Aging and Mortality among Elderly Costa Ricans

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Costa Rican elderly have longer life expectancy than whites in the US: 20.7 years compared to 19.6 years for men age 60, according to official figures for 1995-2000[1]. How can a developing country with a per capita health expenditure that is one-twentieth of the US provide better life expectancy to their senior citizens than the US does? Is this just an artifact of bad data? Very little is known about longevity of the elderly, its differentials and determinants in developing countries. The little evidence available is often disregarded as bad data in the academic circles of developed countries.

In this paper we report the results of a three-year follow up of a representative sample of about 7,200 elderly Costa Ricans with over-sampling of the oldest old. We drew a sample of about 9,000 individuals from the 2000 census and followed up individuals for who we were able to identify their unique, national identification number--the "cedula". We conducted the follow up in the databases of the Costa Rican death registration system (which is 100% accurate for individuals with cedula). We took the birth date information from the birth registry, to avoid the problem of age misreporting in census. And we used the census information on socioeconomic characteristics to study mortality differentials, a rarity for developing countries at these ages. We also used census information about disabilities, to study its differentials and compare them to mortality differentials. Although our data are free of age misreporting and under-registration errors, there is the possibility of selection bias, given that about 19% of individuals in the initial sample were not included in our study (this

[1] Brenes, G. & Rosero-Bixby, L (2002) Tablas de vida completas 1995-2000. San José, Costa Rica: CCP & SUPEN.

figure includes 6% foreigners). The paper discusses the potential for this bias in our mortality estimates.

We found about 800 deaths in a 2.3-year follow up period (we will expand the follow up period one more year as soon as the database is available). The age specific death rates in this sample compare favorably with those of more developed countries (source: Human Mortality Database at http://www.mortality.org), confirming official figures of an exceptional longevity in Costa Rica (Figure 1). Death rates of elderly Costa Ricans are consistently lower than those of US citizens (between 15% and 25% lower), with the two curves being almost parallel in the logarithmic scale. The comparison with Japan shows that Costa Ricans under the age of 80 are in disadvantage, but after the age 85 their mortality risk becomes more and more lower than in Japan

How do socioeconomic and demographic conditions affect the death risk of elderly Costa Ricans? Table 1 shows a preliminary multivariate analysis of the probability of dying using logistic regression. Men in any marital status have about 70% higher death odds that married women. Women with no partner are in an intermediate situation. Health insurance (which in Costa Rica is provided by a social security system with 80% national coverage) seems strongly associated to death risks. Individuals (or their family) with no insurance provided as part of their job have substantially higher death risks, especially if they sought voluntary insurance (60% higher odds). The higher death odds of those with voluntary insurance (provided by government for the destitute or self paid) may be just a reflection of selection bias: the sick are more likely to go after voluntary insurance.

Traditional indicators of living standards such as education and economic status (measured by 13 conveniences in the household) do not show an association with mortality at these ages. These results are at odds with widespread findings of a strong negative gradient of child mortality and education or SES. At the same time, these results are consistent with recent evidence that socioeconomic conditions may not be an important determinant of adult mortality in developing countries like Costa Rica or Taiwan that have controlled communicable diseases.

Another strange result of the multivariate analysis (although in line with the evidence of no improved survival among the most prosperous or educated strata) is the almost 50% higher death odds in the Great Metropolitan Area of San Jose, the capital city, where about 40% of the national population reside. This is not a result of elderly people with chronic conditions moving to be close to national hospitals. On the contrary, immigrants to Metro San Jose in the previous 5 years have lower death rates (table 1)

Seniors with disabilities (as measured in the census) show 33% higher odds of dying. Having a disability is not, however, an intermediate variable through which the aforementioned effects (or the lack of them) act on mortality. Controlling for disabilities does not affect the other results in the regression. On the contrary, the odds of having a disability have in many aspects different cofactors than the odds of dying. In particular, the odds of disabilities do not show the higher risks associated with residence in the capital and

they do show the expected gradient of SES or education: contrary to death, disabilities are less prevalent in educated and prosperous Costa Ricans.

After determining mortality levels and differentials, the paper turns its attention to the effects of aging in mortality of elderly Costa Ricans compared to other populations. To study this effect we use regression techniques to fit the following simple model:

$$m_x = \alpha\, s_x \exp(\beta\,(x - 60))\ \text{error}$$

Where: m_x is the hazard of dying at age x in the Costa Rican population;
s_x is the expected hazard according to an international standard[2] ;
α is an indicator of the general mortality level (the rate ratio at age 60);
β is an indicator of aging effects that are particular to Costa Rica (negative β would indicate that the effect of aging is relatively smaller);
α and β are estimated by regression coefficients.

Preliminary analyses resulted in $\alpha = 0.61$ and $\beta = -0.010$. I. e., the effect o aging is weaker in Costa Rica than in the mortality schedule used as standard. This reduced aging effect is stronger among women ($\beta = -0.014$) and in Metropolitan San Jose ($\beta = -0.017$).

In a further step, the paper determines whether the "level" and "aging" effects on Costa Rican mortality are differential by demographic and socioeconomic characteristics. The corresponding model is:

$$m_{xi} = \alpha_0 s_x \alpha_i v_i \exp(\beta_0\,(x - 60) + \beta_i\, v_i\,(x - 60))\ \text{error}$$

where: v is a vector of i characteristics such as residence in the capital or having secondary education, and
β_i coefficients measure the aging effect specific to each characteristic i.

Conclusion

These Costa Rica data suggest that exceptional longevity among the elderly is possible in developing countries with a fast pace of mortality decline. These countries have controlled most of mortality caused by communicable diseases (which is strongly determined by socioeconomic conditions), without being yet exposed to some health risks of modernity, such as obesity, saturated fat consumption, smoking, stress, and lack of exercise. An important question is whether this advantage is sustainable or, on the contrary, it is just a temporary situation that will be swept away when some of those evils of modernity will start acting as younger generations become old.

[2] We are planning to use the set of standard mortality rates at old ages proposed by Himes C., S. Preston & G. Condran (1994), *A relational model of mortality at older ages in low mortality countries*, in: Population Studies, 48, pp. 269-291.

Table 1. Logistic regression on the probability of death and disability in a sample of 7,235 elderly Costa Ricans 2000-2002

	Odds ratio on the probability of:		
Variable	Death	Death	Disability
With a disability		1.33 *	
No birth record	0.89	0.90	1.02
Age	1.10 *	1.10 *	1.04 *
Institutionalized	1.35	1.29	2.11 *
Sex & marital status			
Married woman	1.00 Ref.	1.00 Ref.	1.00 Ref.
Lone woman	1.27	1.28	0.98
Married man	1.69 *	1.69 *	1.05
Lone man	1.67 *	1.66 *	1.09
SES level			
Low-SES	0.88	0.88	1.07
Middle	1.00 Ref.	1.00 Ref.	1.00 Ref.
High-SES	0.99	1.00	0.74 *
Education			
Illiterate	1.20 +	1.18 +	1.32 *
Elementary	1.00 Ref.	1.00 Ref.	1.00 Ref.
Secondary & higher	1.16	1.18	0.66 *
Health insurance			
Job insurance	1.00 Ref.	1.00 Ref.	1.00 Ref.
Voluntary insurance	1.60 *	1.59 *	1.20 *
Uninsured	1.25	1.25	1.01
Metro San Jose	1.47 *	1.49 *	0.80 *
Immigrant to Metro SJ	0.88	0.89	0.85

* significant at P <0.05. + significant at P < 0.10

Figure 1. Age specific death rates compared to US and Japan