Frailty in older adults: implications for health care and clinical research

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Medical Grand Rounds / Phyllis Gough Huffington Lecture
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Disclosures

Through Dalhousie's Industry Liaison Office, I have asserted copyright of the **Clinical Frailty Scale**, which is made freely available for education, research & not-for-profit health care. Users are asked not to change or commercialize it.

I founded DGI Clinical Inc., which provides outcome measures & advanced data analytics to industry, chiefly pharma.

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Objectives

- Is frailty a risk for dementia?
- Is it important that frailty is a risk for dementia?
- How should we approach dementia diagnosis in a person who is frail?
- Are there special considerations in diagnosing dementia in a person who is frail?

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"The problems of old age come as a package".

Fontana et al. *Nature* 2014;511(7510):405-7.

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2013;153:1194-1217

Cell PRESS

Frailty – the noun: unmeasured heterogeneity

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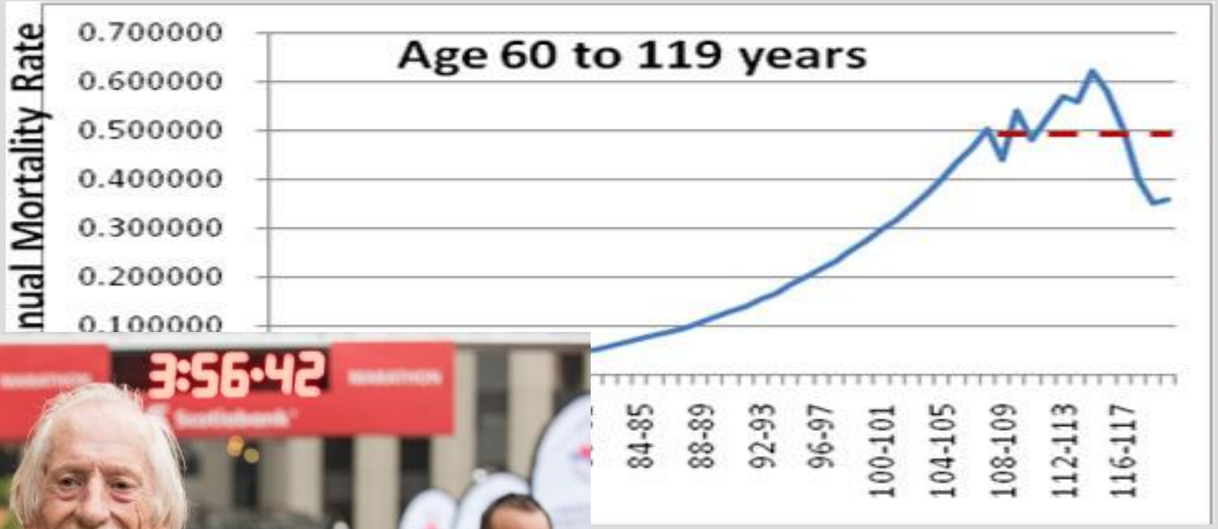
19



adjective: “Is this person
ow can we tell?”
diol 2016;32:1046-50.

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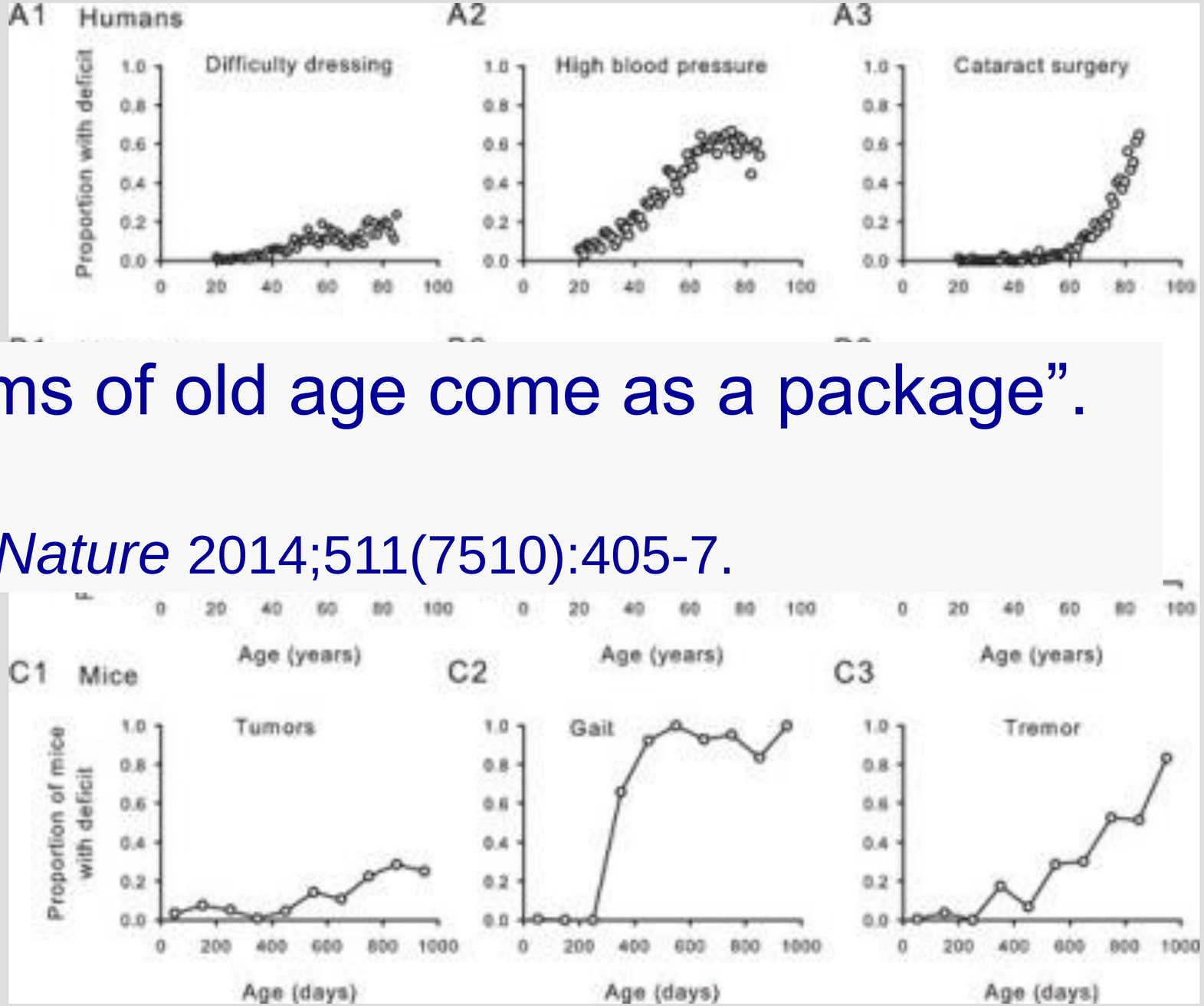
Health deficits accumulate with age, in various patterns across species



"The problems of old age come as a package".

Fontana et al. *Nature* 2014;511(7510):405-7.

Rockwood et al. *Sci Rep* 2017; Feb 21;7:43068

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Deficit accumulation can be estimated with the Frailty Index

Frailty Index score = $\frac{\text{Number of deficits in an individual}}{\text{Total number of deficits measured}}$

e.g. in a dataset with 50 health deficits, a person with 10 things wrong (10 deficits) has a frailty index score of 10/50 = 0.20.

Canevelli M et al., *Front Aging Neurosci 24 Feb 2017 doi:10.33389/fnagi.2017.00036*

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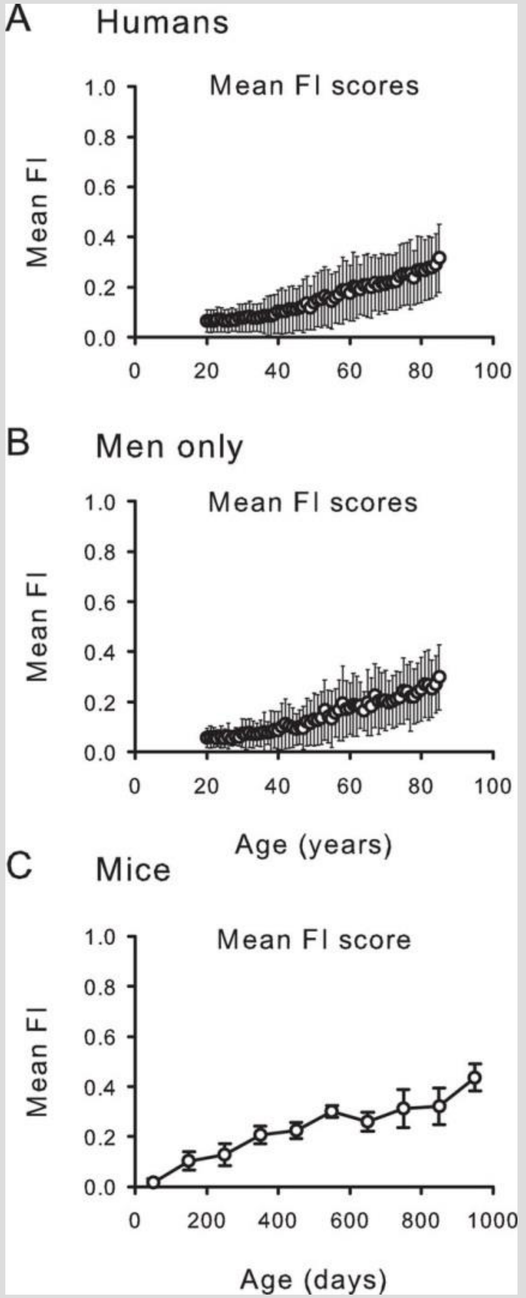
Combined in a frailty index, the variable patterns of deficit accumulation show a steady increase with age

Rockwood et al., *Sci Rep* 2017 Feb 21;7:43068



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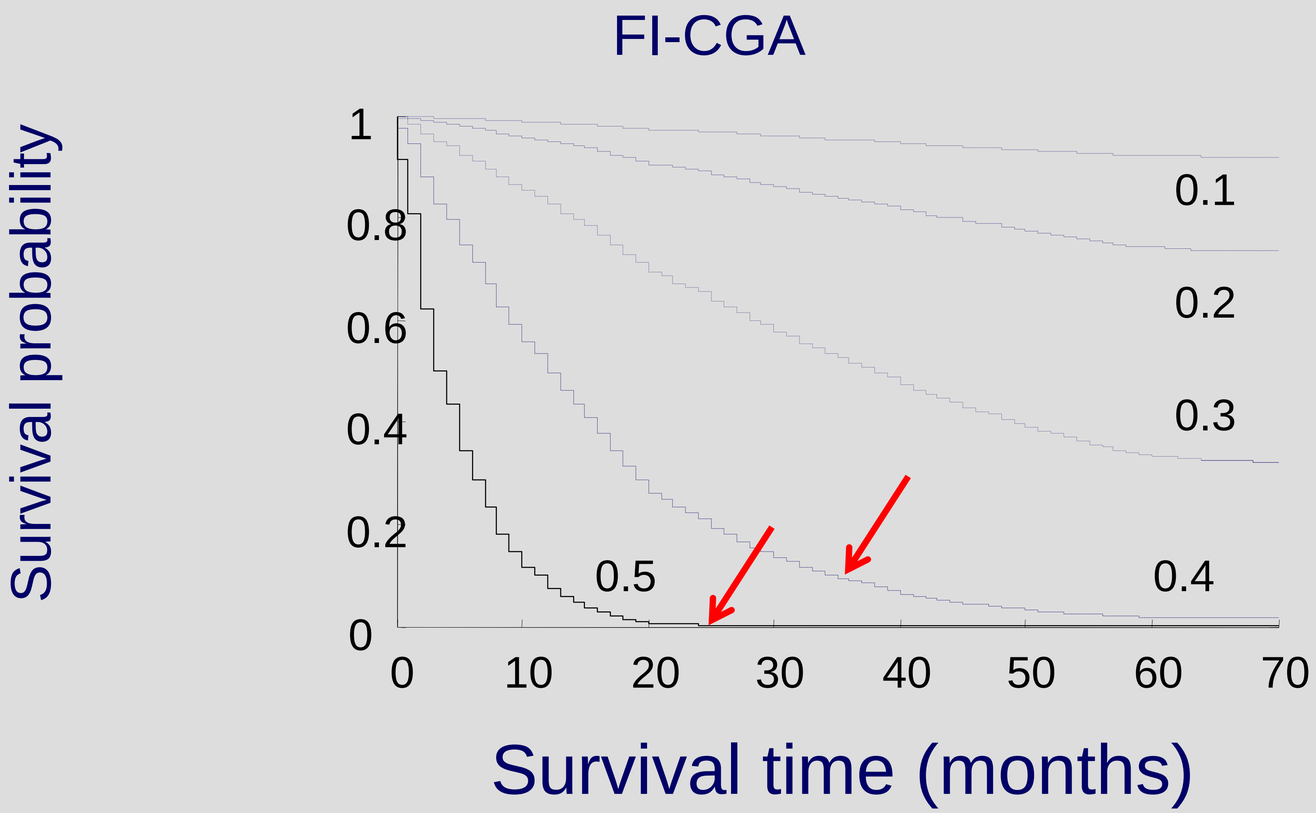
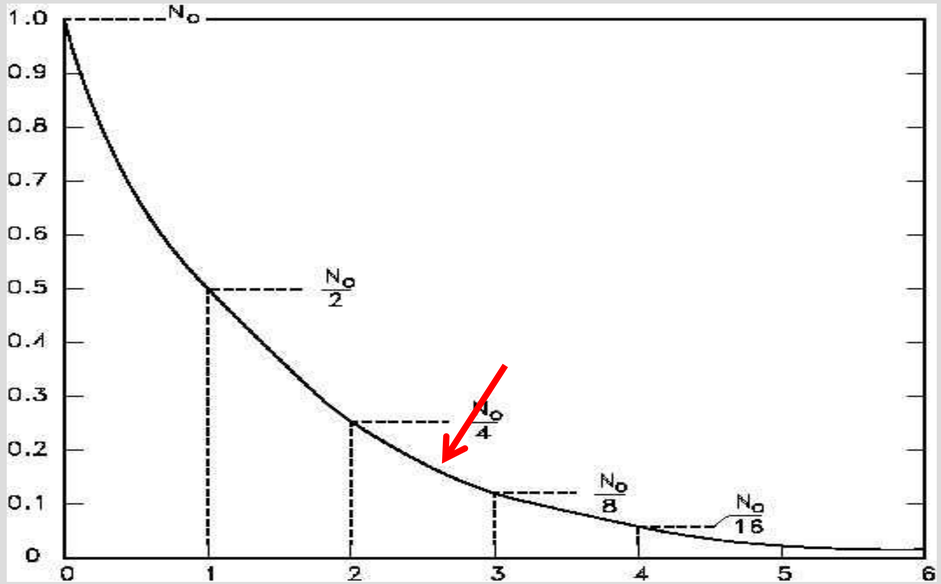
A Frailty Index based on a Comprehensive Geriatric Assessment identifies a group at the highest risk of dying.





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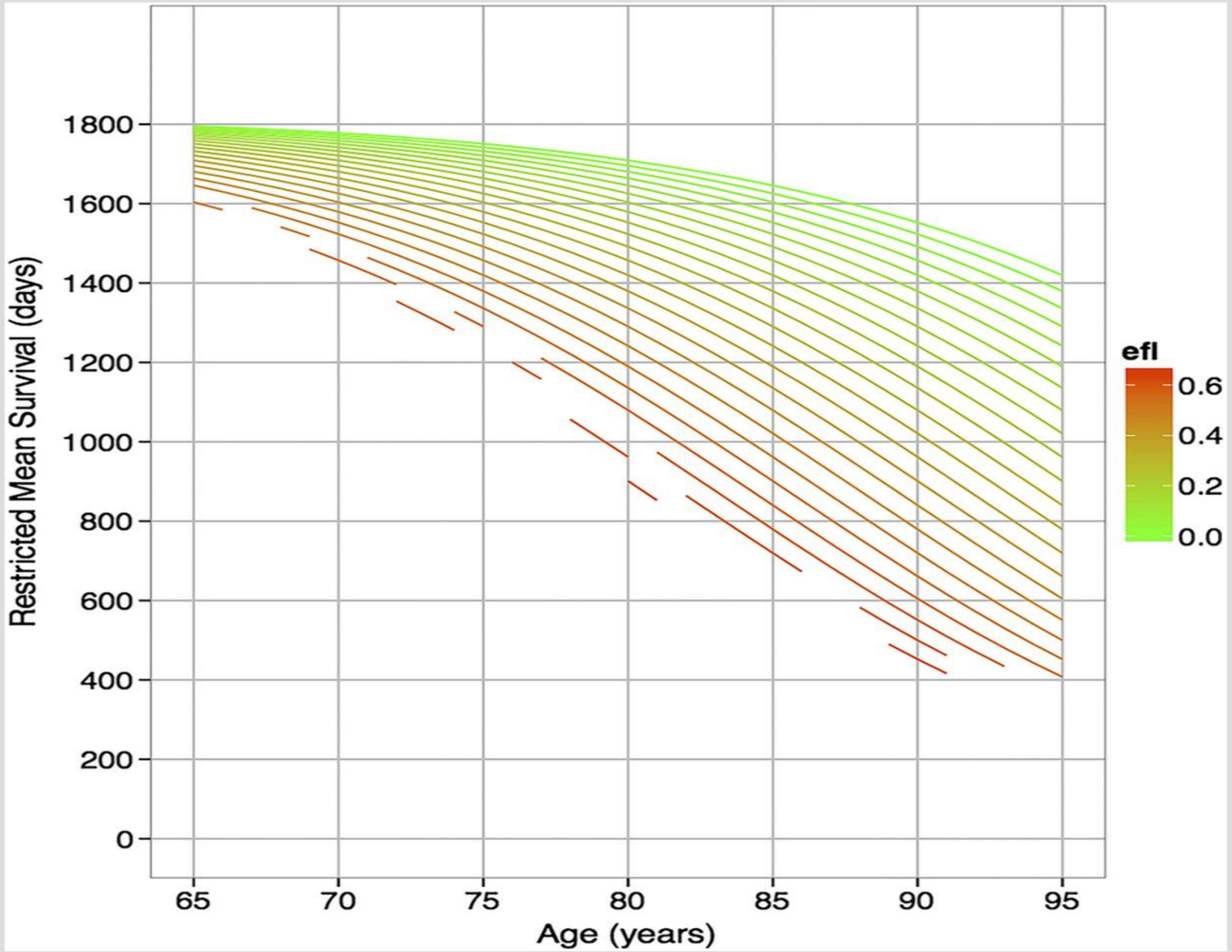
Rockwood, Rockwood, Mitnitski, *J Am Geriatric Soc* 2010;58:318-323.

Relationship between age, electronic frailty index score and mortality.



Andrew Clegg et al. Age Ageing 2016;ageing.afw039

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age and ageing

What I've said so far

Frailty is a multiply determined risk state manifest as not everyone of the same age having the same risk of death (or other adverse outcomes).

It arises due to the stochasticity of age-related deficit accumulation across the life course. (People are frail when they have lots of things wrong with them.)

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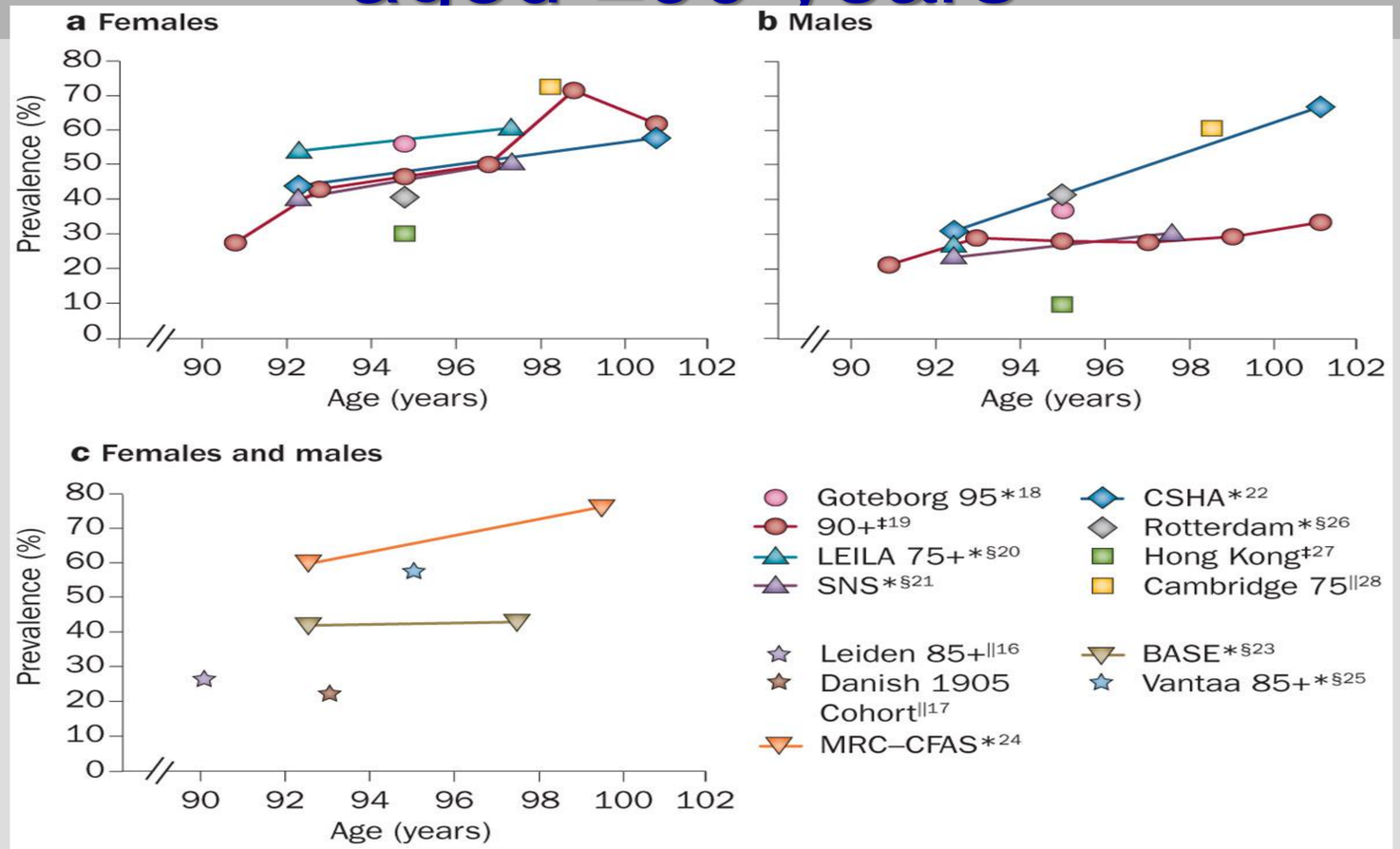
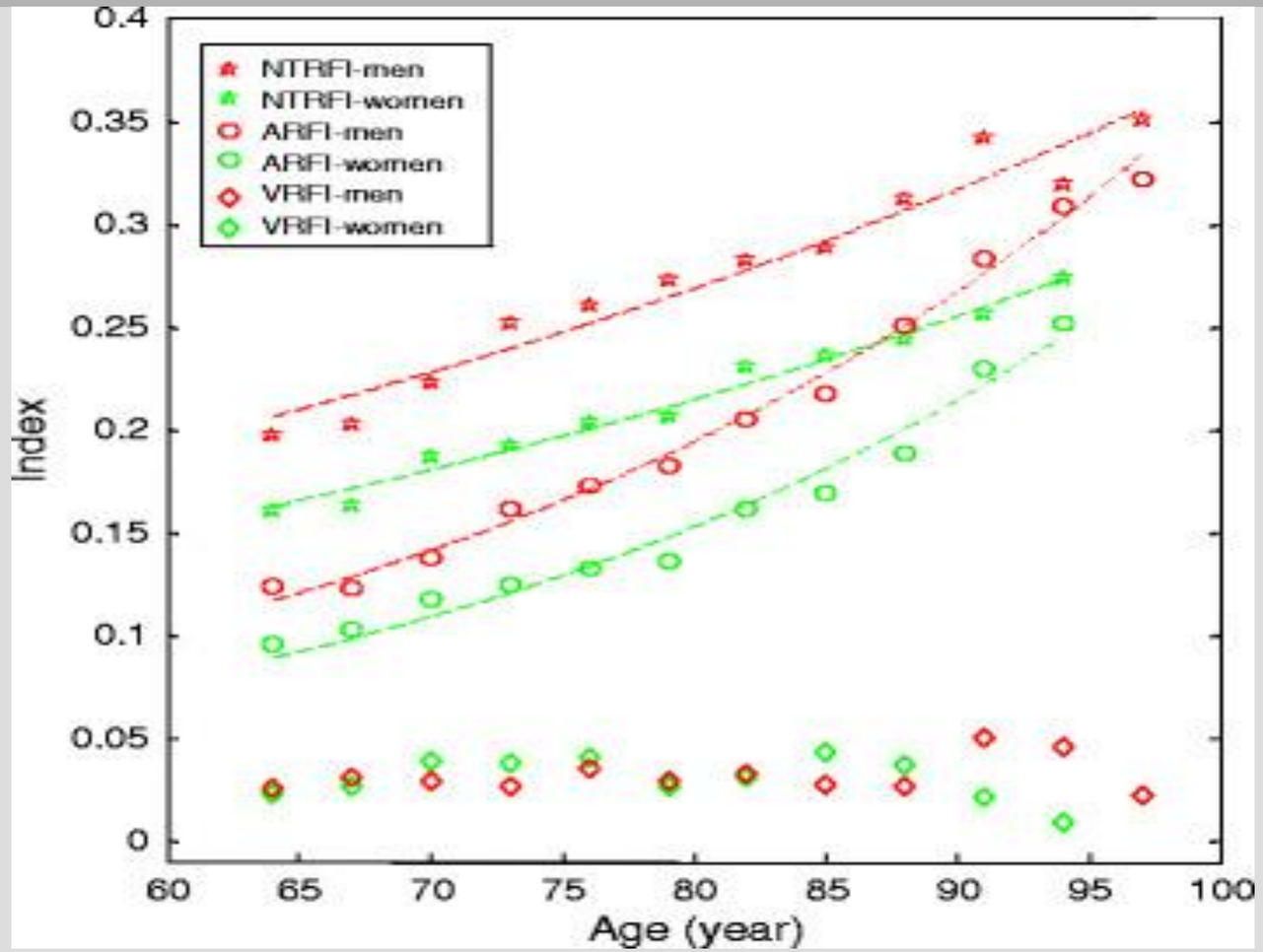
Figure 1: Prevalence of all-cause dementia in population-based studies of individuals aged ≥90 years



Yang, Z. et al. (2013) Dementia in the oldest old
Nat. Rev. Neurol. doi:10.1038/nrneurol.2013.105

Size matters: Dementia risk increases more by the *number* than by the *nature* of the risk factors



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http://alzres.com/content/6/5-8/54

Song *et al. Alzheimer Res Therapy* 2014;6;54

Discriminating risk for death & dementia

Receiver operating characteristic curves for each risk factor index, and the two most significant non-traditional and traditional individual risk factors in predicting 4-year dementia and death (N=18,592, 50+ years)

	Diagnosis of Dementia (n = 85)			Died (n = 496)		
	Area	95% CI	p	Area	95% CI	p
Combined Risk Factor Index	.70	.65-.76	<.001	.68	.66-.71	<.001
Non-traditional risk factor index	.69	.63-.75	<.001	.68	.65-.70	<.001
Traditional risk factor index	.66	.59-.72	<.001	.63	.60-.65	<.001
Poor self-reported health	.61	.55-.68	<.000	.65	.63-.68	<.001
Difficulty stooping, kneeling or crouching?	.64	.58-.71	<.001	.60	.57-.63	<.001
History of heart attack?	.57	.51-64	.02	.58	.56-.61	<.001
Are you physically inactive?	.57	.50-.64	.03	.57	.54-.60	<.001

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Streniczuk R, et al., Traditional and non-traditional risk factors and dementia risk. In preparation.

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Streniczuk R, et al., Traditional and non-traditional risk factors and dementia risk. In preparation.

Predicting death and dementia

Adjusted 4-year predictive validity of the Nontraditional (NT), Traditional (T) and Combined (C) Risk Factor Index (RFI) for dementia and death (N=18,592, 50+ years)

	Diagnosis of Dementia (n = 85)			Died (n = 496)		
	OR	**95% CI**	***p***	**OR**	**95% CI**	***p***
Model 1						
NTRFI (per 0.1 score)	1.33	1.10-1.59	<.01	1.42	1.31-1.54	<.001
Model 2						
NTRFI (per 0.1 score)	1.34	1.13-1.60	.001	1.48	1.37-1.60	<.001
TRFI (per 0.1 score)	1.42	1.18-1.72	<.001	1.17	1.07-1.28	.001
Model 3						
CRFI (per 0.1 score)	1.65	1.37-1.98	<.001	1.66	1.53-1.80	<.001

Adjusted for age, sex and education

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Frailty increases the risk of dementia

Criterion	Met?
Effect size	✓ **Small-very large**
Statistically significant	✓ **Yes**
Dose response	✓ **Yes**
Reproducible	✓ **Yes**
Exposure before outcome	✓ **Yes**
Biologically plausible	✓ **Post hoc**

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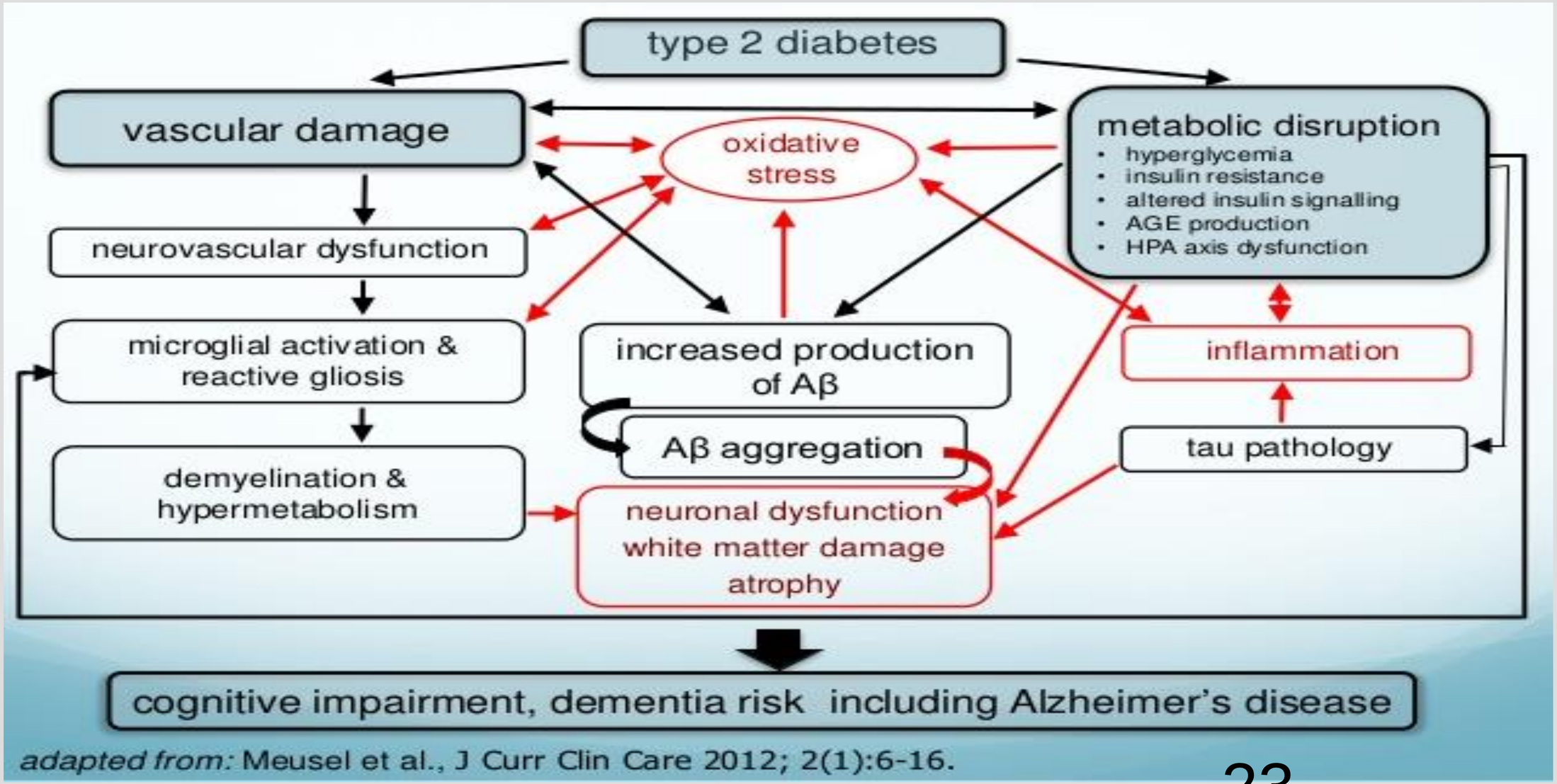
Roberston *Ageing Res Rev* 2013;12(4): 840-851. Kulmala J, *Gerontology*. 2013 Aug 17; Sterniczuk R, *Curr Alzheimer Res*. 2013;10(7):767-75; Gray SL, *J Gerontol A Biol Sci Med Sci*. 2013 Sep;68(9):1083-90. *Song Alzheimer Res Therapy* 2014 Searle & Rockwood *Alzheimers Res Ther*. 2015 Aug 3;7(1):54

Type 2 Diabetes: A Compromised Brain



adapted from: Meusel et al., J Curr Clin Care 2012; 2(1):6-16.

A single-nucleotide flaw in the presenilin-1 gene (the Paisa mutation) is stalking 25 families in the hilly Antioquia region of northwest Colombia

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How understanding overall health affects the assessment of people who present with a memory complaint

Four questions in a patient with a memory complaint:

- Is this a memory problem?
- What type?
- What is the cause?
- What should be done?

Rockwood K, MacKnight C. *Understanding Dementia: a primer.* Halifax: Pottersfield Press, 2001.

Is it a memory problem?

Other cognitive items that can mimic memory impairment

- Disordered language
- Disordered attention

Other health problems that can mimic memory impairment

- Impaired hearing
- Impaired mood

Rockwood K, MacKnight C. *Understanding Dementia: a primer.* Halifax: Pottersfield Press, 2001.

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If so, what type?

A. Memory problem in isolation?

- (VS. Impairment in other aspect of cognition)
- (VS. Impairment in other aspects of brain & physical health)

B. How severe?

C. Does it interfere with function?

- (Do other aspects of brain & physical health interfere with function?)

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Rockwood K, MacKnight C. *Understanding Dementia: a primer.* Halifax: Pottersfield Press, 2001.

What is the cause?

- Single cause (Alzheimer disease)
- Mixed causes (mixed brain lesions; role of physical health & medications)

Rockwood K, MacKnight C. *Understanding Dementia: a primer.* Halifax: Pottersfield Press, 2001.

What should be done?

- Specific dementia medications
- Exercise
- Medication review
- Other psychosocial intervention
  - Socialization
  - Power of attorney

Rockwood K, MacKnight C. *Understanding Dementia: a primer.* Halifax: Pottersfield Press, 2001.

Special considerations in diagnosing dementia in someone who is frail?

- Delirium is more common
- Mobility impairment is more common
- Competing factors that exacerbates cognitive impairment are more common (e.g. Anticholinergic drug burden which includes factors that increases risk to for example cardiovascular disease.

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Summary

- Is frailty a risk for dementia?
- Is it important that frailty is a risk for dementia?
- How should we approach dementia diagnosis in a person who is frail?
- Are there special considerations in diagnosing dementia in a person who is frail?

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- Canadian Institutes of Health Research
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- Alzheimer Society of Canada
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- China Scholarship Council
- Dalhousie Medical Research Foundation

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- Olga Theou
- Melissa Andrew
- Samuel Searle
- Lindsay Wallace
- Oliver Hathaway
- Judah Goldstein
- Kathryn Hominick
- Swadhin Taneja
- Spenser Farrell
- Quikui Hao
- Rob Beiko
- Andrew Rutenburg
- Xiaowei Song
- Susan Howlett

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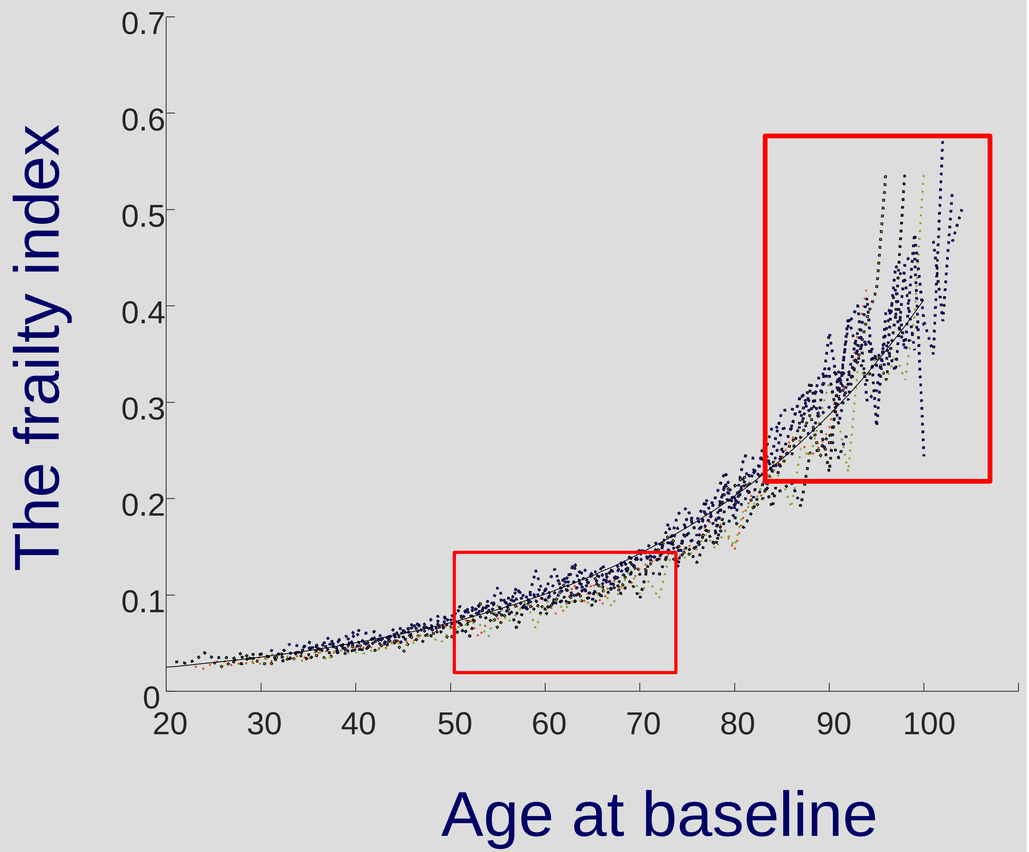
As the mean Frailty Index score increases, so does its variability.



*Increasing mortality with age

*Broadening of FI distribution with age,

*Nonlinear increase of the FI with age,

*Higher mortality with higher FI scores

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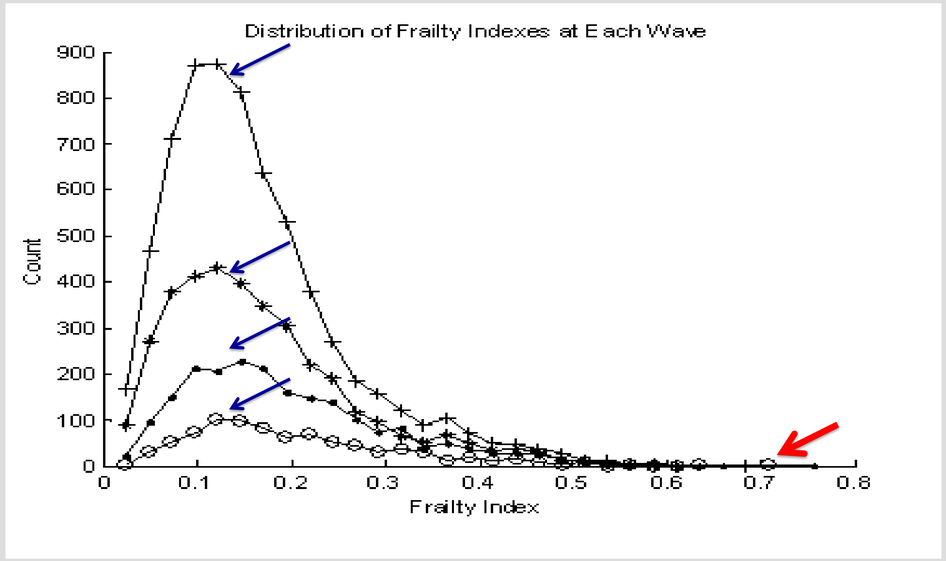
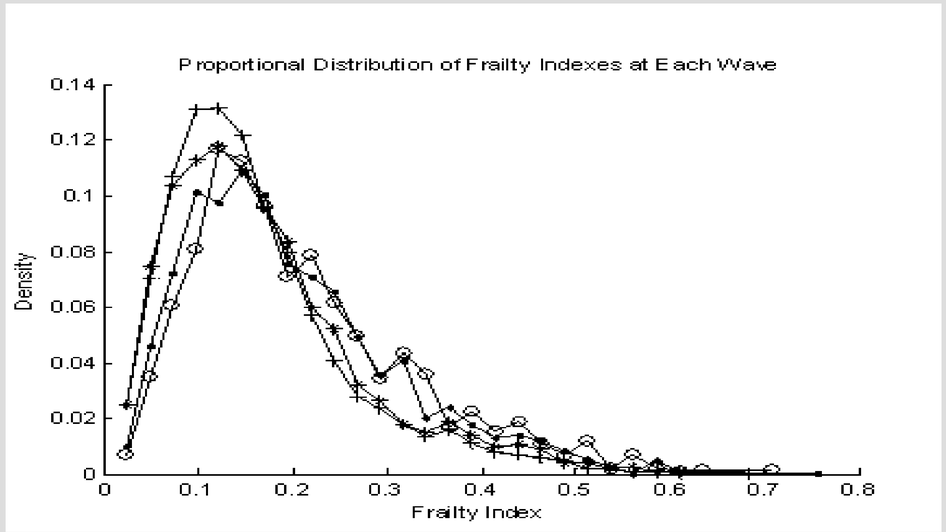
Mitnitski & Rockwood *Biogerontology* 2016;17:199-204

Distribution of the Frailty Index

4 waves of the Chinese Longitudinal Health and Longevity Study;

6664 people ages 80-99





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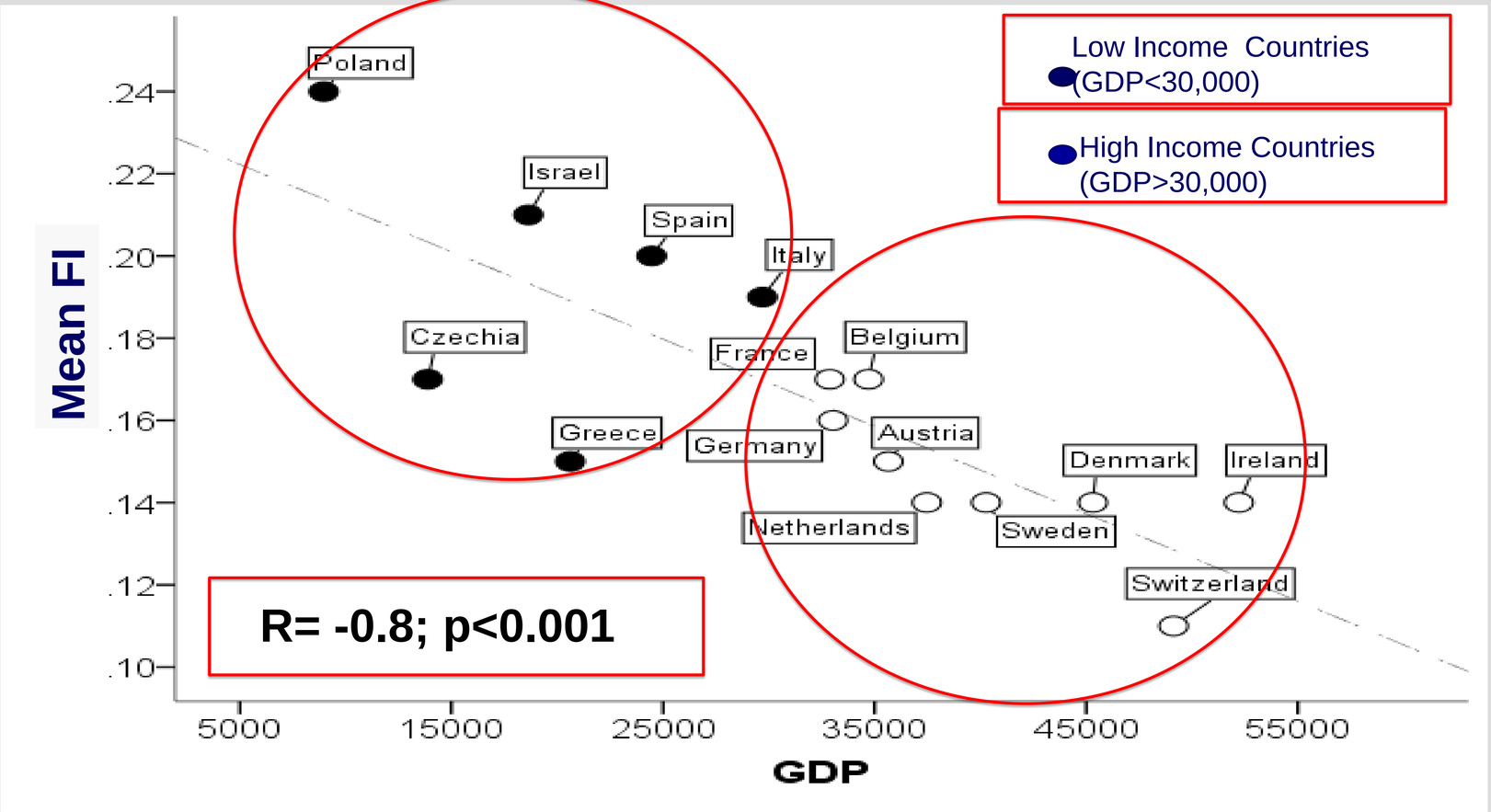
Bennett et al., *Age Ageing* 2013;42(3):372-7.

China + Canada

NSFC CIHR IRSC

Frailty and National Income

Mean FI and Gross Domestic Product (GDP)



Theou et al., *Age Ageing* 2013;42(5):614-9.

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Comprehensive Geriatric Assessment Form

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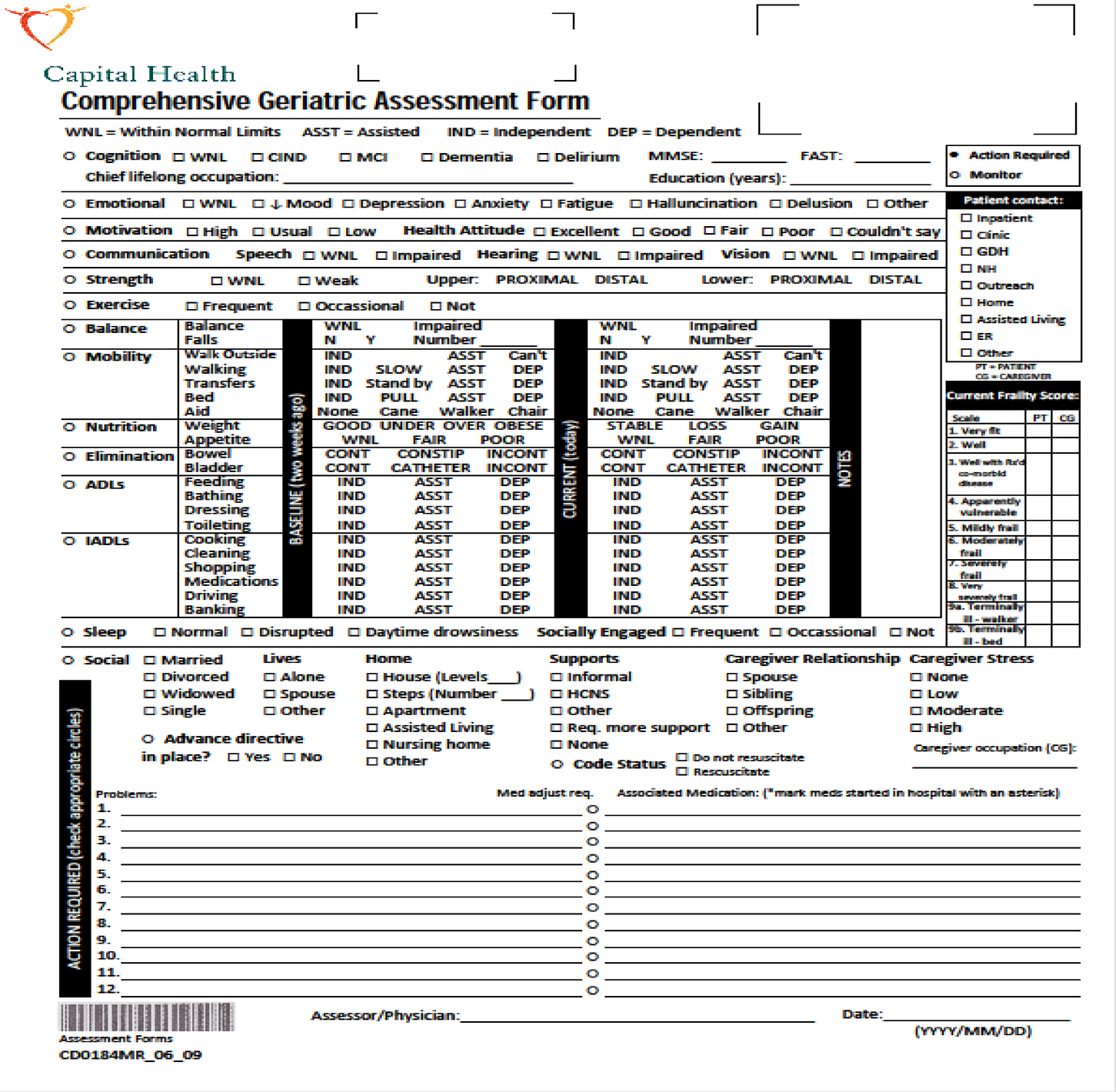

Capital Health

Comprehensive Geriatric Assessment Form

WNL = Within Normal Limits ASST = Assisted IND = Independent DEP = Dependent

○ **Cognition** ☐ WNL ☐ CIND ☐ MCI ☐ Dementia ☐ Delirium MMSE: _____ FAST: _____
Chief lifelong occupation: _____ Education (years): _____

○ **Emotional** ☐ WNL ☐ ↓ Mood ☐ Depression ☐ Anxiety ☐ Fatigue ☐ Hallucination ☐ Delusion ☐ Other

○ **Motivation** ☐ High ☐ Usual ☐ Low **Health Attitude** ☐ Excellent ☐ Good ☐ Fair ☐ Poor ☐ Couldn't say

○ **Communication** **Speech** ☐ WNL ☐ Impaired **Hearing** ☐ WNL ☐ Impaired **Vision** ☐ WNL ☐ Impaired

○ **Strength** ☐ WNL ☐ Weak Upper: PROXIMAL DISTAL Lower: PROXIMAL DISTAL

○ **Exercise** ☐ Frequent ☐ Occassional ☐ Not

		BASELINE (two weeks ago)	CURRENT (today)	NOTES
○ **Balance**	Balance	WNL N Y Impaired Number _____	WNL N Y Impaired Number _____	
○ **Mobility**	Walk Outside	IND ASST Can't	IND ASST Can't	
	Walking	IND SLOW ASST DEP	IND SLOW ASST DEP	
	Transfers	IND Stand by ASST DEP	IND Stand by ASST DEP	
	Bed	IND PULL ASST DEP	IND PULL ASST DEP	
	Aid	None Cane Walker Chair	None Cane Walker Chair	
○ **Nutrition**	Weight	GOOD UNDER OVER OBESE	STABLE LOSS GAIN	
	Appetite	WNL FAIR POOR	WNL FAIR POOR	
○ **Elimination**	Bowel	CONT CONSTIP INCONT	CONT CONSTIP INCONT	
	Bladder	CONT CATHETER INCONT	CONT CATHETER INCONT	
○ **ADLs**	Feeding	IND ASST DEP	IND ASST DEP	
	Bathing	IND ASST DEP	IND ASST DEP	
	Dressing	IND ASST DEP	IND ASST DEP	
	Toileting	IND ASST DEP	IND ASST DEP	
○ **IADLs**	Cooking	IND ASST DEP	IND ASST DEP	
	Cleaning	IND ASST DEP	IND ASST DEP	
	Shopping	IND ASST DEP	IND ASST DEP	
	Medications	IND ASST DEP	IND ASST DEP	
	Driving	IND ASST DEP	IND ASST DEP	
	Banking	IND ASST DEP	IND ASST DEP	

○ **Sleep** ☐ Normal ☐ Disrupted ☐ Daytime drowsiness **Socially Engaged** ☐ Frequent ☐ Occassional ☐ Not

○ **Social**

☐ Married
☐ Divorced
☐ Widowed
☐ Single

Lives
☐ Alone
☐ Spouse
☐ Other

○ **Advance directive in place?** ☐ Yes ☐ No

Home
☐ House (Levels___)
☐ Steps (Number ___)
☐ Apartment
☐ Assisted Living
☐ Nursing home
☐ Other

Supports
☐ Informal
☐ HCNS
☐ Other
☐ Req. more support
☐ None

○ **Code Status** ☐ Do not resuscitate ☐ Rescuscitate

Caregiver Relationship
☐ Spouse
☐ Sibling
☐ Offspring
☐ Other

Caregiver Stress
☐ None
☐ Low
☐ Moderate
☐ High

Caregiver occupation (CG): _____

ACTION REQUIRED (check appropriate circles)

Problems:	Med adjust req.	Associated Medication: (*mark meds started in hospital with an asterisk)
1. _____	○	_____
2. _____	○	_____
3. _____	○	_____
4. _____	○	_____
5. _____	○	_____
6. _____	○	_____
7. _____	○	_____
8. _____	○	_____
9. _____	○	_____
10. _____	○	_____
11. _____	○	_____
12. _____	○	_____

● Action Required
○ Monitor

Patient contact:
☐ Inpatient
☐ Clinic
☐ GDH
☐ NIH
☐ Outreach
☐ Home
☐ Assisted Living
☐ ER
☐ Other

PT = PATIENT
CG = CAREGIVER

Current Frailty Score:

Scale	PT	CG
1. Very fit		
2. Well		
3. Well with Rx'd co-morbid disease		
4. Apparently vulnerable		
5. Mildly frail		
6. Moderately frail		
7. Severely frail		
8. Very severely frail		
9a. Terminally ill - walker		
9b. Terminally ill - bed		

Assessor/Physician: _____ Date: _____ (YYYY/MM/DD)

Assessment Forms
CD0184MR_06_09

Comprehensive Geriatric Assessment Form: **function signals illness severity**

	Instrumental Activities of Daily Living	Baseline (two weeks ago)			Current (today)		
○ **IADLs**	Cooking	IND	ASST	DEP	IND	ASST	DEP
	Cleaning	IND	ASST	DEP	IND	ASST	DEP
	Shopping	IND	ASST	DEP	IND	ASST	DEP
	Medications	IND	ASST	DEP	IND	ASST	DEP
	Driving	IND	ASST	DEP	IND	ASST	DEP
	Banking	IND	ASST	DEP	IND	ASST	DEP

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Comprehensive Geriatric Assessment Form: **function signals illness severity**

	Instrumental Activities of Daily Living	Baseline (two weeks ago)			Current (today)		
○ **IADLs**	Cooking	IND	ASST	DEP	IND	ASST	DEP
	Cleaning	IND	ASST	DEP	IND	ASST	DEP
	Shopping	IND	ASST	DEP	IND	ASST	DEP
	Medications	IND	ASST	DEP	IND	ASST	DEP
	Driving	IND	ASST	DEP	IND	ASST	DEP
	Banking	IND	ASST	DEP	IND	ASST	DEP

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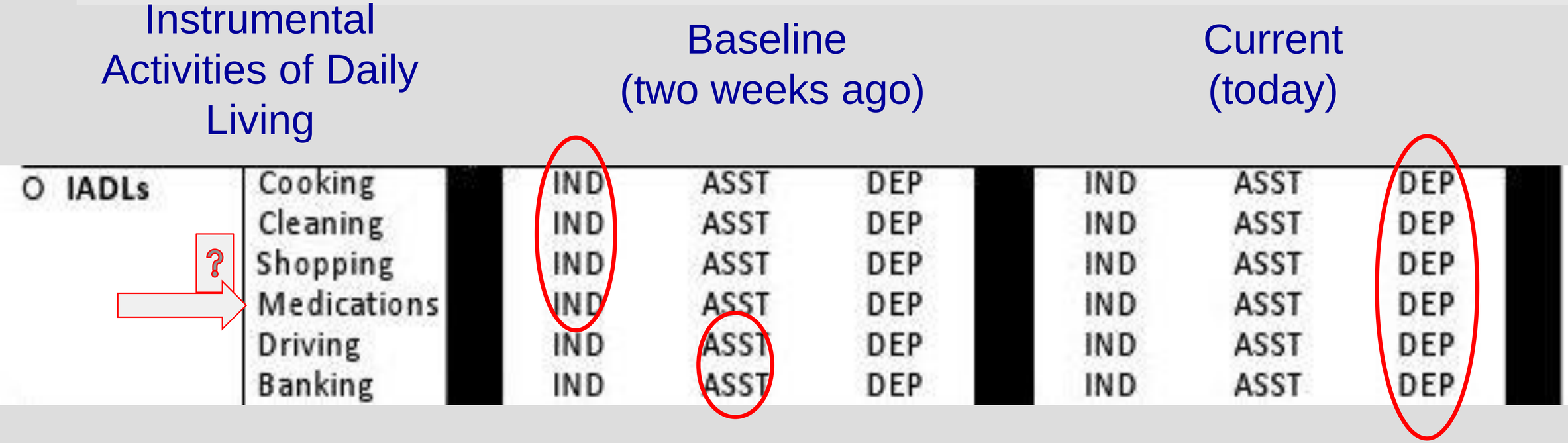
Comprehensive Geriatric Assessment Form: **function allows care planning**



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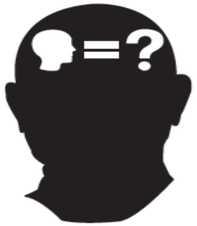
Pictorial Frailty Assessment

	1	2	3	4	5	6	7
Mobility							
Function							
Cognition							

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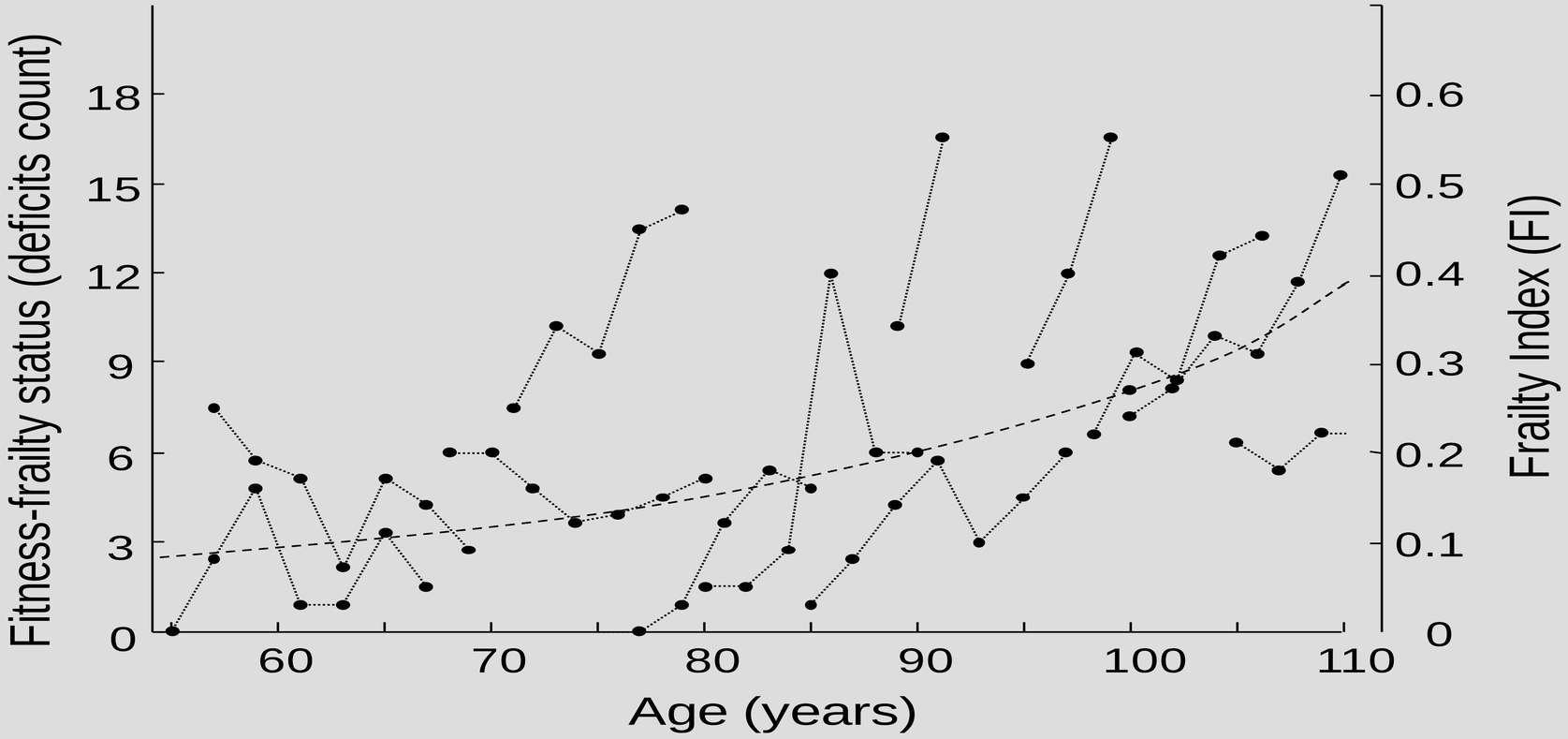
Individuals show many trajectories in accumulation health deficits



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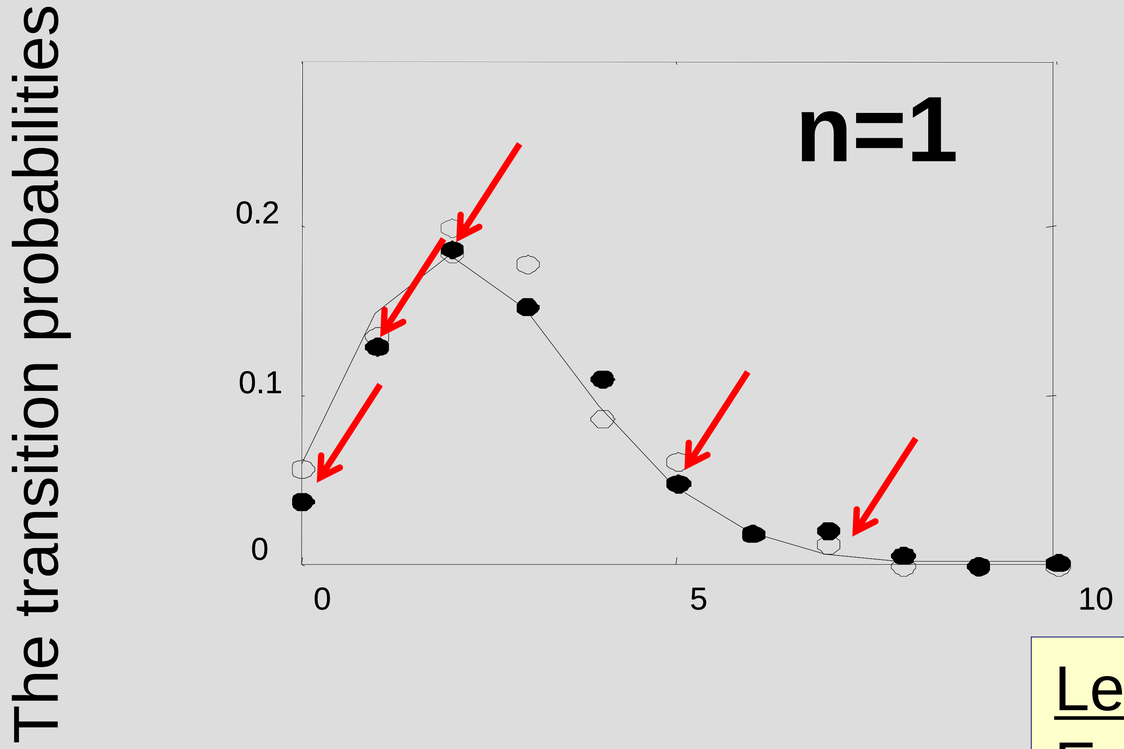
Mitnitski et al., *Exp Gerontol* 2012;(12):893-899.

Outcomes of people with one health deficit at baseline



Legend:
Empty circles: CSHA-1 → -2
Solid circles: CSHA-2 → 3

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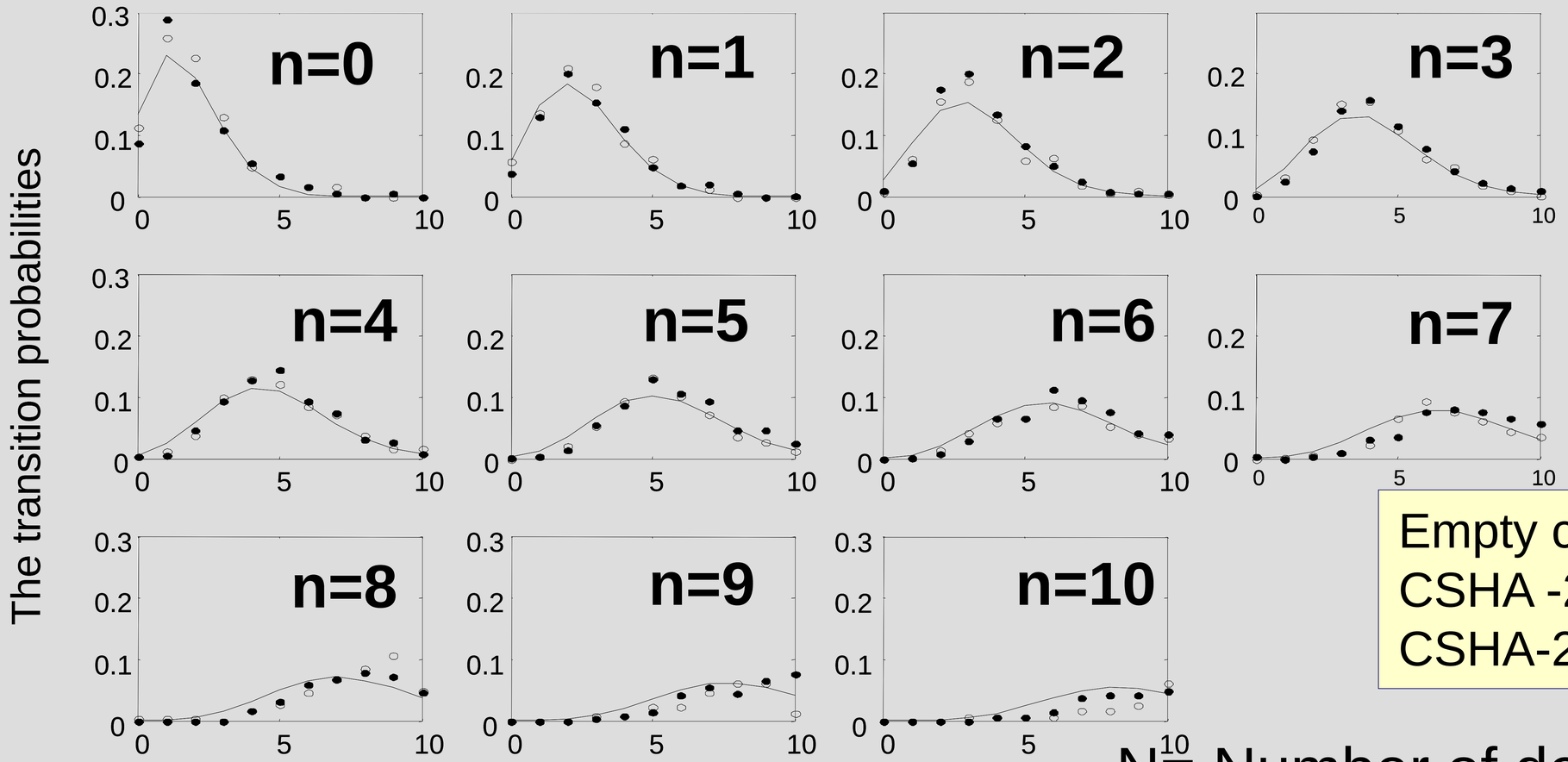
Change in the number of deficits is orderly, in relation to the number of deficits at baseline.



Empty circles: CSHA-1 → CSHA -2; Solid circles: CSHA-2 → CSHA-3

N= Number of deficits at baseline

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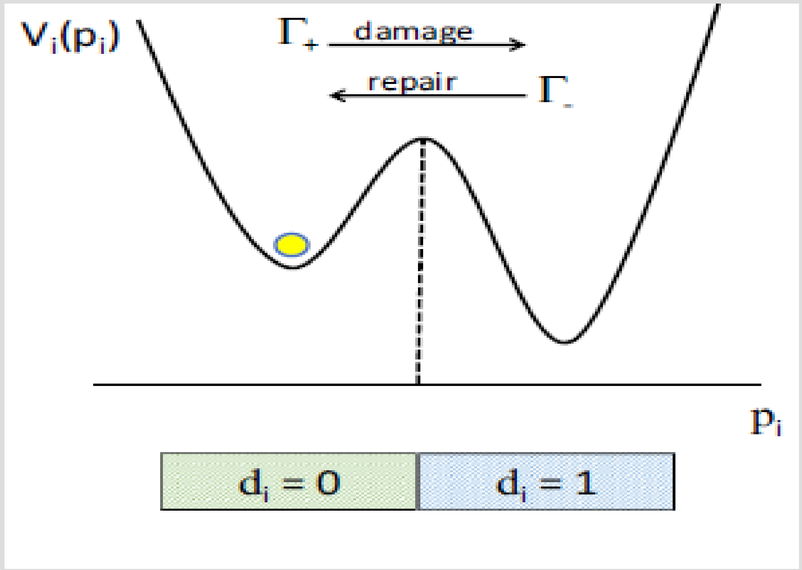
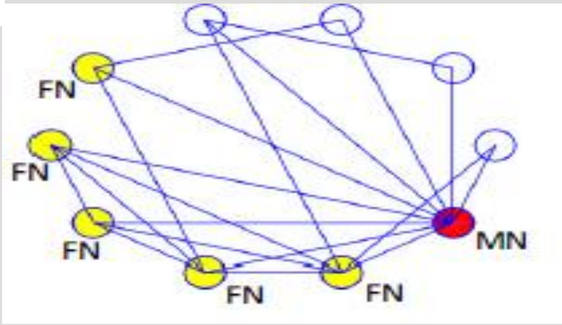
Mitnitski et al., *Mech Ageing Dev* 2006, 127;490-493

How deficits arise and propagate

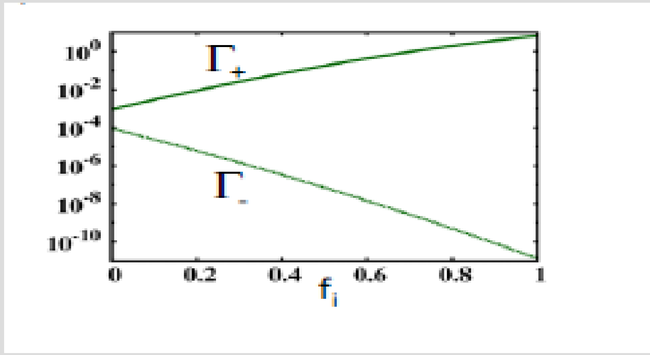
(a)



(b)



(c)



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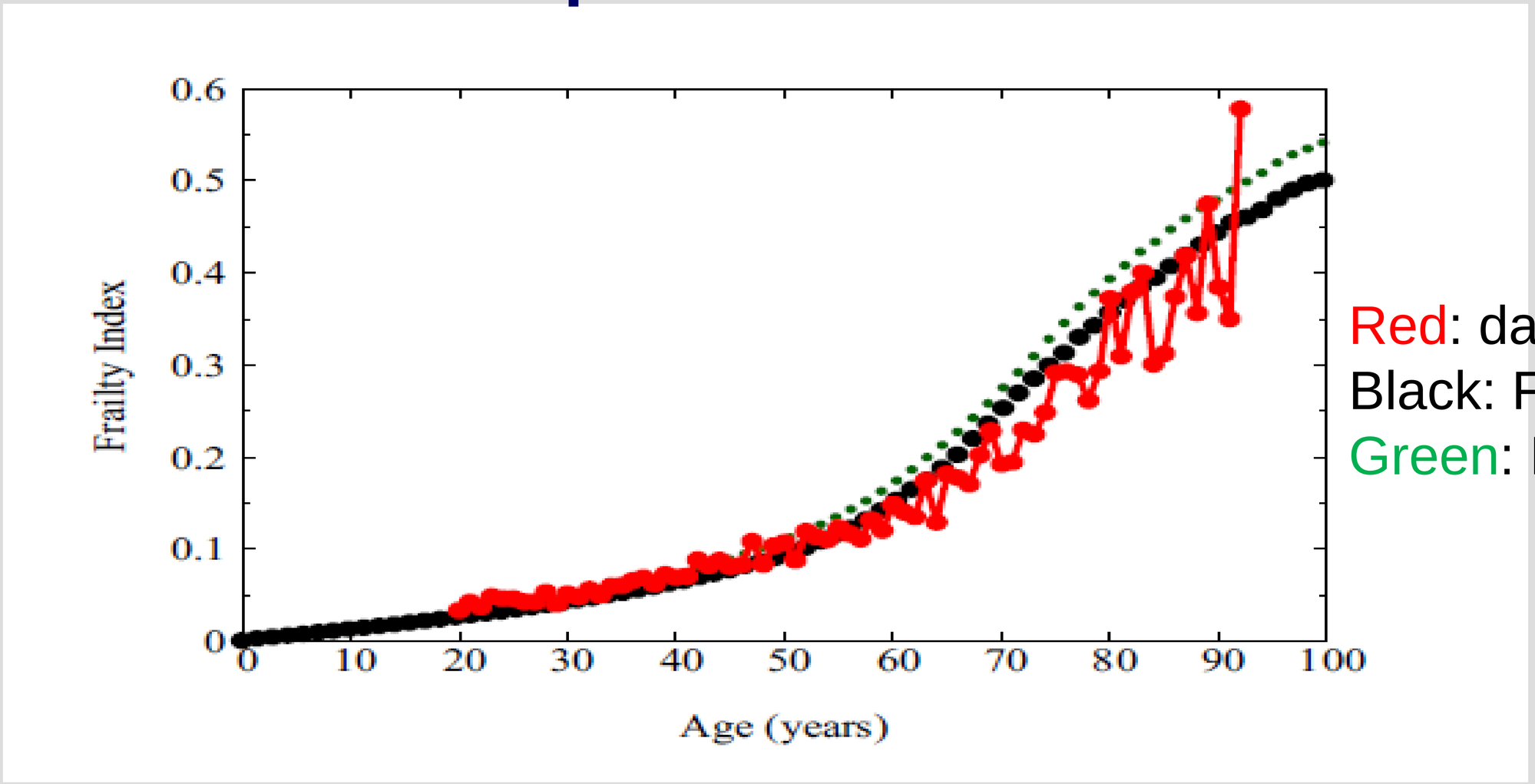
Taneja S, et al. *Physical Review E* 2016: **93**, 022309

How the model compares with Canadian data.



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