Costa Rican nonagenarians: Are they the longest-living humans?

Luis Rosero-Bixby
University of Costa Rica
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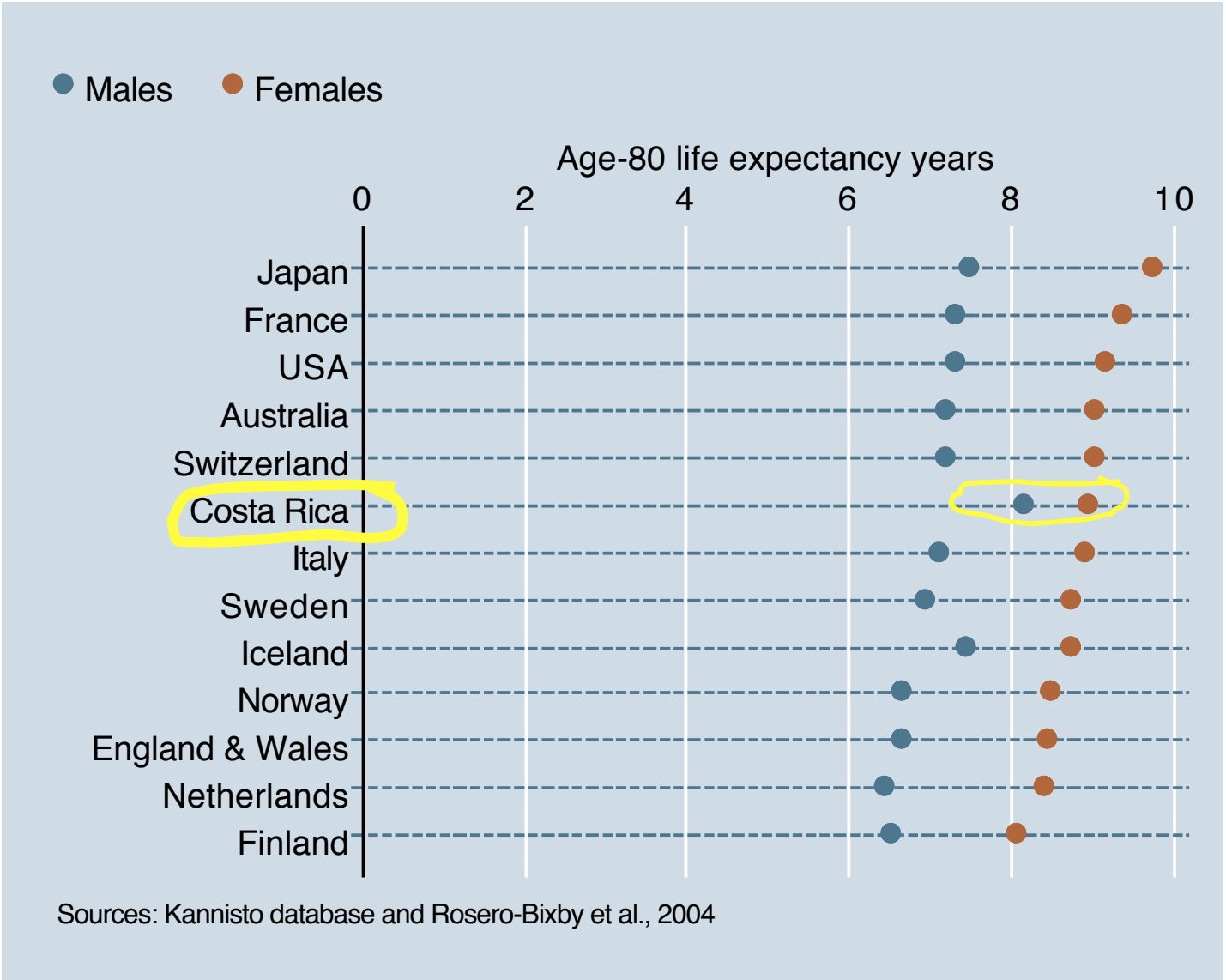
Longevous populations

- No those with many oldest-old
- Should look at high survival ratios or life expectancy
- Bogus claims (Andes and Caucasus)
- Okinawa and Sardinia seems genuine
- Age exaggeration of the elderly is big problem in census (inflates very-old population)
- Under-registration of deaths in vital statistics
- Little is known in developing countries

Nonagenarians in the population ~ year 2000

Country	In population (%)		Cohort 30 yr. (%) *		Female ratio**
	Female	Male	Female	Male	
CR census	0.22	0.17	9.2	6.9	1.4
CR-estimate	0.19	0.14	7.4	5.6	1.3
France	1.09	0.33	6.1	2.5	3.5
Italy	0.90	0.31	5.4	2.3	3.0
Japan	0.77	0.26	8.3	3.3	3.0
Russia	0.39	0.10	2.8	1.6	4.2
Sweden	1.05	0.37	5.6	2.2	2.9
USA	0.78	0.26	6.9	2.9	3.1

Age-80 life expectancy, 1990s



Sources: Kannisto database and Rosero-Bixby et al., 2004

The research questions

- Is this high longevity for real? Or due to:
  - Under registration of deaths
  - Inflated denominators by age exaggeration
- How could it be? (health expenditure per person in Costa Rica is 1/15 of the USA!)
- Is it sustainable?

Our database

- 24,000 **nonagenarians (aged 90+),** death in 1984-2004 (73%) or alive by Nov. 2004, from the voting registry.
- 101,000 person years, 48% extinct cohorts
- No selection bias: almost impossible to have lived in Costa Rica with no "*cédula*" (5,900 nonagenarians in the registry vs. 7,000 in census)
- Check age misreporting: If registry is in ledgers of the birth year. Late registration: 17%
- Record linkage with vital statistics to get cause of death.

Analysis methods

- Quasi-extinct cohort to estimate mortality.
- Three-parameter mortality model as function of a standard set of m_x rates
- Poisson regression to estimate the model
- Life tables to estimate life expectancy from the m_x rates

The mortality model

$$m_{xd} = V_{xd}\, exp\{\beta_0 + \beta_1(x-90) + \beta_2 d\}\, error$$

$$m_{xd} = V_{xd}\, M\, A^{(x-90)} S^{d} error$$

m_{xd} death rate at age *x, sex d*

V_{xd} standard or expected death rate at *x, d (Kannisto average for 13 countries with reliable data)*

β_i Coefficients, estimated with Poisson regression

M Mortality level parameter (rate ratio at age 90)

A Relative ageing parameter

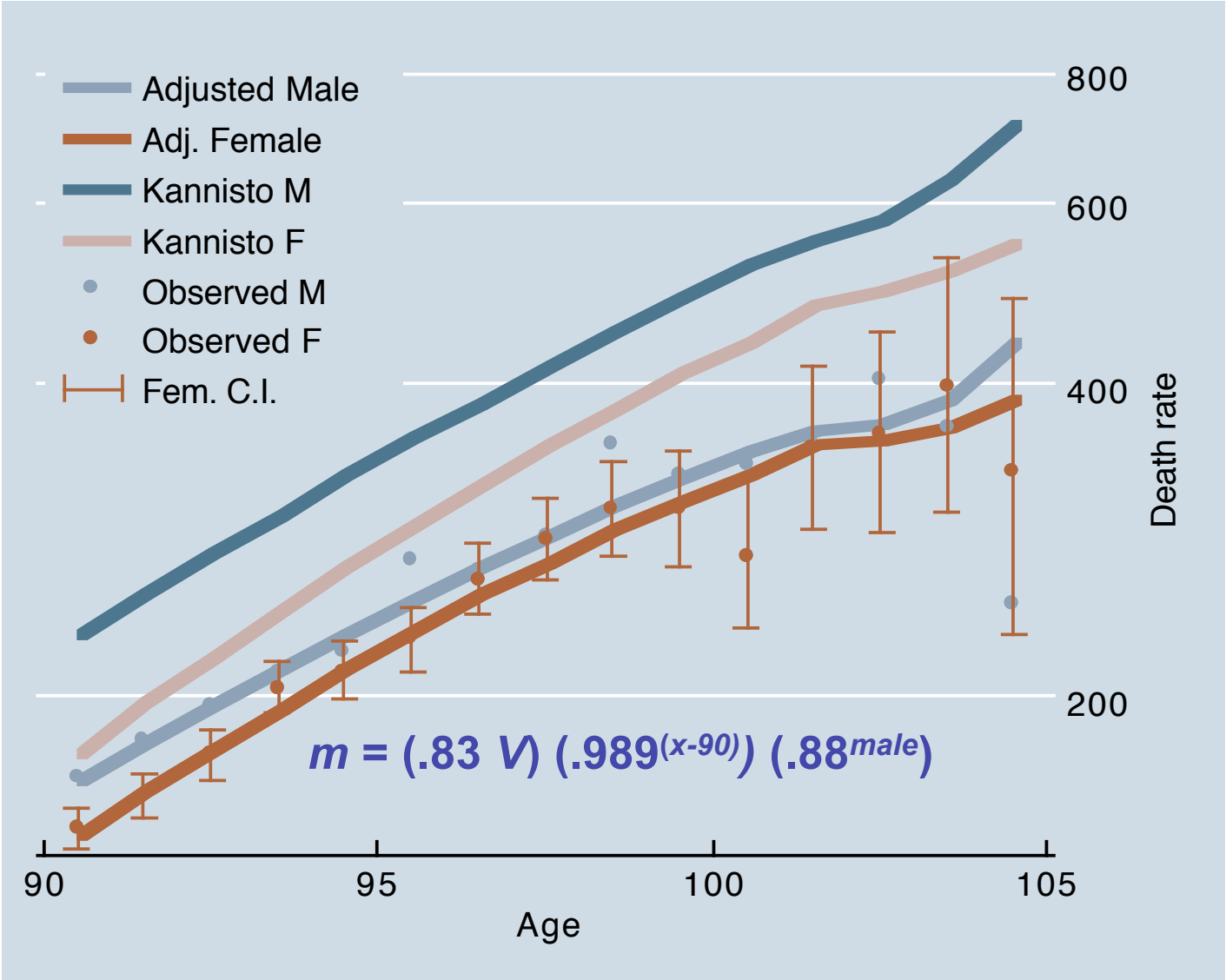
S Relative over-mortality of males.

Pssing the Kannisto tests for centenarians

1. Deaths ages105+ as percent of deaths ages 100+ is expected to be less than 5% and to be smaller for men.
   - In our database: 5.2% men and 5.9% women

2. Death risk higher at age 101 than at age 100 and the ratio < 1.0
   - In our database: 0.94 for men and 0.79 women

Low mortality rates, volatile in centenarians



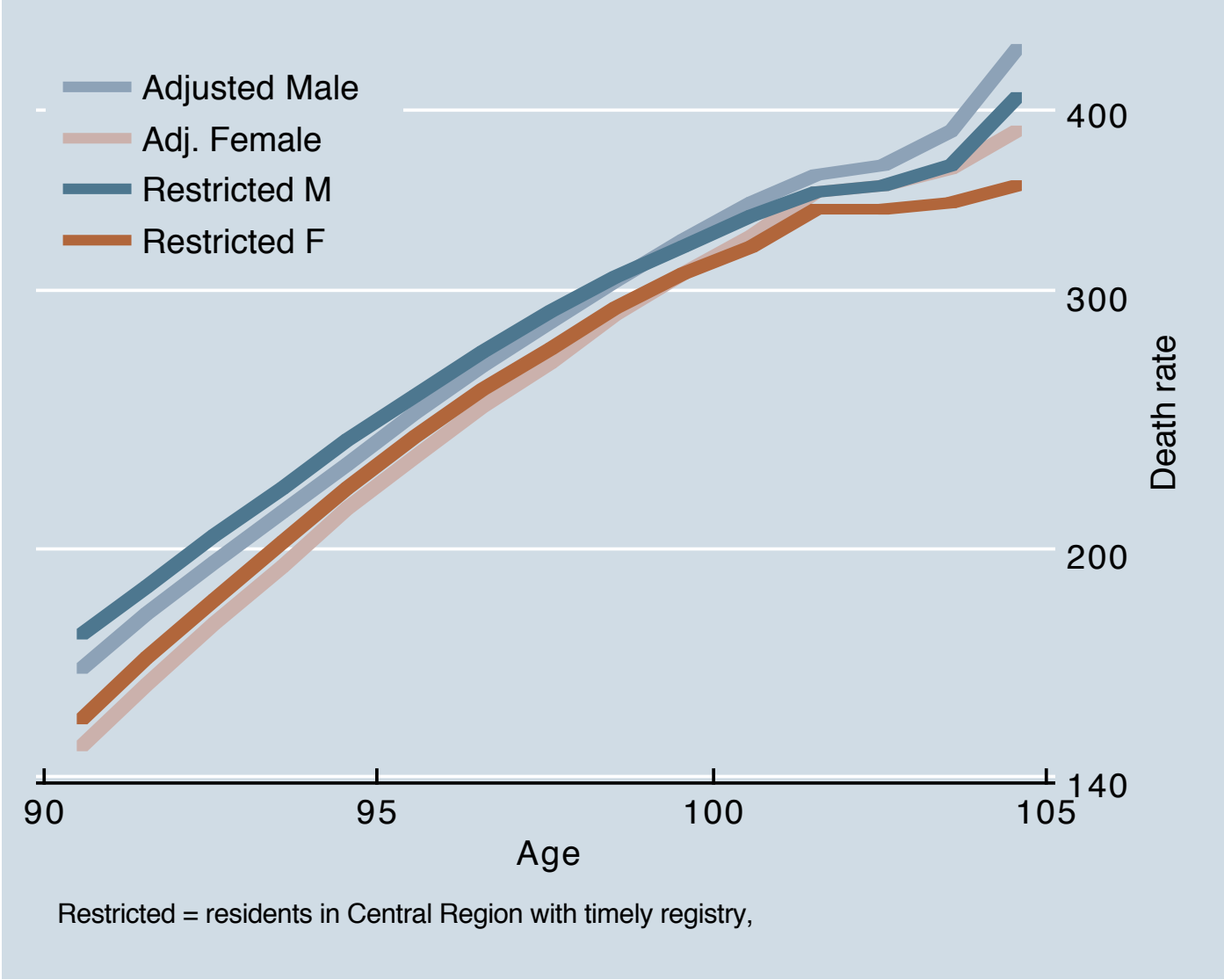
The full model

Explanatory variable	RR	Sig.	RR	Sig.
M Constant	0.852	**	0.868	**
A Age (90=0)	0.991	**	0.989	**
S Male	0.888	**	0.875	**
Late registry	0.986		0.938	*
Year (1995=0)	0.991	**	0.996	*
Noncentral region	0.892	**	0.851	**
Nonextinct cohort	1.005			
Interactions				
Male-late registry			1.089	*
Age-year			0.998	**
Age-region			1.013	*
Year-region			1.007	*

RR rate ratio (exponentiated regress. coefficient)

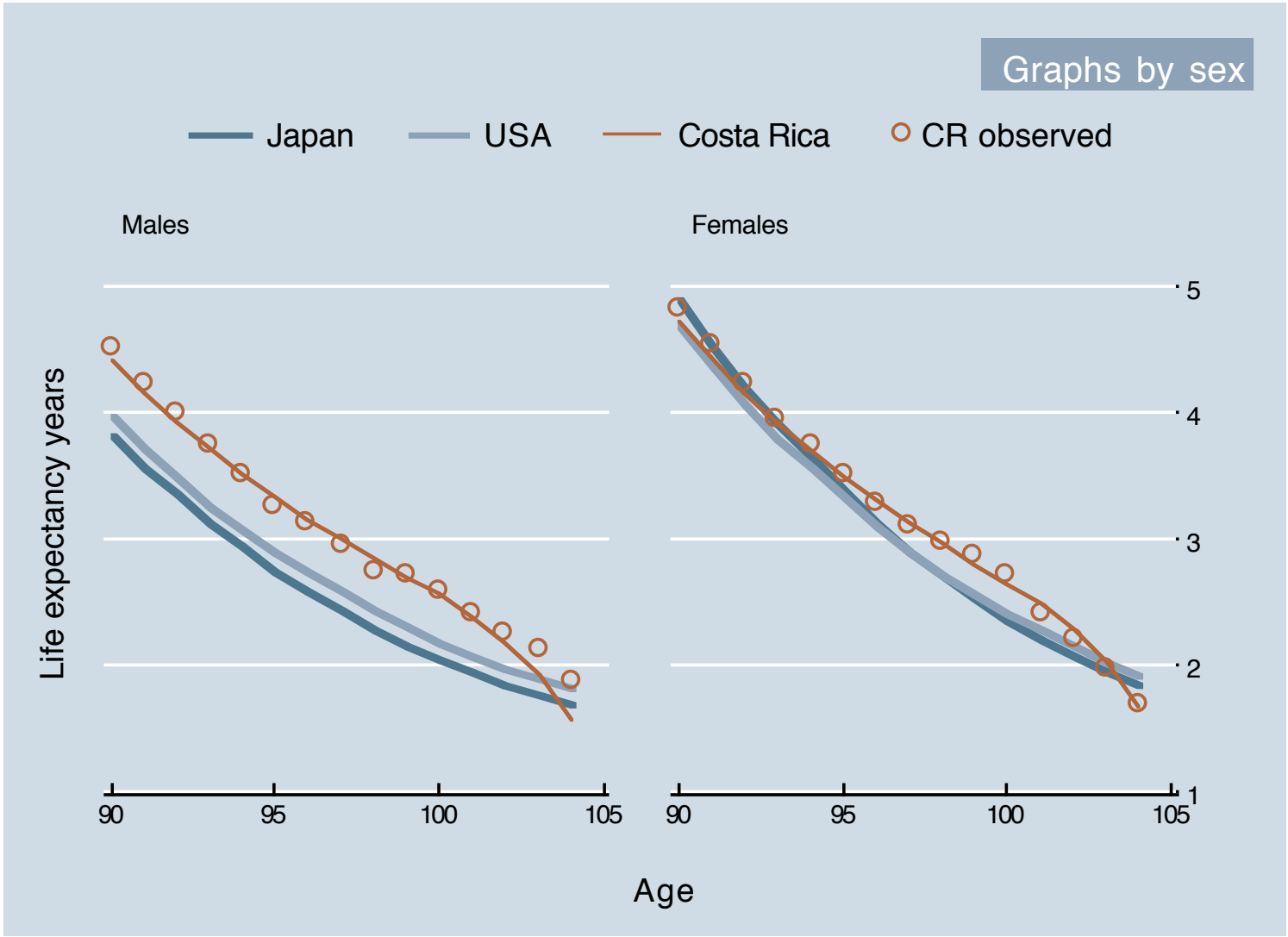
* significant at P < .05 ** significant at P < .01

Restricted death rates (small correction)

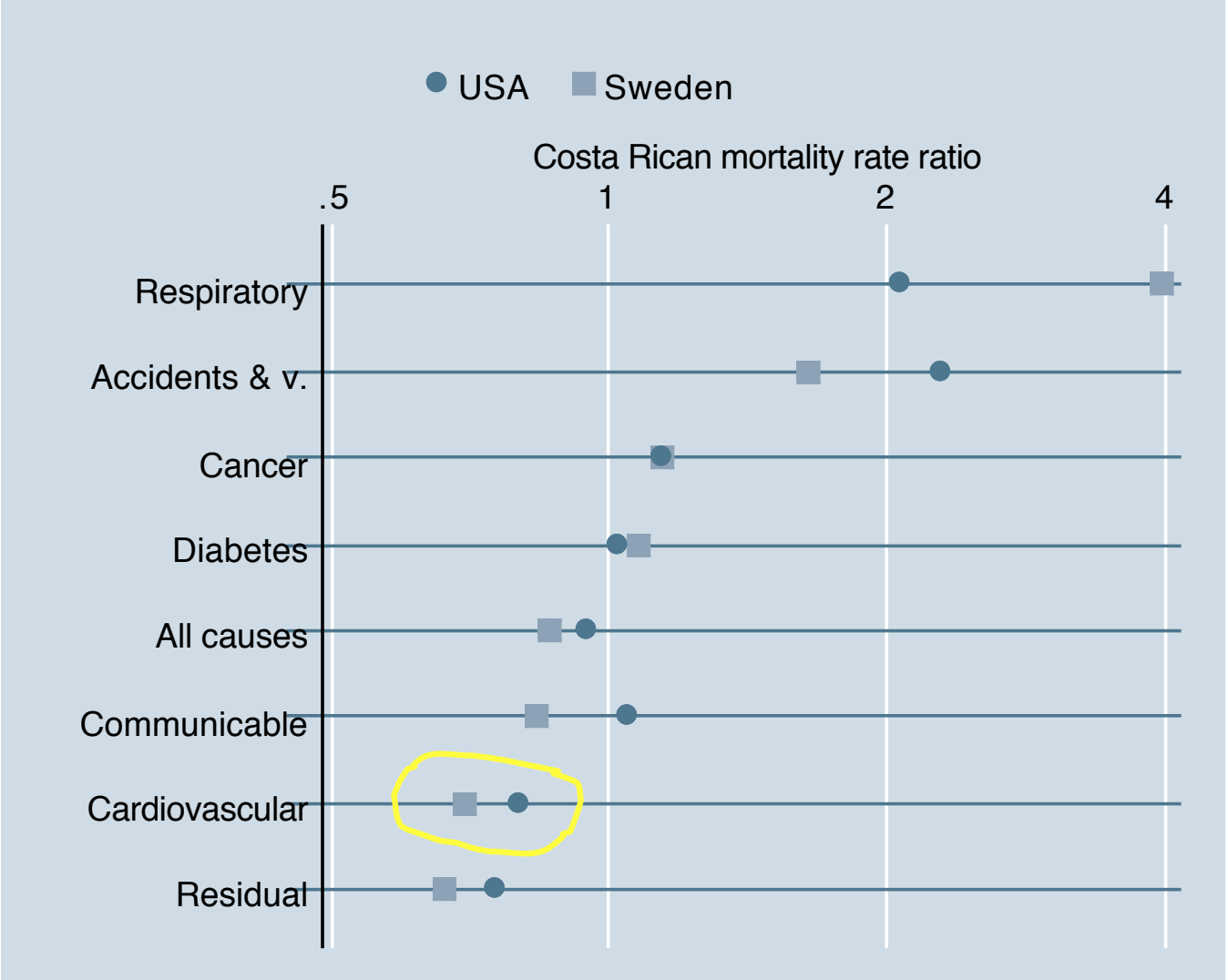


Restricted = residents in Central Region with timely registry,

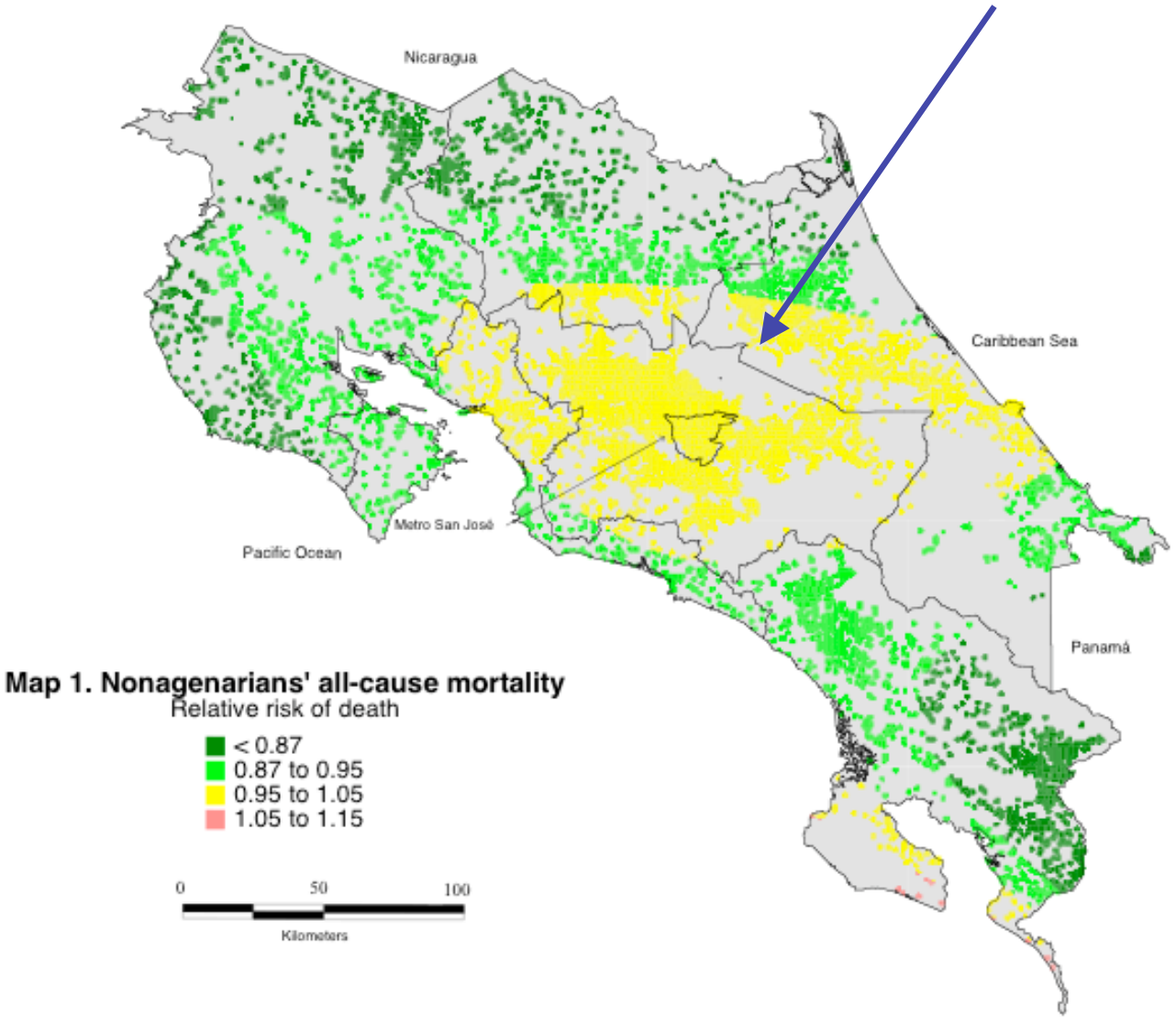
Age expectancy is lower than in Japan and the USA



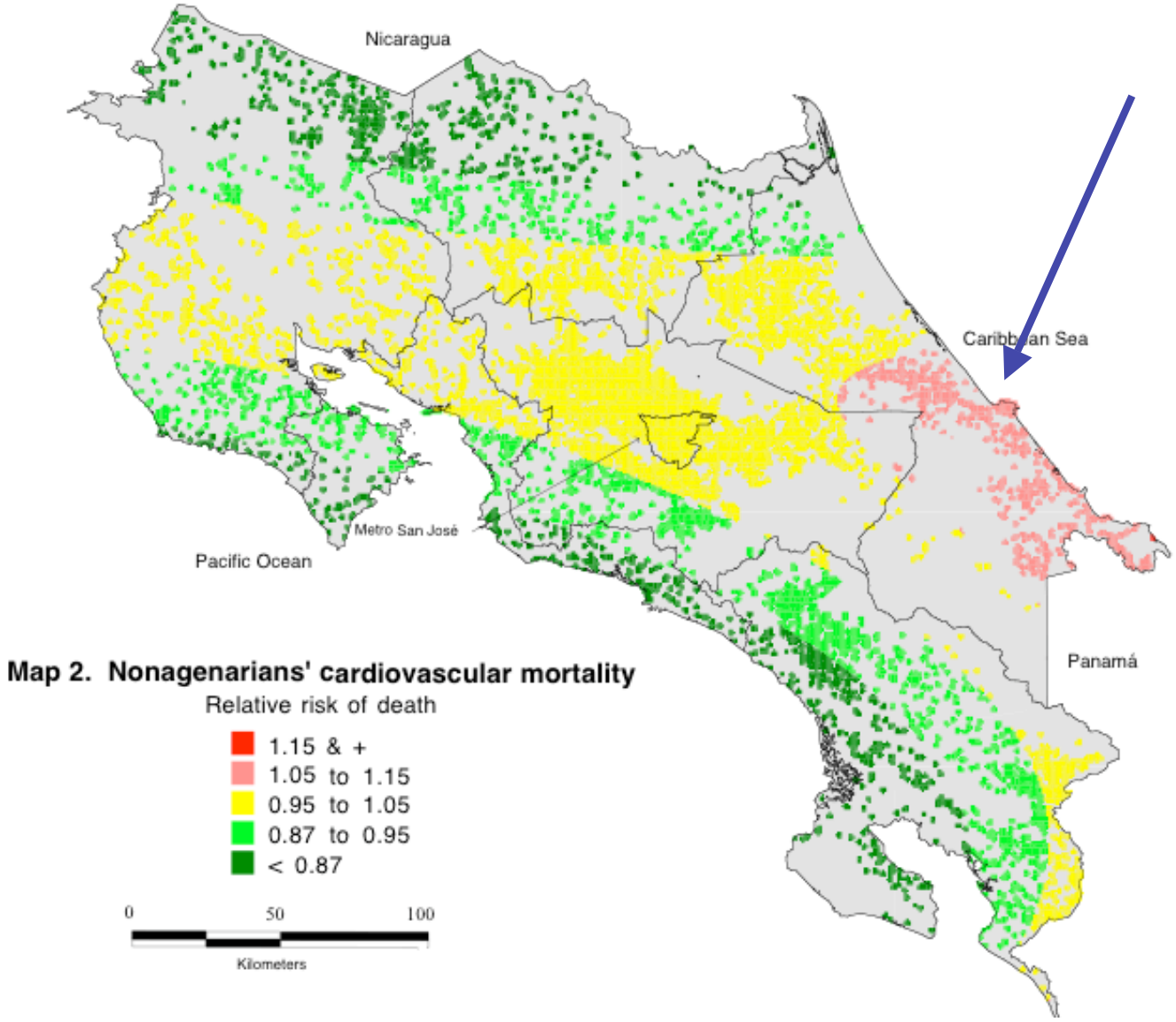
Costa Rican advantage in cardiovascular mortality



Higher mortality in the center



Higher cardiovascular death in Afro-Caribbeans



Human faces

	Juan	Miguel
Birth year	1901	1902
Registration ledger	1901	1902
BMI	23	21.7
Blood presure	160/77	138/75
Total cholesterol (<200)	217	203
Good cholesterol (35+)	47	64
Bad cholesterol (<160)	143	108
Triglycerides (<160)	133	155
Creatinine-blood (.5-1.2)	1.6	1.1
Creatinine-urine (50-110)	56	51
Glucose (70-109)	102	128
smoking	4 cigars	No
Self reported health	Vgood	Vgood
Main ocupation	Agric	?
Age retirement	81	92

Don Juan, 104 year old

Don Miguel, 103 year old

Conclusions

- Can you believe that elderly Costa Rican males are the most longevous humans?
- Carefully analyzed data say so. There is no possibility of age misreporting or under registration error
- Selection of the less-frail a possible explanation. Why mostly in men?
- If selection, then advantage is ephemeral

More research is needed!

Thank you