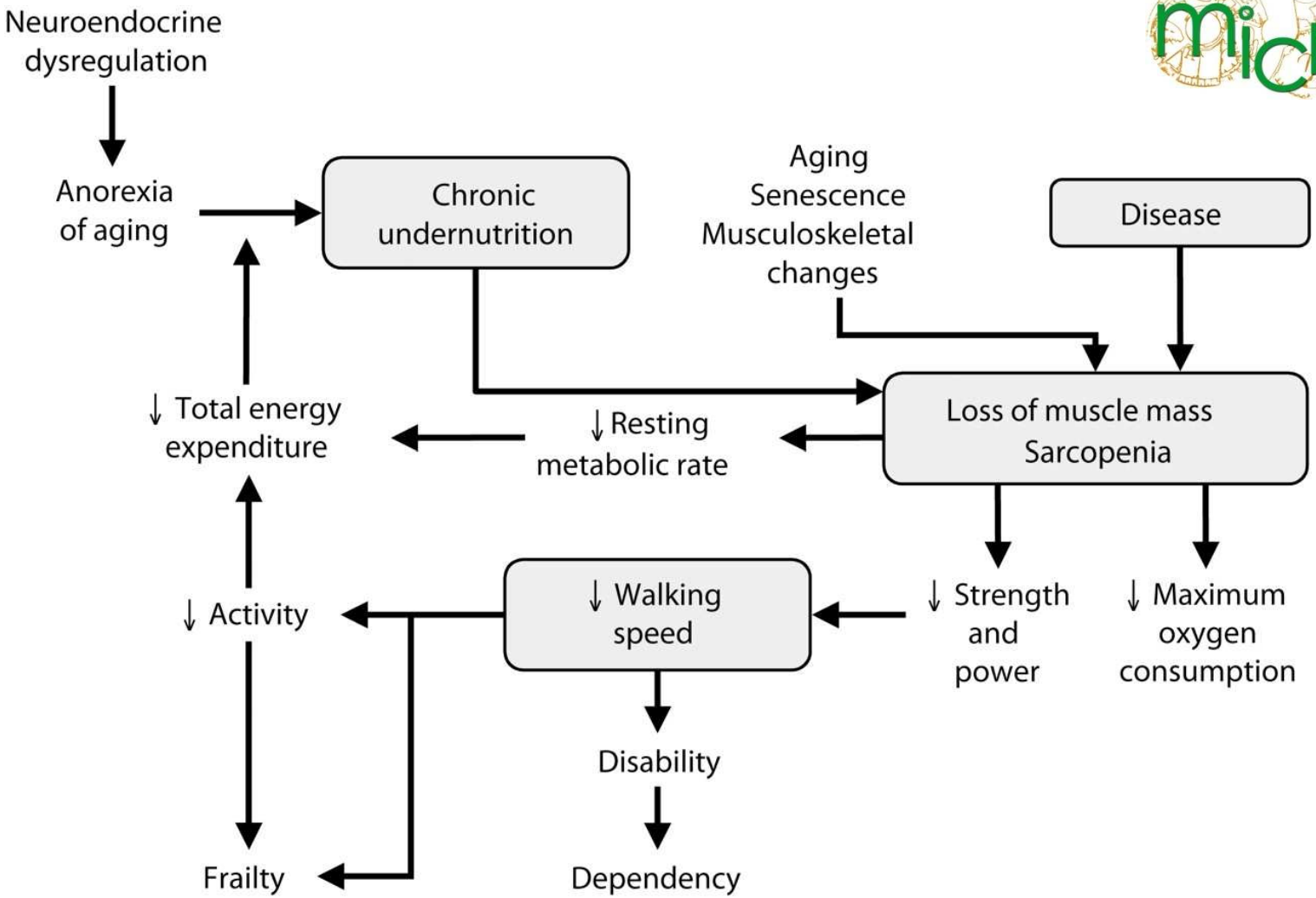
Trajectories of health and functioning.



Singh M et al. Mayo Clin Proc. 2008;83:1146-1153

MAYO CLINIC
Mayo Clinic Proceedings

Cycle of frailty combines elements of body composition, nutrition, and mobility into a pathophysiologic pathway.



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Frailty: concerns

- **We can see it how do we measure it? Are there internationally agreed operational definition of frailty?**
- Do we have conceptual framework for frailty?
- Geriatric syndrome or not?
- Frailty and ageing is there any difference?
- Frailty and multi-morbidity any difference?
- Frailty beyond the physical?

Frailty: Fried phenotype

- Used data from Cardiovascular Health Study (USA)
- Proposed phenotype (see over)

Table 1. Operationalizing a Phenotype of Frailty

A. *Characteristics of Frailty*	B. *Cardiovascular Health Study Measure**
Shrinking: Weight loss (unintentional) Sarcopenia (loss of muscle mass)	Baseline: >10 lbs lost unintentionally in prior year
Weakness	Grip strength: lowest 20% (by gender, body mass index)
Poor endurance; Exhaustion	"Exhaustion" (self-report)
Slowness	Walking time/15 feet: slowest 20% (by gender, height)
Low activity	Kcals/week: lowest 20% males: <383 Kcals/week females: <270 Kcals/week
	C. *Presence of Frailty*
	Positive for frailty phenotype: ≥3 criteria present
	Intermediate or prefrail: 1 or 2 criteria present

*See Appendix.

Fried et al, J Gerontol 2001 56 M146-156

Frailty: Fried

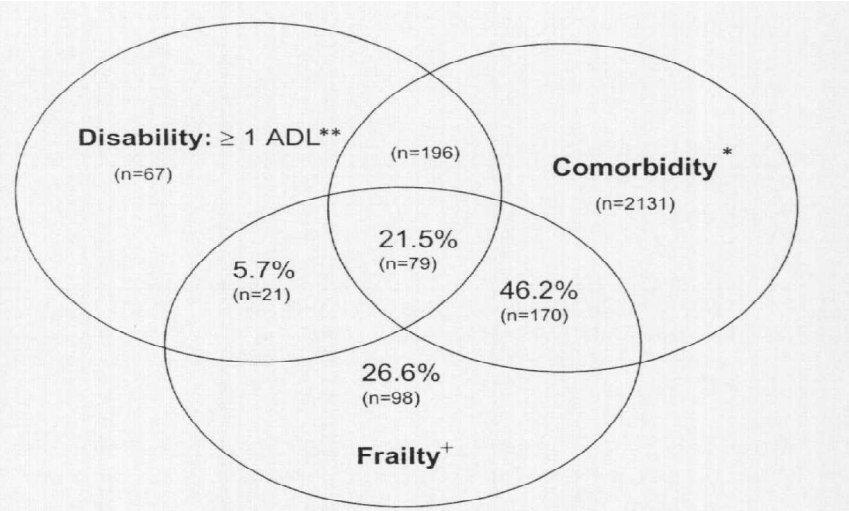


Figure 3. Venn diagram displaying extent of overlap of frailty with ADL disability and comorbidity (≥2 diseases). Total represented: 2,762 subjects who had comorbidity and/or disability and/or frailty. *n* of each subgroup indicated in parentheses. + Frail: overall $n = 368$ frail subjects (both cohorts). *Comorbidity: overall $n = 2{,}576$ with 2 or more out of the following 9 diseases: myocardial infarction, angina, congestive heart failure, claudication, arthritis, cancer, diabetes, hypertension, COPD. Of these, 249 were also frail. **Disabled: overall $n = 363$ with an ADL disability; of these, 100 were frail.

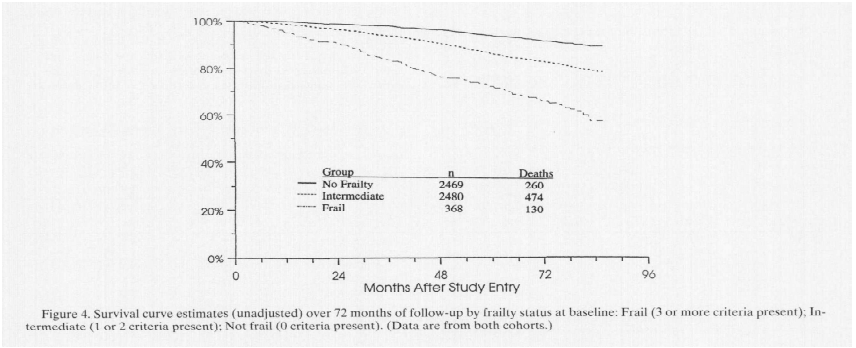


Figure 4. Survival curve estimates (unadjusted) over 72 months of follow-up by frailty status at baseline: Frail (3 or more criteria present); Intermediate (1 or 2 criteria present); Not frail (0 criteria present). (Data are from both cohorts.)

Fried et al, J Gerontol 2001 56 M146-156

Frailty: Frailty Index

- Rules based frailty definition
- Accumulation deficits
- CSHA study 70 item

- Be related to health status (cannot include grey hair, wrinkles, etc. which are age related)
- Show an increase with age
- Deficits should not appear too early in a person's life
- Must cover a range of systems and not be concentrated on one domain
- If the index is to be used continuously in the same set of people, the variables used to make up the frailty index should not differ in the next wave of measurement.

Rockwood et al, CMAJ 2005 173 490-485

Frailty: Frailty Index

Appendix 1: List of variables used by the Canadian Study of Health and Aging to construct the 70-item CSHA Frailty Index

- Changes in everyday activities
- Head and neck problems
- Poor muscle tone in neck
- Bradykinesia, facial
- Problems getting dressed
- Problems with bathing
- Problems carrying out personal grooming
- Urinary incontinence
- Toileting problems
- Bulk difficulties
- Rectal problems
- Gastrointestinal problems
- Problems cooking
- Sucking problems
- Problems going out alone
- Impaired mobility
- Musculoskeletal problems
- Bradykinesia of the limbs
- Poor muscle tone in limbs
- Poor limb coordination
- Poor coordination, trunk
- Poor standing posture
- Irregular gait pattern
- Falls
- Mood problems
- Feeling sad, blue, depressed
- History of depressed mood
- Tiredness all the time
- Depression (clinical impression)
- Sleep changes
- Restlessness
- Memory changes
- Short-term memory impairment
- Long-term memory impairment
- Changes in general mental functioning
- Onset of cognitive symptoms
- Clouding or delirium
- Paranoid features
- History relevant to cognitive impairment or loss
- Family history relevant to cognitive impairment or loss
- Impaired vibration
- Tremor at rest
- Postural tremor
- Intention tremor
- History of Parkinson's disease
- Family history of degenerative disease
- Seizures, partial complex
- Seizures, generalized
- Syncope or blackouts
- Headache
- Cerebrovascular problems
- History of stroke
- History of diabetes mellitus
- Arterial hypertension
- Peripheral pulses
- Cardiac problems
- Myocardial infarction
- Arrhythmia
- Congestive heart failure
- Lung problems
- Respiratory problems
- History of thyroid disease
- Thyroid problems
- Skin problems
- Malignant disease
- Breast problems
- Abdominal problems
- Presence of snout reflex
- Presence of the palmomental reflex
- Other medical history

Rockwood et al, CMAJ 2005 173 490-485

Frailty: Frailty Index

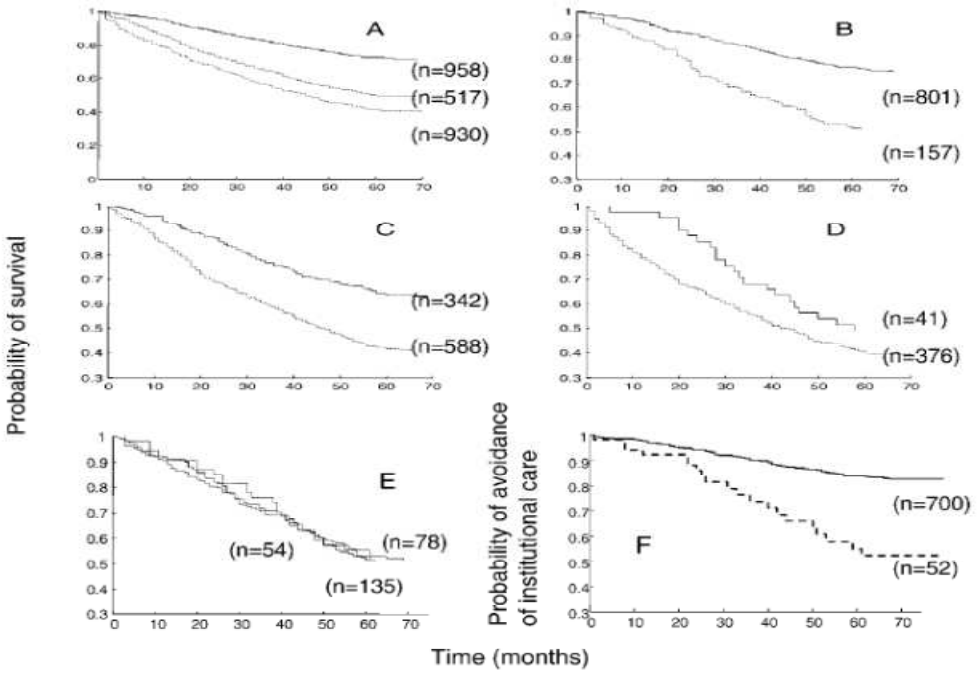


Figure 4. Kaplan–Meier 5-year survival curves for people by the phenotypic definition of frailty. **A,** Robust people (*upper line, solid*) have the highest survival; frail people (*lowest line, dashed*) have the lowest, and the pre-frail are in between. **B,** Five-year survival for people defined as robust, stratified by two levels of the frailty index. This is repeated in **C** for the pre-frail, and in **D** for the frail. Within each phenotypic stratum, people with higher degrees of frailty ($\geq$ 0.25, *dashed lines*) have worse survival than those with less frailty ($<$ 0.25, *solid lines*). **E,** Survival of people with intermediate frailty index values (0.25 $\pm$ 0.05) is shown stratified by classification as robust, pre-frail, or frail. **F,** Differences in the proportion of robust people who become institutionalized. *Solid line:* people with frailty index values $<$ 0.25; *dashed line:* people with values $\geq$ 0.25.

Rockwood et al, CMAJ 2005 173 490-485

Frailty: others

- Rockwood Frailty Scale
- Seven Point Clinical Frailty Scale
- Strawbridge Model Frailty
- Prognostic Score of Frailty
- Edmonton Frail Scale
- FRAIL Scale (Geriatric Advisory Panel International Advisory Panel Nutrition Health and Ageing 2008)

Frailty: potential instruments

- Systematic review by De Vries et al, 2011
- Clinimetric approach (see over)
- Studies had to explicitly and operationally describe instrument

- Content validity
- Internal consistency
- Construct validity
- Agreement
- Reliability
- Responsiveness
- Floor/ceiling effects
- Interpretability

De Vries et al, Ageing Res Reviews 2011 10 104-114

Frailty: FRAIL scale

- Geriatric Advisory Panel International Advisory Panel Nutrition Health and Ageing 2008
- Combination of Fried phenotype and FI

- **F**atigue
- **R**esistance (stairs)
- **A**mbulation
- Number of **I**llnesses
- **L**oss of weight

Frailty: potential instruments

Table 1
Operationalization of the frailty factors.

Frailty factor	Operationalization
Nutritional status	- Body weight - Appetite - Body Mass Index (BMI)
Physical activity	- Level of physical activity - Leisure time physical (group) activity
Mobility	- Difficulty or needing help walking/moving in and around the house - Gait speed
Energy	- Tiredness - Energy level (for example exhaustion/fatigue)
Strength	- Lifting an object that weighs over 5 kg - Weakness in arms and/or legs - Performing chair stands - Climbing stairs - Grip strength - Calf muscle circumference
Cognition	- Memory problems - Diagnosed dementia or cognitive impairment
Mood	- Depression/depressed mood - Sadness - Anxiety - Nervousness
Social relations/social support	- Social recourses (when help is needed, can someone provide this?) - Emptiness/missing people around

De Vries et al, Ageing Res Reviews 2011 10 104-114

Frailty: potential instruments

- Systematic review indicates many (twenty) instruments
- Physical function bias to instruments
- No instrument had information on to support analysis of clinimetric properties (maximum 3)
- Perhaps only FI reasonably approximates 3 dimensions but not all factors
- FI chosen most appropriate evaluative outcome measure

De Vries et al, Ageing Res Reviews 2011 10 104-114

Frailty: prevalence by measure

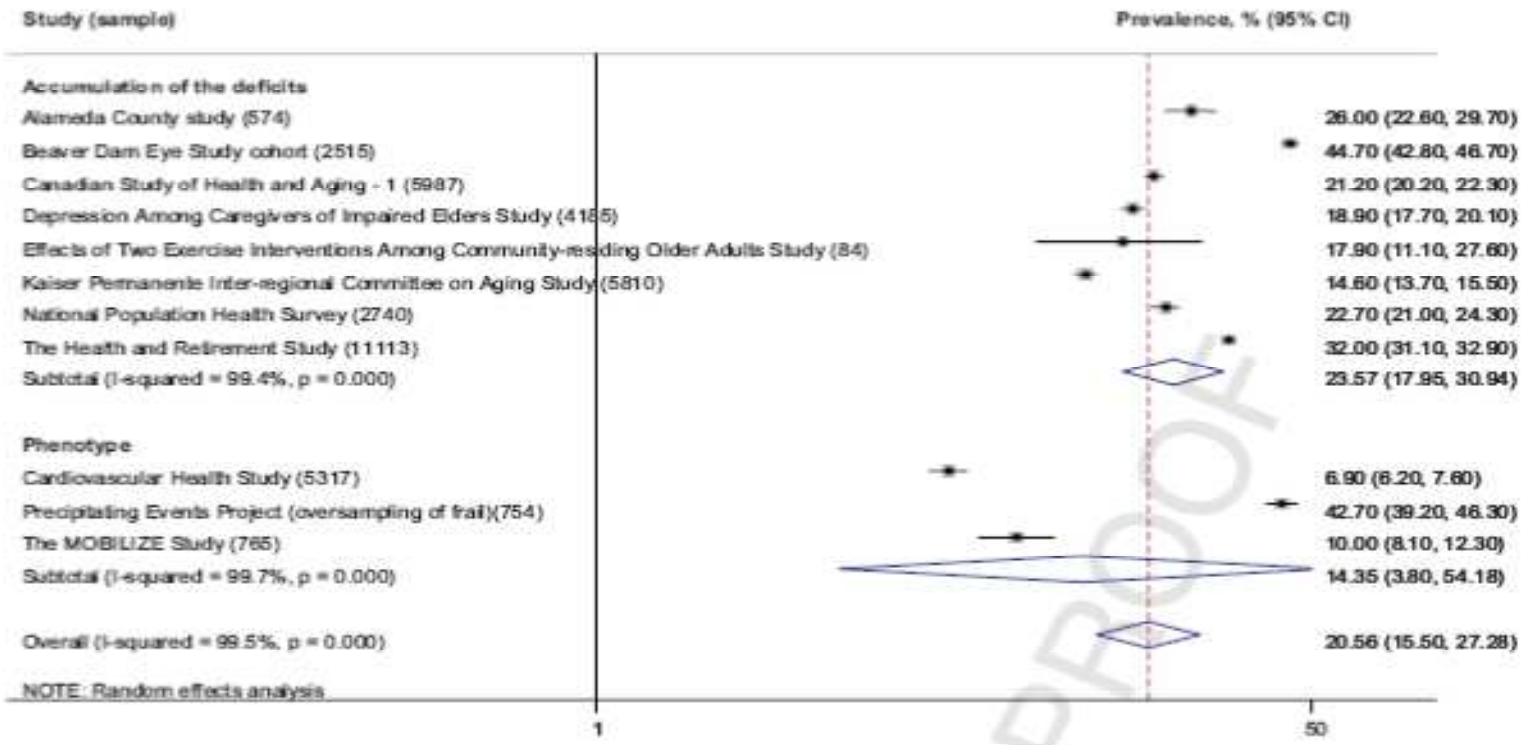


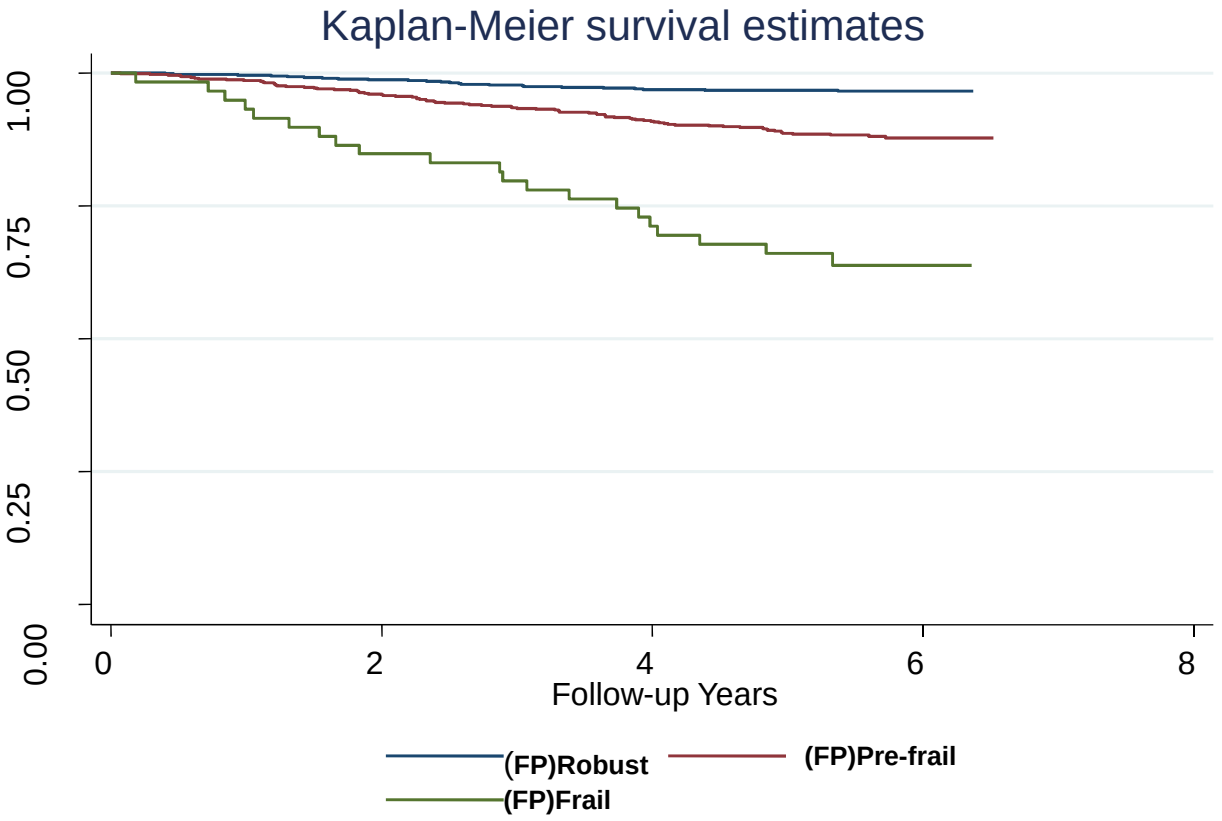
Fig. 1. Prevalence of frailty in older persons (high level of evidence) (Brody et al., 1997; Cigolle et al., 2009; Dayhoff et al., 1998; Fried et al., 2001; Gutman et al., 2001; Hardy et al., 2005; Kiely et al., 2009; Klein et al., 2005; Song et al., 2010; Tennstedt et al., 1992).

Shamliyan et al, Age Research Reviews 2012 in press

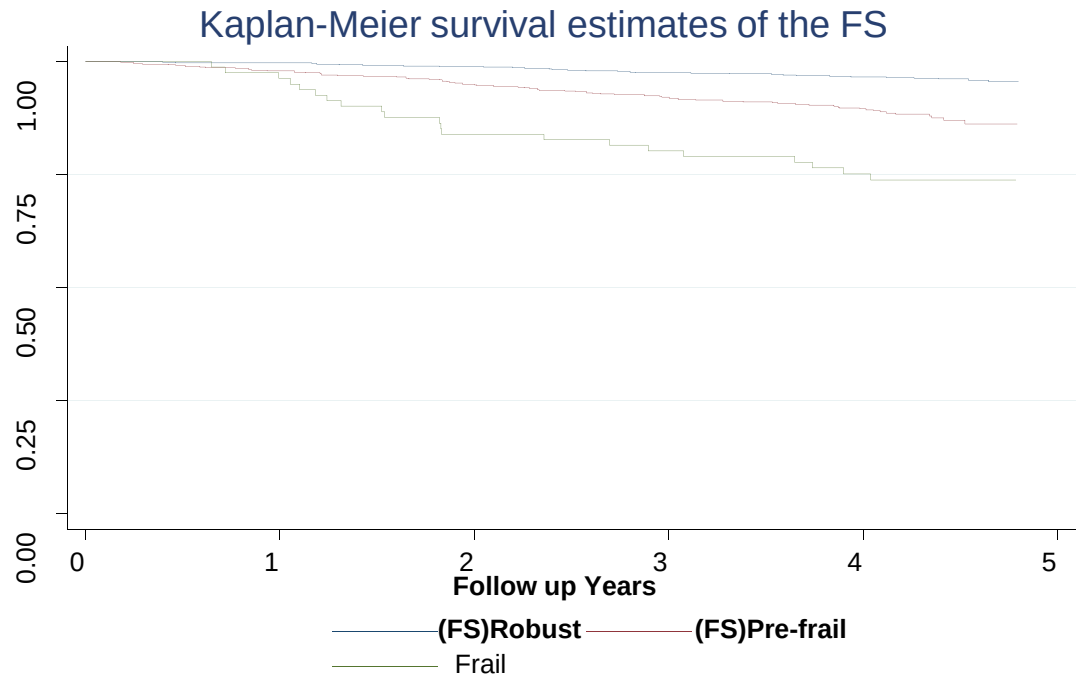
Incidence of Frailty in 4.8 year interval by three methods EMAS cohort

Frailty status	Frailty phenotype Fried (number %)	Frail Scale (number %)	Frailty Index (number %)
Non-frail	2073 (96.4)	1862 (96.8)	2240 (91.6)
Frail	78 (3.6)	61 (3.2)	205 (8.4)
Total	2151 (100)	1923 (100)	2445 (100)

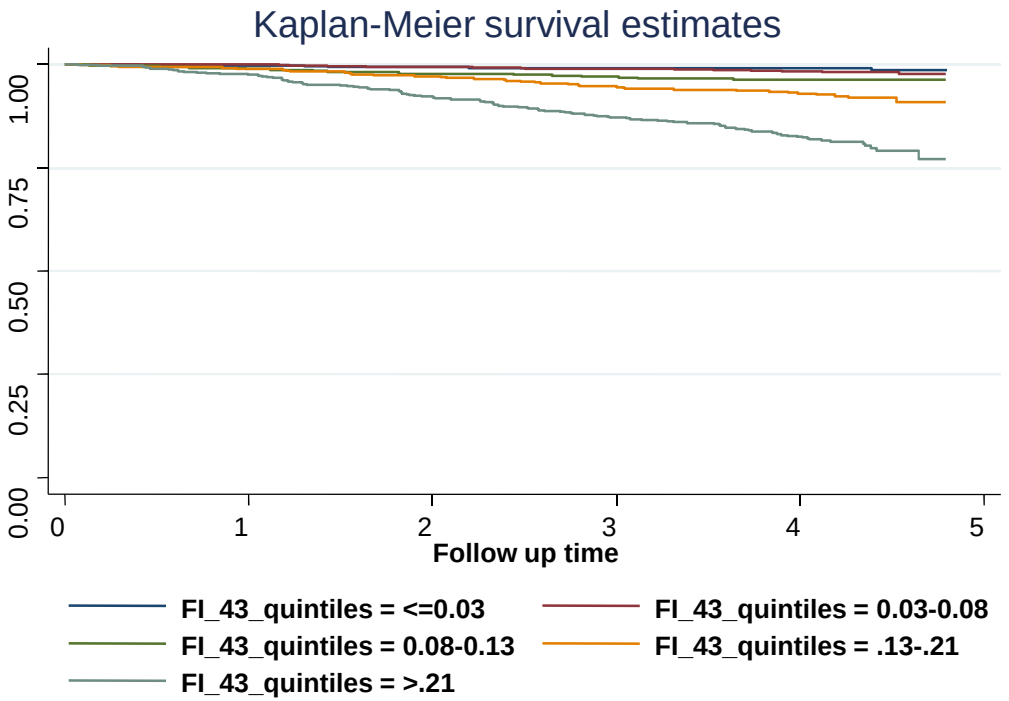
Survival EMAS cohort over 4.8 years follow up for Frailty Phenotype



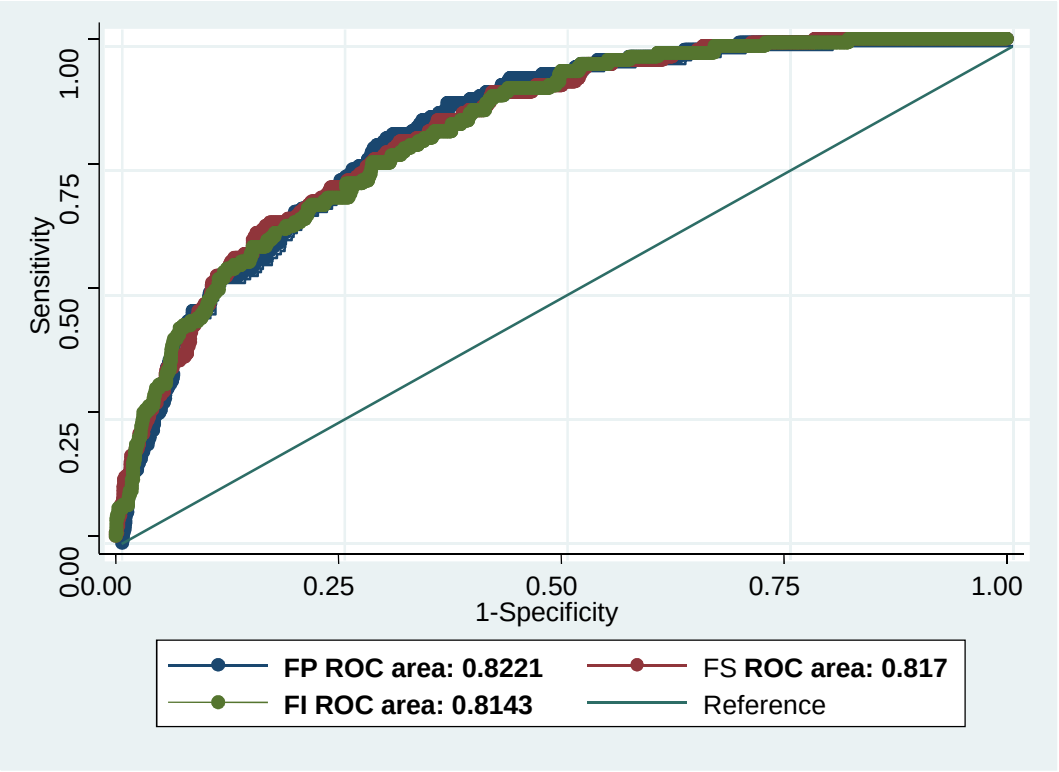
Survival EMAS cohort over 4.8 years follow up for Frail Scale



Survival over 4.8 years follow up for Frailty Index



Age adjusted Receiver operator curves for frailty measures prediction of mortality EMAS cohort over 4.8 years follow up



Predictive accuracy of Frailty Scores

- Citeria selection: major theoretical view of frailty; provided data of an AUC
- Literature search cited articles in Pubmed, EMBASE and Cochrane databases December 2010 (417 total)
- Included 2 well known co morbidity measures Charlson Index and CIRS

Pijpers et al, European Journal Medicine 2012 21 118-122

Predictive accuracy of Frailty Scores

Table 1
Co-morbidity indices and frailty assessment models and prediction of negative health outcomes.

Predictors of negative health outcomes	Population cohort study	Domains	High risk score	Follow up in months	Endpoint	AUC ROC curve
Co-morbidity indices						
1. Co-morbidity						
1.1.1 Charlson co-morbidity index [28]	Retrospective, hospitalized patients > 1 y (n = 792.839)	19 co-morbid conditions, some representing 2 degrees of severity	>5	12	Mortality	0.87
1.1.2 Charlson co-morbidity Index [28,29]	Prospective, primary care adults > 60 y (n = 3.496)	19 co-morbid conditions, some representing 2 degrees of severity	>5	12	Mortality	0.76
					Inpatient admission	0.66
1.2 Cumulative illness rating scale (CIRS [17,30,31])	Retrospective, autopsy validated (n = 2.305)	All co-morbid conditions in 13–14 systems	>25–30	70	Mortality	0.58
					Institutionalization	0.62
Frailty assessment models						
2. Age and a single modality						
2.1 Modified mini mental state examination (3MS) [30,32,33]	Prospective, adults > 64 y (n = 2.305)	Cognitive screening test	<77	70	Mortality	0.64
					Institutionalization	0.69
2.2 Canadian study of health and aging (CSHA) clinical frailty scale [30]	Prospective, adults > 64 y (n = 2.305)	Clinical "pattern recognition" very fit to severely frail	>6	18	Mortality	0.70
					Institutionalization	0.75
3. Burden						
3.1 CSHA frailty scale [30]	Prospective, adults > 64 y (n = 2.305)	70 domains, cumulative scale	≥0.25	70	Mortality	0.69
					Institutionalization	0.72
4. Biologic syndrome						
4.1. Cardiovascular health study (CSH) frailty index	Prospective, community dwelling women > 69 y (n = 6.701); community dwelling men > 69 y (n = 3.132)	5 domains, weight loss, reduced energy, reduced grip strength, slow walking speed and low physical energy	≥3	70		
4.1.1 Phenotype of frailty (women) [34]					Mortality (f)	0.72
4.1.2 Phenotype of frailty (men) [35]					Mortality (m)	0.72

Pijpers et al, European Journal Medicine 2012 21 118-122

Frailty: how to move measurement forward

- Agreed operational definition
- Decide what is the purpose of its measurement
- Phenotype of *at risk* ageing?
- Consider frailty as risk calculation for intervention/prevention
- Need for longitudinal (life course) studies of the pathways to frailty
- Use data that exists with multidimensional, dynamic and multilevel scoring system

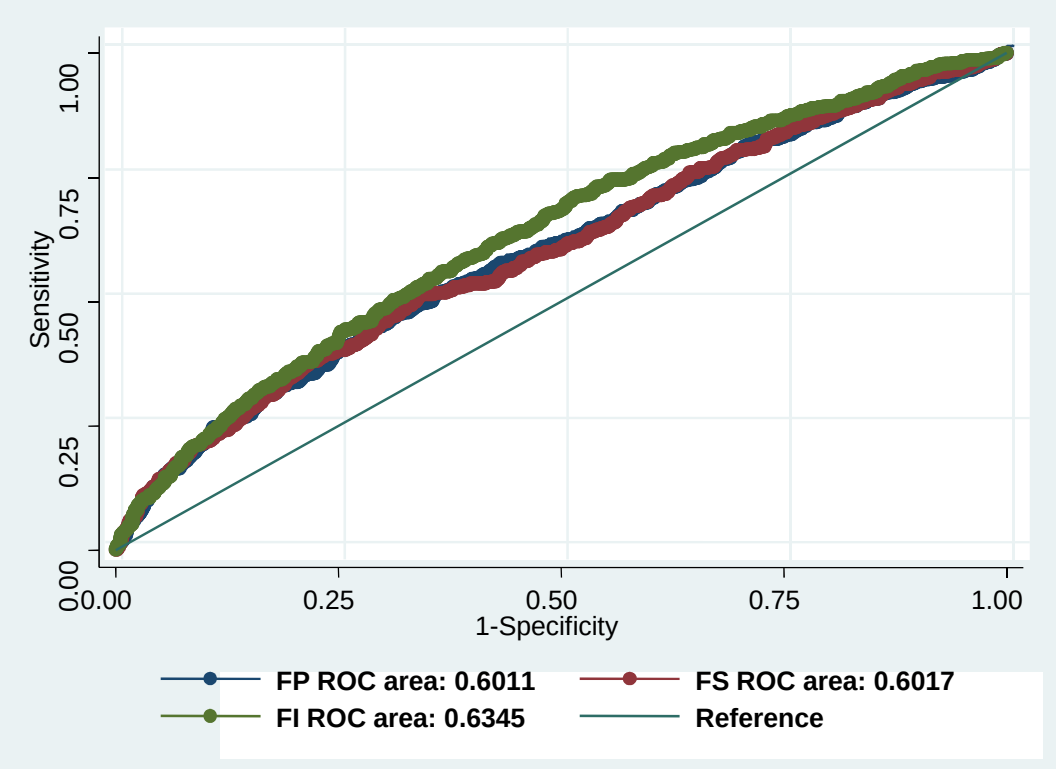
Effect on life expectancy of Frailty models

Table 3
Differences in remaining life expectancy in elderly persons from the general population and with frailty.

Age	Remaining life expectancy in the general population	Frailty (phenotype)	Frailty (accumulation deficit)
65	18.4	−3.2	−1.1
70	14.9	−2.8	−1.0
75	11.7	−2.5	−0.9
80	8.9	−2.1	−0.7
85	6.5	−1.6	−0.6
90	4.6	−1.2	−0.4
95	2.8	−0.7	−0.2
100	0.4	−0.1	−0.1

Shamliyan et al, Age Research Reviews 2012 in press

Age adjusted Receiver operator curves for frailty measures prediction of falls EMAS cohort over 4.8 years follow up



Frailty: potential instruments

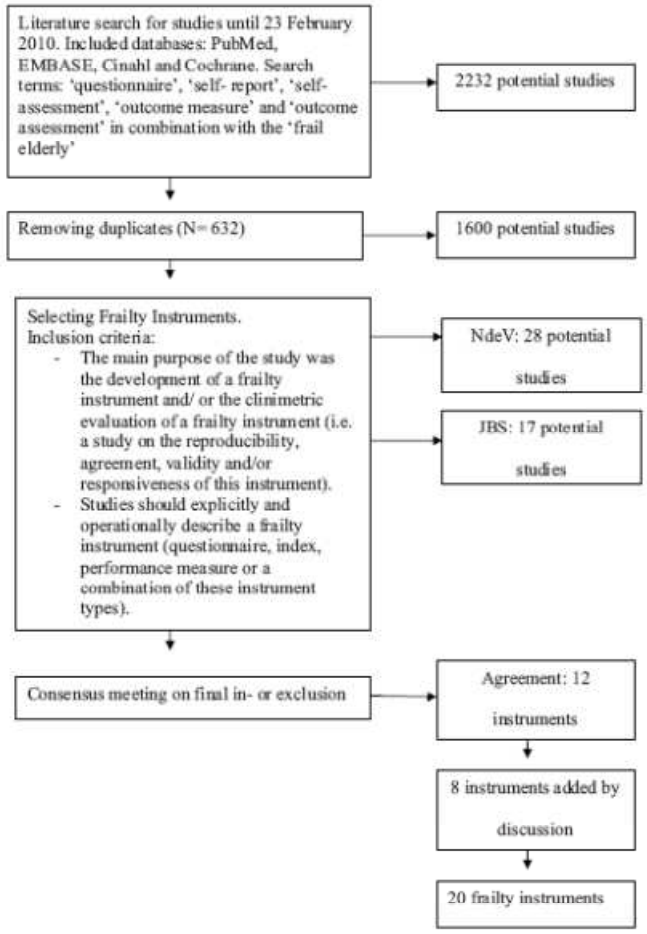


Fig. 1. Review procedure.

De Vries et al, Ageing Res Reviews 2011 10 104-114