Socio-economic (demographic) Correlates of Life Expected in Degrees of Frailty

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Defining *frailty*

Dictionary definition: "The condition of being weak and delicate".

Malhotra et al., REVES, 2018: "A clinical state in which there is an increase in an individual's risk for developing increased dependency and/or mortality when exposed to a stressor."

Rockwood & Mitnitski 2007: "State of increasing risk, which reflects multisystem physiological change".

Canadian Frailty Network: "State of health where the person's … ability to function independently is reduced and vulnerability to deterioration is increased."

Malhotra, R., et al., (2018). Years of life lived by elderly Singaporeans with and without frailty. Presented at REVES in Ann Arbor, MI, June 1, 2018.
Rockwood, K., & Mitnitski, A. (2007). Frailty in relation to the accumulation of deficits. *Journal of Gerontology: Medical Sciences, 62*(7), 722-727.

What is *frailty*?

- Frailty is a holistic term for a physiological state that reflects vulnerability to health deterioration and death.

- While increasing frailty is not aging, it encompasses indicators associated with aging and is highly correlated with aging.

- Frailty exists on a spectrum of intensity.

Research on frailty at REVES

Seven presentations on frailty-free life expectancy at REVES meetings 2005 to 2019:

	Authors	Meeting	Title
1	Matthews, F., et al.	Barcelona, 2019	Inequalities in frailty free life expectancies by socioeconomic status across generations
2	Malhotra, R., et al.	Ann Arbor, 2018	Years of life lived by elderly Singaporeans with and without frailty
3	Herr, M., et al.	Ann Arbor, 2018	Life expectancy in the state of frailty after age 70: Findings in the SIPAF study
4	Gonzalez, C.	Santiago, 2017	Frailty and disability in older adults in low- and middle-income countries: The SAGE study
5	Matthews, F., et al.	Vienna, 2016	Frailty-free life expectancy across two decades and three regions
6	Jagger, C., et al.	Austin, 2013	Frailty-Free Life Expectancy at age 70 between European Countries
7	Deeg, D., & Puts, M.	Beijing, 2005	Frailty free life expectancy in the older population: the Netherlands

Publications on frailty-free life expectancy

Romero-Ortuno, R., Fouweather, T., & Jagger, C. (2013). Cross-national disparities in sex differences in life expectancy with and without frailty. *Age and ageing*, 43(2), 222-228.

Herr, M., Arvieu, J.-J., Ankri, J., & Robine, J.-M. (2018). What is the duration of life expectancy in the state of frailty? Estimates in the SIPAF study. *European journal of ageing*, 15(2), 165-173.

Main findings so far...

- There are sex and geographic variations.

- There is some evidence that life expected free of severe frailty has increased.

- Women are disadvantaged in percent of life frailty-free.

SES and frailty-free life expectancy

Education and income are frailty determinants (Gobbens et al. 2010; Szanton et al. 2010).

With the exception of Matthews et al. (today), there are (almost) no studies of SES and life expected in degrees of frailty.

Education and income may affect distinct stages of health problems differently (Herd et al., 2007; Zimmer & House 2003). There is evidence that...

- **Education is more likely to impact onset of problems**
- **Income is more likely to impact worsening health**

So, education and income might associate with FFLE differently for those healthy versus those already frail.

This suggests that status-based estimates could be revealing.

Gobbens, R. J., et al. (2010). Determinants of frailty. Journal of the American Medical Directors Association, 11(5), 356-364.
Herd, P., et al. (2007). Socioeconomic position and health: the differential effects of education versus income on the onset versus progression of health problems. Journal of Health & Social Behivor, 48(Supp): 223-238.
Szanton, S. L., et al. (2010). Socioeconomic status is associated with frailty: the Women's Health and Aging Studies. Journal of Epidemiology & Community Health, 64(1), 63-67.
Zimmer, Z., & House, J. S. (2003). Education, income and functional limitation transitions among American adults: Contrasting onset and progression. International Journal of Epidemiology, 32(6), 1089-1097.

Methods

8 waves of data from 2000 to 2014
Ages: 55 to 109
N = 26,513
N frailty transitions = 112,735
N deaths = 8,547

Estimates use: IMaCh .99r17

Separate estimates by sex

Measuring frailty

A frailty index (FI) is constructed for each person/wave using the 'deficit' approach:

"The proportion of potential deficits that are present in a given individual,"
with deficits represented by multifactorial health indicators (Rockwood and Mitnitski 2007).

Category	Examples	# Items
Medical conditions, symptoms and procedures	Heart problems; Heart surgery	13
System utilization	Doctor visits; Meal delivery	11
Functional limitations	Climbing stairs; Pushing a chair	9
ADLs	Bathing; Toileting	6
Help with ADLs	Help with bathing; Help with toileting	6
IADLs	Grocery shopping; Taking medications	4
Medications	For blood pressure; For diabetes	4
Sensory	Use hearing aid; Self-assessed vision	3
Equipment use	For walking; For getting into bed	2
Global	Self-assessed health	1
Total Items		**59**

Rockwood, K., & Mitnitski, A. (2007). Frailty in relation to the accumulation of deficits. *Journal of Gerontology: Medical Sciences, 62*(7), 722-727.

Modeling LE in degrees of frailty

FI scores are divided into three groups defined as follows:

A transition model is constructed that allows people to move from any frailty state at baseline to any frailty state at follow-up

Frailty-free
Scores less than .20

Frail
Scores .20 to .40

Severely frail
Scores more than .40
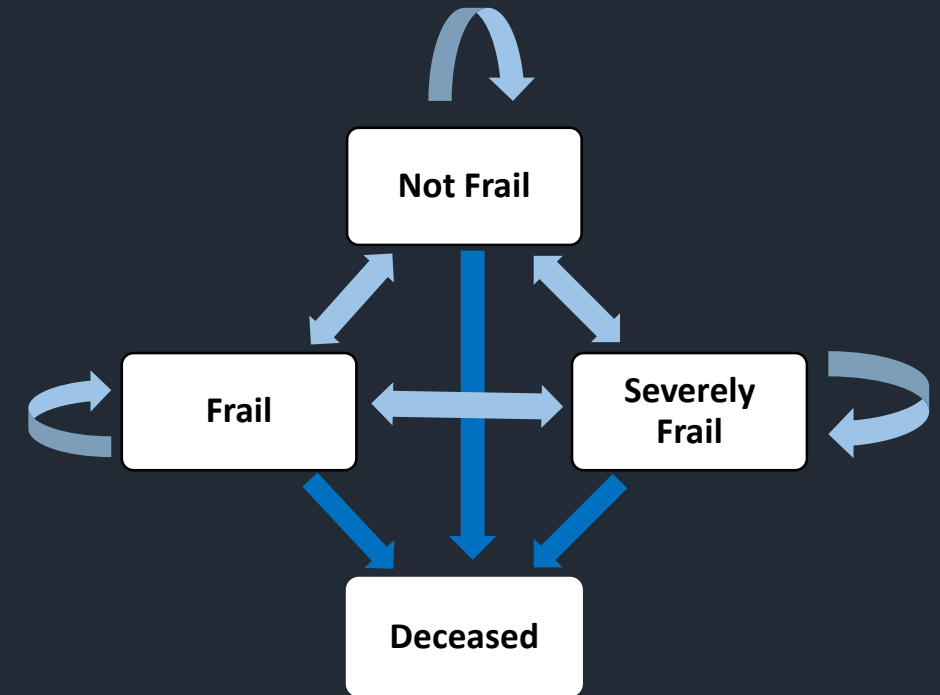
Average FI scores at baseline by age and sex, HRS, 2000-2014, showing frailty states as defined in this analysis

FI 0.4+ = Severely frail

FI 0.2-0.4 = Frail

FI 0.0-0.2 = Frailty free

Frailty Index

Age
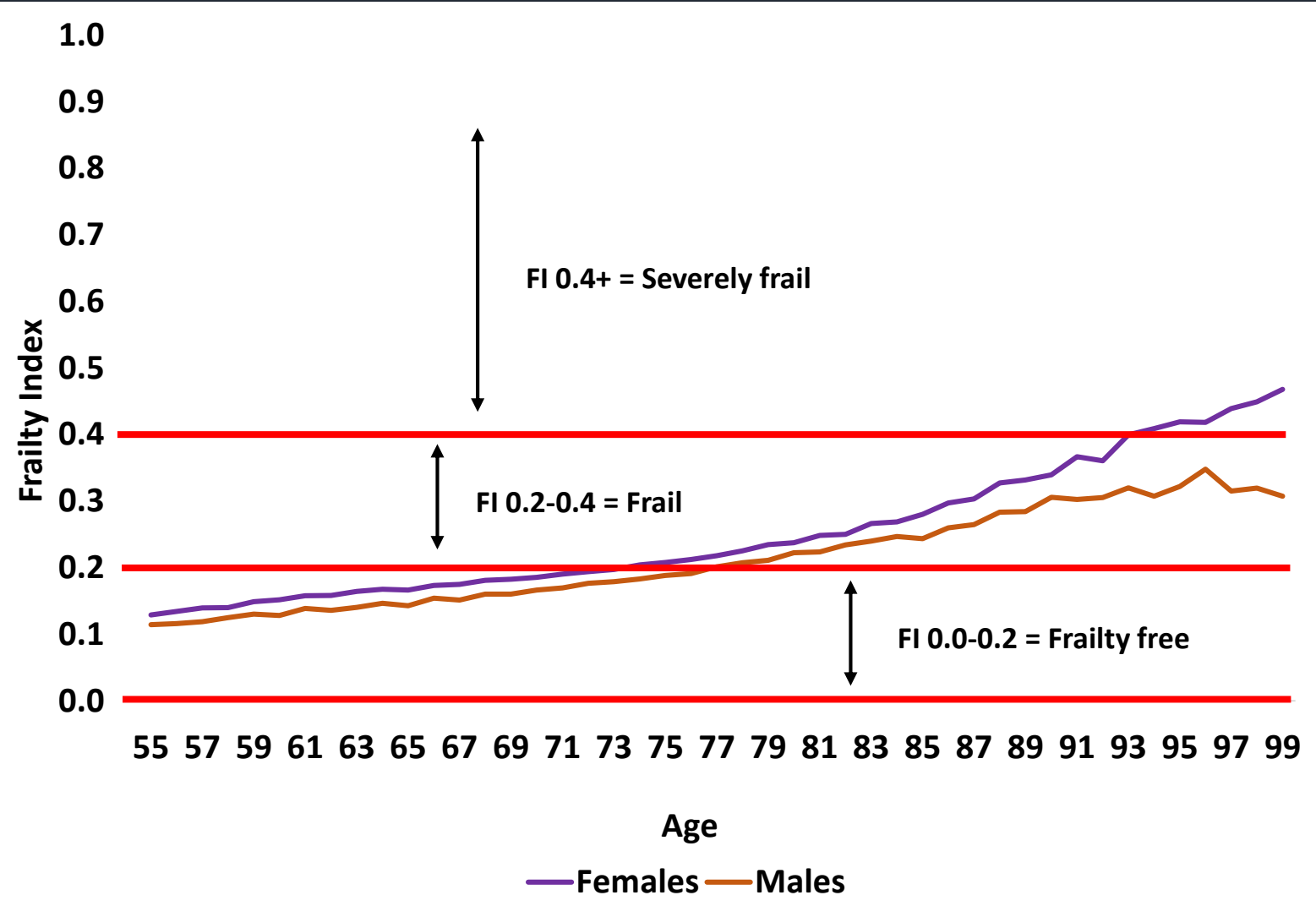
— Females — Males

Distribution of frailty states at baseline by sex

Baseline state	Females (N=65,055)	Males (N=47,680)
Frailty-free	62.7	72.7
Frail	27.6	21.5
Severely Frail	9.6	5.8
Total	100	100

Transition probabilities across frailty states by sex

Follow-Up	Females baseline				Males baseline		
	Frailty-free	Frail	Severely Frail		Frailty-free	Frail	Severely Frail
Frailty-free	.842	.145	.003		.855	.170	.009
Frail	.132	.638	.149		.109	.588	.168
Severely Frail	.009	.138	.551		.008	.115	.481
Deceased	.017	.080	.297		.028	.128	.342

Life expected and proportion of life expected in frailty states by age and sex (with 95% confidence intervals)
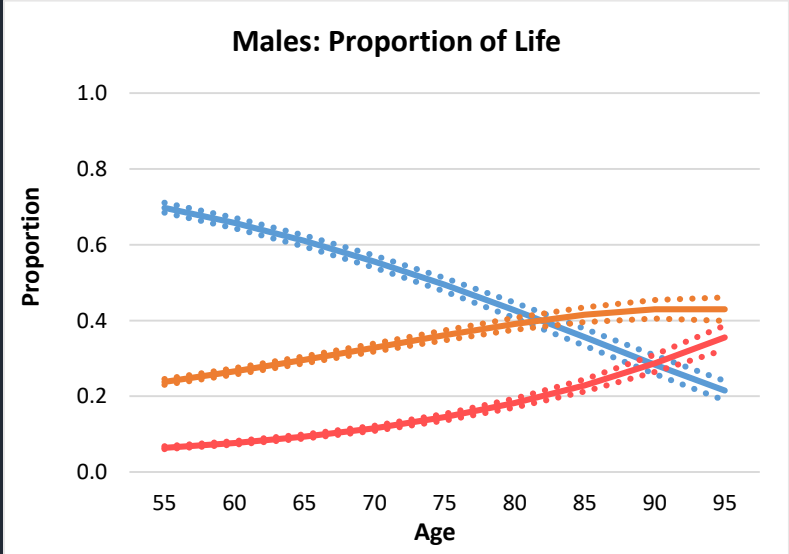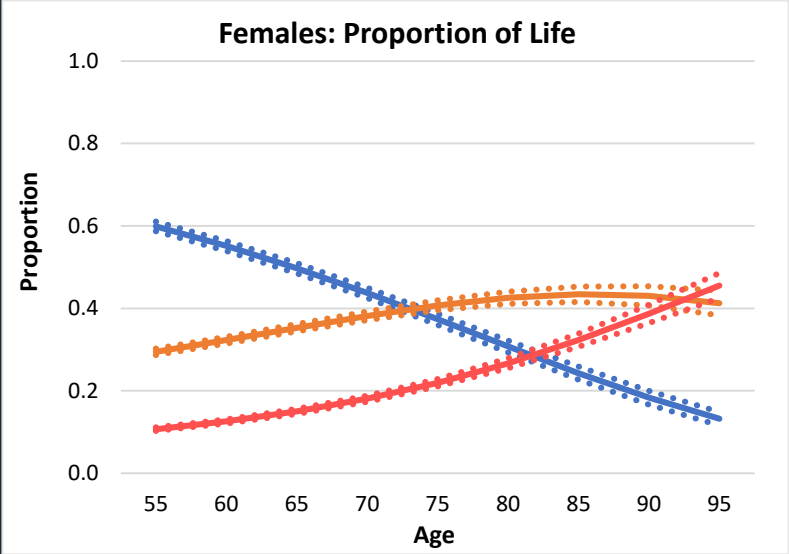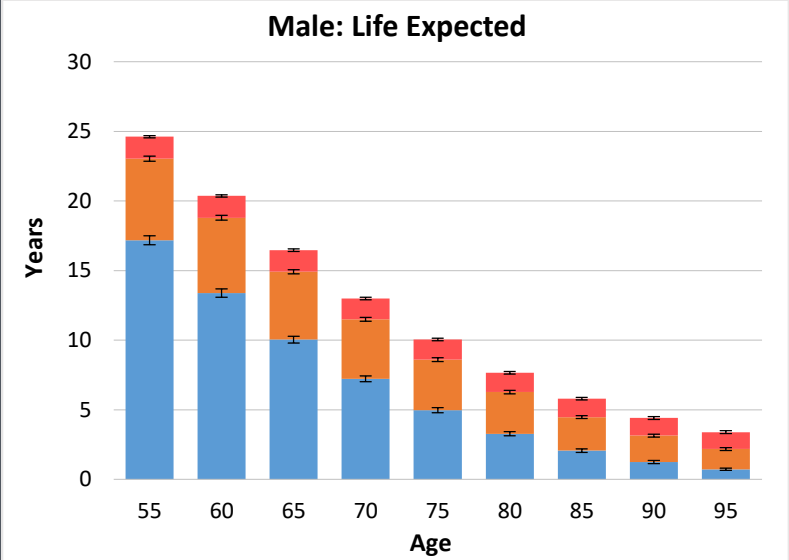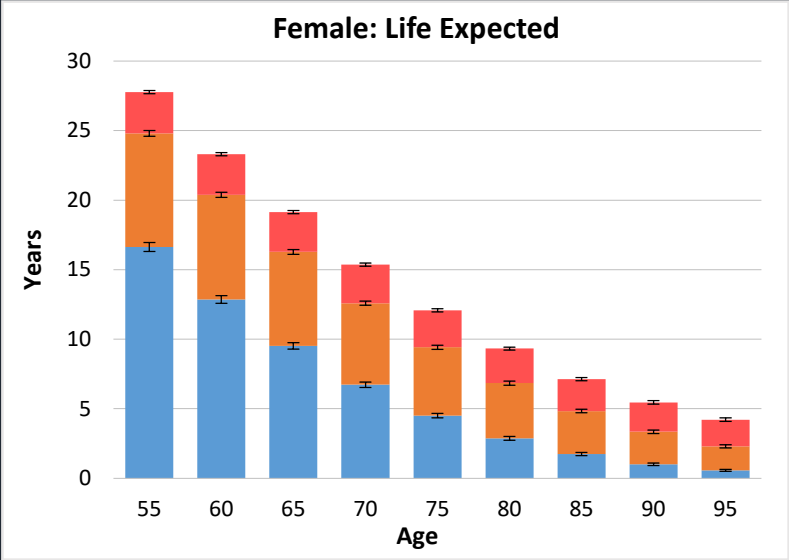
We now examine these estimates by education and wealth

**Wealth is based on RAND wealth calculation, standardized to 2014 USD, divided into tertiles**

Distribution (N) of wealth/education at baseline

Wealth tertiles	Educ 1 Less than completed high school	Educ 2 Completed high school	Educ 3 Some college	Total
Wealth 1 Lowest	3,380	2,952	2,504	8,836
Wealth 2 Middle	1,356	3,487	3,995	8,838
Wealth 3 Highest	501	2,348	5,987	8,836
Total	5,237	8,789	12,486	26,512

Population-based estimates

Only for age 75

LE estimates (age 75) in states of frailty by education and wealth
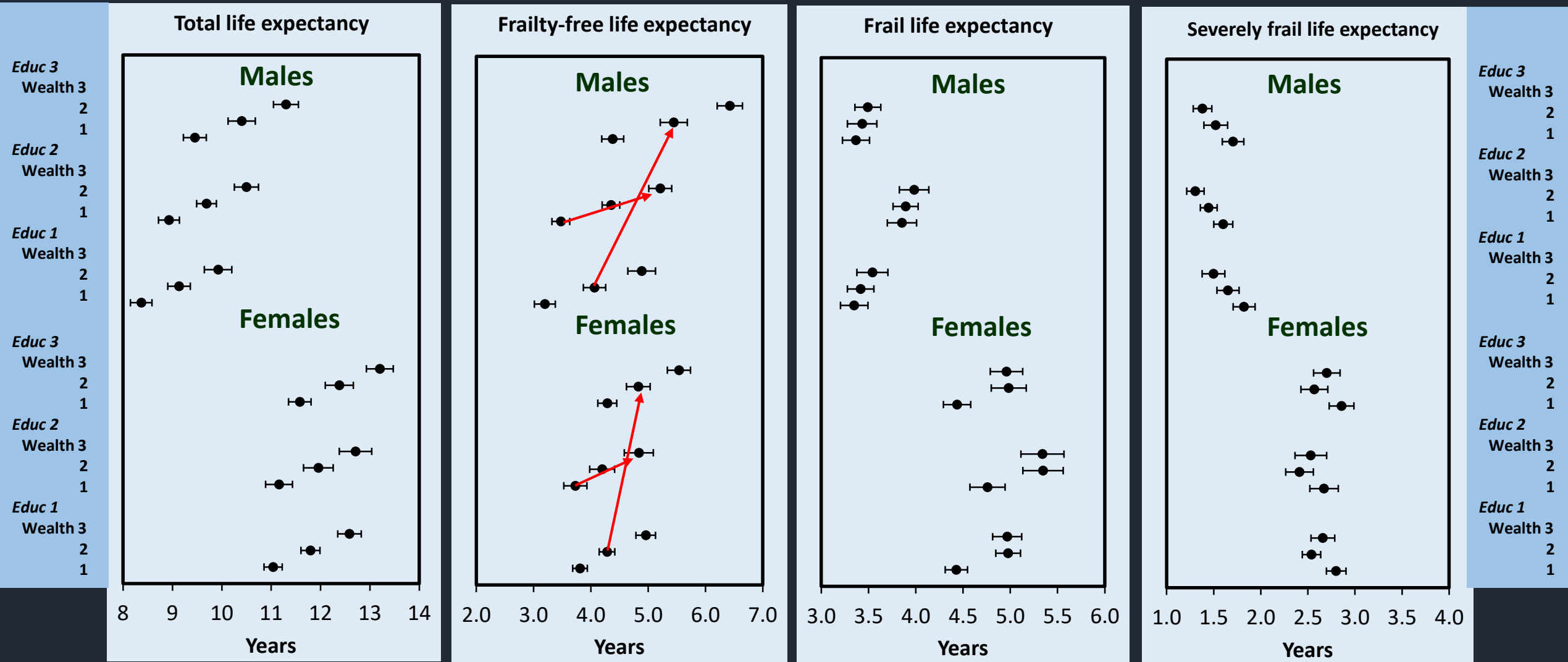
Summarizing the net gain/loss in years by sex and wealth/education*

		Total	Frailty-free	Frail	Severely frail
Males	Wealth	+1.57	+1.74	+0.13	-0.30
	Education	+1.27	+1.38	+0.02	-0.13
Females	Wealth	+1.55	+1.11	+0.58	-0.14
	Education	+0.58	+0.55	+0.01	+0.03

* Calculated as difference in years, highest minus lowest level of indicator, holding other indicator constant at its mid value

First conclusion

Men with higher wealth and education live longer.
The total life gain for men is made up of more frailty-free and fewer severely frail years.

Women with higher wealth live longer.
Women gain from education as well, but less so.
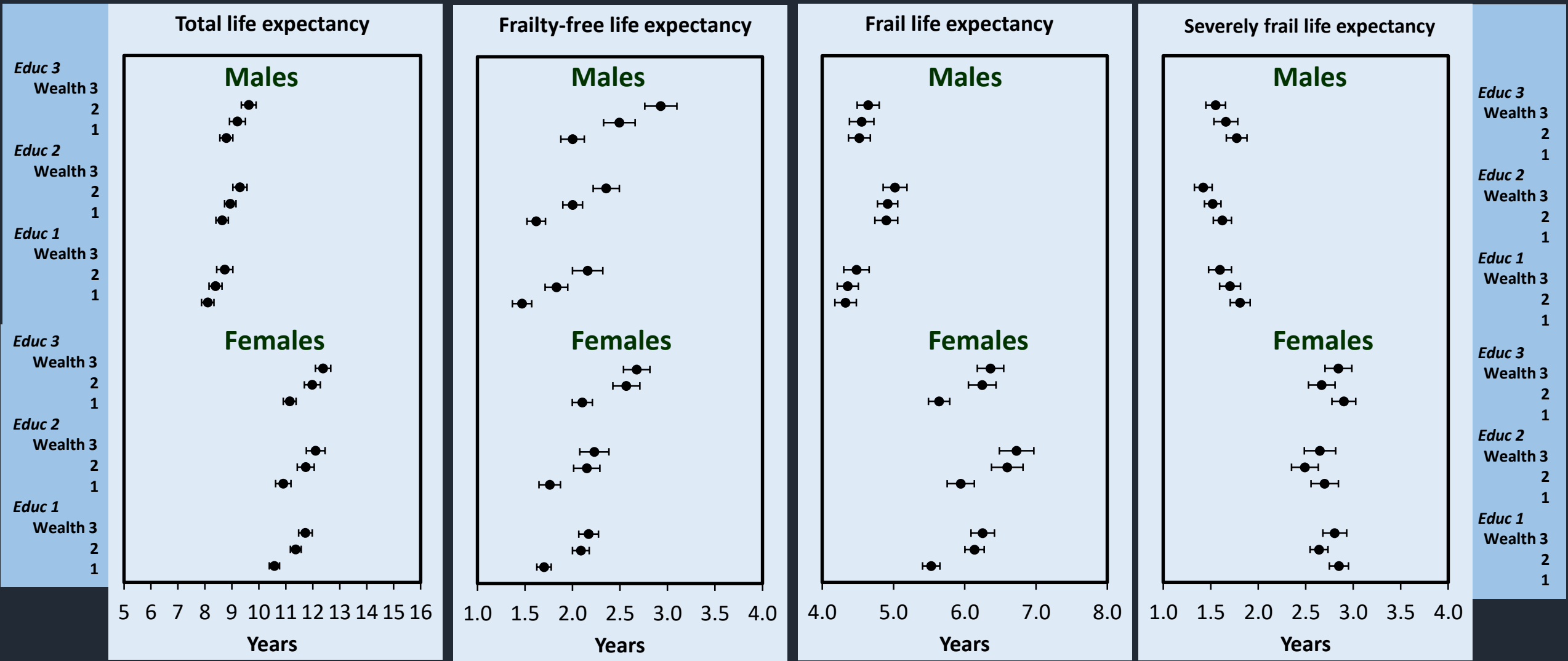The total life gain for women is made up of more frailty-free years plus more frail years.

Status-based estimates

Only for those age 75

LE estimates for those *frailty-free at baseline* by education and wealth

LE estimates for those *frail at baseline* by education and wealth

Summarizing the net gain/loss in years by *baseline state*, sex and wealth/education*

		Baseline: Frailty-free					Baseline: Frail			
		Total	Frailty-free	Frail	Severely frail		Total	Frailty-free	Frail	Severely frail
Males	Wealth	1.43	1.54	0.08	-0.19		0.66	0.74	0.12	-0.20
	Education	1.10	1.21	-0.04	-0.07		0.81	0.66	0.20	-0.04
Females	Wealth	1.48	1.11	0.45	-0.08		1.20	0.47	0.78	-0.05
	Education	0.39	0.35	-0.03	0.07		0.62	0.48	0.11	0.03

* Calculated as difference in years, highest minus lowest level of indicator, holding other indicator constant at its mid value

LE estimates for those *severely frail at baseline* by education and wealth
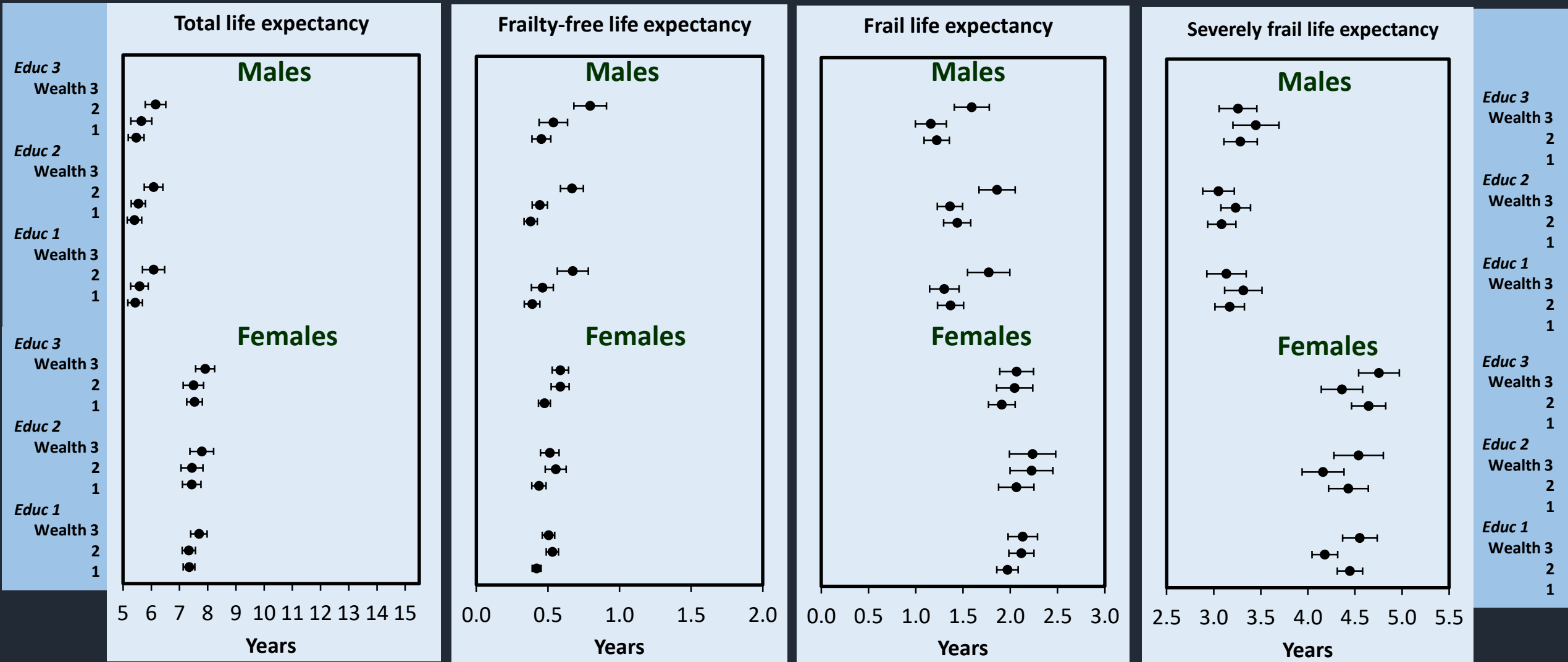
Summarizing the net gain/loss in years by sex and wealth/education for those severely frail at baseline*

		Total	Frailty-free	Frail	Severely frail
Males	Wealth	+0.68	+0.29	+0.42	-0.03
	Education	+0.07	+0.08	-0.14	+0.13
Females	Wealth	+0.36	+0.08	+0.17	+0.11
	Education	+0.17	+0.05	-0.07	+0.18

* Calculated as difference in years, highest minus lowest level of indicator, holding other indicator constant at its mid value

Second conclusion

Among those severely frail, higher wealth may associate with FFLE where education does not.

Otherwise, status-based results look a lot like population-based results in that:

Men that are frailty-free or frail live longer if they have higher wealth and education.
The gain in life is made up of more frailty-free years and fewer severely frail years.

Women that are frailty-free or frail at baseline with higher wealth live longer.
Women that are frailty-free or frail with higher education gain as well, but less so.
Years gained for women are more likely lived in a frail state than are years gained for men.

Thank-you

Gracias

Gràcies