Education Gradients in Older Adult Cardiovascular Health: A Comparison Between Mexico and Costa Rica

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Introduction and Research Questions

The education gradient in adult health in the United States and other high income countries is one of the most robust relationships in social science (Mirowsky and Ross 2003). This relationship has also been shown to be strengthening in recent years and among more recent birth cohorts (Goesling 2007; Liu and Hummer 2008; Lynch 2003; Martin et al. 2007; Masters et al. 2012; Mirowsky and Ross 2008), suggesting that education is perhaps more important for health and mortality outcomes than ever before in some contexts.

Despite advances in this area of research, large gaps remain. Most notably, population-related work on education and adult health outcomes has largely focused on high-income countries, with much less research focused on developing countries. This clearly has been the case in Latin America, where relatively little scholarship has focused on the education-health gradient among adults. However, given both rapid population aging and increased levels of education throughout Latin America, it is more and more important to understand if and how the population health of older adults is being structured by education. This paper examines gradients in older adult cardiovascular health in two Latin American countries, Mexico and Costa Rica. Both countries are characterized by rapid population aging, increasing levels of education, and relatively low adult mortality rates, but also have very different historical, social and health contexts. The aim of the study is to document the education gradients in cardiovascular risk health factors in each setting among older adults and to compare the extent to which the education gradients are similar or different.

Country Contexts

Mexican life expectancy at birth increased from an estimated 32.9 years in 1940, compared to 77.0 years in 2010, with the most accelerated gains occurring between 1942 and 1960 (Partida 2006; Population Reference Bureau 2013). According to population projections from the Mexican National Population Council (CONAPO), the percent of population aged 60 and older will grow rapidly, from 6% in the year 2000 to 15% in 2027. By way of comparison, it took the United States 70 years to make that transition. The current cohorts of Mexican adults aged 50 or older that we focus on in the present analysis were born roughly between 1900 and 1950. These cohorts are survivors of a revolutionary war from 1910 to 1921, and the (still ruling) Constitution that was approved in 1917, which secured basic rights to Mexican citizens. Among them was education; while the general literacy rate was only about 50% in 1943, it was over 90% by 2000 and close to 95% in 2010. Later, the Mexican Social Security Institute (IMSS) was created in 1943, offering old age and disability pensions to workers in the formal labor market, while the equivalent institution for federal workers (ISSSTE) was created in 1959. Around the same time, state-level and other decentralized organizations launched their social security systems, (Montes de Oca 2001). All of these institutions initially covered the urban population and offered health care services as well as old-age pensions to their beneficiaries. The uninsured population has traditionally been served by the Ministry of Health, which was also created in 1943, and provides

care to those in the informal labor market, the unemployed and those out of the labor force. All of these institutions of the health system contributed to the major gains in Mexican life expectancy experienced in the second half of the 20th century.

More recently, the Mexican government launched a series of reforms and experimental programs that may further impact the well being of the elderly in significant ways. For example, a modality of the anti-poverty program "Oportunidades" (formerly "Progresa"), which was originally targeted to children, now includes cash assistance to the elderly. The program aims to improve the living conditions of older adults in households of extreme-poverty. The first financial transfers from Oportunidades were made in early 2006. Almost 75% of the recipients lived in small rural communities with 2,500 people or less. Another modality of the Mexican government policies is the cash transfer to the elderly given (without means test) to every resident aged 70 or older of the Federal District starting in 2001-2002. The recipient must show proof of age and residence in the Federal District for the previous three years. A handful of other states have started similar programs on an experimental basis.

Another reform started to take place in the health sector. In 2003, a structural reform was launched, with the goal of offering publicly provided health insurance to the 50 million Mexicans not covered by social security. This new system of social protection of the poor operates through a "seguro popular" (popular health insurance); it was passed into law in 2003 and began operating in 2004 (Knaul & Frenk, 2005). From the beginning, the system has included a package of high-cost tertiary-level services as well, and has focused on cancers, cardiovascular problems, cerebro-vascular disease, severe injuries, and long term rehabilitation, which disproportionately affect older adults. The system works through a three-pillar system to which affiliated families, the state governments, and the federal government each contribute per affiliated household. By the end of 2006, it is estimated that 4 million families were affiliated (Knaul, Arreola, Méndez, & Torres, 2007).

Despite these recent attempts to improve the wellbeing of the Mexican elderly, aging is occurring in an environment in which the proportion of population protected by public health and social security systems has been traditionally limited (Cutler et al. 2000). According to the 2000 Mexican Population Census, about one-half of the population aged 65 or older reported no health-care-coverage, while only about one-fifth were receiving an old-age pension (INEGI, 2000). By 2010, the population covered by health insurance had increased by about 30%, with the major increase taking place among rural area residents (INEGI 2010). Most undergoing reforms in social security include a move towards privatization and are considered to produce further reductions in access to social protection, while including public components to protect the poorest (Cruz-Saco & Mesa-Lago, 1998; Klinsberg, 2000; James, Cox-Edwards & Wong, 2003). These are still in progress, and evaluations of their impact and sustainability are still premature. Thus the highly compressed aging process in Mexico is taking place in a fragile institutional context. As such, education may be taking on greater importance for both health and health care access among older Mexican adults as the resources, information, and networks to maintain good health and access high quality care are stratified within such a context of rapid social change and institutional fragility.

Costa Rica offers a different social, economic, and health care context. Historically, Costa Rica began massive investments in education far earlier than did Mexico and has long made health care access and population health a national priority. Costa Rica's health achievements in the post World War II context, particularly given the country's relatively low level of income, were highlighted in Caldwell's (1986) classic article on the roles of political will and social investments in shaping population health. One strong indicator of where governmental priorities have been focused is that the 1949 national constitution abolished the armed forces (Rosero-Bixby 1991). In contrast, investments in the social security system, health care coverage, and health services were pronounced, leading to near universal health coverage for Costa Rica's elderly population by the late 1970s (Rosero-Bixby and Dow 2009). Costa Rica's overall life expectancy rose quickly during the 20th century, also earlier than Mexico, and currently is estimated to be 79 years (Population Reference Bureau, 2013). This is the second highest level in the Americas (trailing Canada), although Mexico's recent gains have elevated its overall life expectancy to 77. Overall levels of social and economic inequality have historically been lower in Costa Rica in comparison to Mexico and most other countries in the Americas, although income inequality has been trending upward over the past 20 years and is now similar to the level in Mexico.

Previous work comparing education and cardiovascular health in Costa Rica and the United States found much weaker education gradients in Costa Rica (Rehkopf et al. 2010). Moreover, while some cardiovascular risk factors (smoking, high systolic blood pressure, sedentary lifestyle) were more common among low educated Costa Rican adults, other cardiovascular risk factors (obesity, high calorie diet, high fat diet) were more common among highly educated Costa Rican adults. Earlier, Rosero-Bixby and Dow (2009) showed that while metabolic syndrome and mortality were higher among highly educated Costa Ricans, hypertension and obesity were higher among less educated Costa Ricans. Overall then, such a mixed pattern of education differences among Costa Ricans is expected in our analysis to follow. How such patterns will compare to those of Mexicans is unknown.

Data Sets

For Mexico, we use the Mexican Health and Aging Study (MHAS). The MHAS is a prospective panel of individuals aged 50 and older in Mexico, with representation in national, urban (defined as areas with 100,000 people) and non-urban areas (the rest). The baseline survey interviewed 15,186 individuals in 2001, with a follow-up in 2003 (Wong, Espinoza, & Palloni 2007). Wave 3 of the study included another follow-up in 2012, when additional sample was also added to the study (n=6,259). Of relevance to the current paper is that in 2012, a sub-sample was selected to receive a health visit by specialized personnel ten-fifteen days after the main interview. During this visit, anthropometric measures, performance tests and blood samples were obtained. A total of 2,086 individuals participated in this health visit, which is the analytic data set we use in the present analysis. The anthropometric measures included height, weight, hip and waist circumference, and foot-to-knee distance. Capillary blood was obtained to measure hemoglobin (Hb) using hemocue and circulating Glucose using A1c. Intravenous blood was also obtained for measurement of C-reactive Protein (CRP), Total and HDL cholesterol, Thyroid-Stimulating Hormone (TSH), Vitamin D. In addition, blood pressure was measured (twice), a balance test, hand grip and timed walk were completed. The current paper uses the capillary blood results

because the intravenous blood has not yet been analyzed. Individuals with missing health data, those younger than 55 years of age, and those older than 79 years were excluded from the analysis due to small numbers, leaving an analytic sample of 1,171 respondents (641 women and 530 men).

For Costa Rica, we use the Costa Rican Longevity and Healthy Aging Study (CRELES, or "*Costa Rica Estudio de Longevidad y Envejecimiento Saludable*"). The CRELES is a set of nationally representative longitudinal surveys of health and life course experiences of the Costa Rican population aged 55 years or more. A first set of CRELES data targeted cohorts born before 1945; a second set targeted the 1945-1955 cohorts. We use here the second wave of interviews to the pre-1945 cohort, which took place mostly in 2007, and the first wave of interviews to the 1945-1955 cohort, which took place mostly in 2010. We include the 1,268 participants aged 65-79 years at the time of the interview from the first CRELES set and 2,526 participants aged 55-64 years from the 2010 set. Sampling weights allow estimating national averages with these data. The weights take into account the different sampling fractions in the two surveys, as well as oversampling of older individuals in the first survey and differential response rates by age, region and education. During CRELES interviews, field workers took two blood pressure measures, about 20 minutes apart, with digital monitors. We use in the analysis only the second measure, which tends to be a bit lower than the first measure. The CRELES field workers were trained and certified to conduct the anthropometric measurements as part of the interview and with updates about every year. The equipment was also periodically calibrated. The HbA1c assay was conducted in certified laboratories on blood drew by venipuncture in 5ml tubes with anticoagulant (VACUTAINER / EDTA). The blood samples were kept in iceboxes while on the road and centrifuged the same day to separate the plasma of the cells. Laboratory results were validated in a lot of 20 samples. About 5% of observations were lost because of refusals to the venipuncture procedure or mobility restrictions to take the anthropometric measurements, leaving us with 3,486 (2,042 women and 1,444 men) cases in our analytic sample.

Results

Descriptive Results

Table 1 displays the descriptive statistics for both the Mexican and Costa Rican data, stratified by gender. Cardiovascular health is similar in the two countries on some dimensions, and more favorable in Costa Rica on other dimensions. Some gender differences are also apparent. Whether or not individuals ever reported or were currently measured with hypertension is similar for women and men in both contexts, as are the gender-specific ever-smoking patterns. However, obesity, high abdominal girth, diabetes, and metabolic syndrome are all less favorable in Mexico compared to Costa Rica, for either women or men, or both. Obesity, for example, is higher in Mexican men (29%) than Costa Rican men (20%), while diabetes is higher for both Mexican women (44%) and men (33%) than for Costa Rican women (30%) and men (26%). Because the metabolic syndrome index is comprised of the girth, hypertension, and diabetes measures, it is not surprising then that both Mexican women (71%) and men (39%) exhibit somewhat higher levels on this indicator compared to Costa Rican women (66%) and men (33%).

The two countries also differ to some degree in their education, age, and urban/rural compositions. Costa Rican women and men exhibit much higher levels of education than their Mexican counterparts. Twice as many Mexican women (23%) and men (17%) report no formal

education compared to Costa Rican women (10%) and men (9%). And on the upper end of the distribution, roughly one-third of Costa Rican women and men report 7 or more years of schooling, compared to roughly one-fourth of Mexican women and men. The Costa Rican sample has a somewhat older age structure than the Mexican sample as well, which may be working to suppress even larger health and education differences between the two countries.

Preliminary Regression Results

Table 2 shows education gradients in cardiovascular health separately for Costa Rican women and men (top panel) and Mexican women and men (bottom panel). These estimates control for both age and urban/rural residence. Education gradients in cardiovascular health are mixed for Costa Ricans. Costa Rican men with low education are *less likely* to be obese or have high abdominal girth compared to those with 7+ years of education. However, low educated Costa Rican men are much more likely to be ever smokers compared to more highly educated Costa Rican men. Costa Rican women with low levels of education mostly exhibit higher cardiovascular risks than women with 7+ years of education: low educated Costa Rican women are more likely to be hypertensive and more likely to be categorized with high metabolic syndrome compared to their more highly educated counterparts. At the same time, Costa Rican women with 1-5 years and 6 years of education are less likely to be ever smokers than their more highly educated counterparts.

There are very few education differences in cardiovascular health among Mexicans. There is some indication that low educated Mexican men have higher odds of hypertension and diabetes than higher educated Mexican men, but these are not particularly strong patterns. Ever smoking is also lower among low educated Mexican women in comparison to more highly educated Mexican women. Overall, the Mexican data reveal no consistently strong signs of an education gradient in cardiovascular risk for either women or men.

Table 3 combines the Mexican and Costa Rican samples to formally test whether education differences in cardiovascular health differ between the two settings. Two differences are of note. First, the education gradient in ever smoking for women differs across settings. Low educated Mexican women are especially unlikely to be ever smokers, while the education gradient in smoking for Costa Rican women is less pronounced. Second, there is some indication that lower educated Costa Rican men are less likely to be obese or have diabetes compared to low educated Mexican men. Overall, though, the education gradients in cardiovascular health are modest in both settings and, when data from the two countries are combined, the education differences are most often not distinct from one another.

Forthcoming

This very preliminary paper will be substantially updated for PAA, with increased attention given to the educational and health contexts of each country and to data and measurement issues. Overall, we do not expect our main findings to change; that is, educational gradients in cardiovascular health are weak in both settings, with only modest variations between them. Such weak gradients are nonetheless of research and policy interest given the very strong gradients shown in the US and Europe in recent studies. How education-health patterns may be changing in all contexts, and particularly so as larger and much more highly educated cohorts of Mexicans and Costa Ricans age into older adulthood, is an important topic for future research in this area.

Table 1. Weighted Sample Proportions, Men and Women, Aged 55-79, Costa Rica and Mexico

	Costa Rica		Mexico	
	Women	Men	Women	Men
Cardiovascular Health				
Obese (BMI >30)	0.35	0.20	0.38	0.29
High abdominal girth (>102 cm)	0.77	0.27	0.76	0.42
Ever hypertensive, all (2nd BP measure >140 or 90mmHg or self-report	0.72	0.64	0.71	0.58
Diabetes, all (>6.5 HbA 1c or self-report)	0.30	0.26	0.44	0.33
Metabolic syndrome (At least two of following conditions: high girth, hypertension, & diabetes)	0.66	0.33	0.71	0.39
Ever smoked	0.21	0.66	0.22	0.62
Education				
No formal education	0.10	0.09	0.23	0.17
Education 1-5 Years	0.34	0.30	0.35	0.36
Education 6 Years	0.23	0.25	0.19	0.21
Education 7+ Years	0.34	0.37	0.23	0.26
Age				
55-59	0.33	0.33	0.51	0.45
60-64	0.27	0.28	0.25	0.23
65-69	0.18	0.18	0.13	0.16
70-74	0.12	0.12	0.08	0.10
75-79	0.09	0.10	0.03	0.05
Urban	0.60	0.52	0.56	0.51
N	2042	1444	641	530

Source: Costa Rican Longevity and Healthy Aging Study; Mexican Health and Aging Study

Table 2A. Marginal Effects from Logistic Regression Models Predicting Cardiovascular Health among Adults Aged 55 - 79, Costa Rica

	Obesity		High girth		Ever hypertensive		Diabetes		Metabolic Syndrome		Ever smoke	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Years of Education (ref = 7+ years)												
No formal education	-0.038	-0.103~	0.023	-0.103~	0.048	0.127*	0.060	-0.026	0.029	-0.031	-0.005	0.179**
	(0.046)	(0.053)	(0.039)	(0.053)	(0.043)	(0.055)	(0.043)	(0.055)	(0.045)	(0.059)	(0.036)	(0.057)
1 - 5 years	0.026	-0.077*	0.051	-0.077*	0.085**	0.064	0.043	-0.013	0.086*	-0.052	-0.069*	0.066~
	(0.033)	(0.033)	(0.031)	(0.033)	(0.031)	(0.039)	(0.032)	(0.040)	(0.034)	(0.042)	(0.029)	(0.038)
6 years	0.021	-0.017	0.059~	-0.017	0.034	0.052	0.017	-0.038	0.058~	-0.054	-0.087**	0.021
	(0.033)	(0.030)	(0.032)	(0.030)	(0.031)	(0.040)	(0.033)	(0.040)	(0.035)	(0.042)	(0.031)	(0.039)
N	2177	1542	2142	1524	2208	1572	2096	1483	2114	1467	2211	1579

Source: Costa Rican Longevity and Healthy Aging Study

Notes: Standard errors in parentheses. Data are weighted. Models control for age and urbanicity. *** p<0.001, ** p<0.01, * p<0.05, ~ p<0.1

Table 2A. Marginal Effects from Logistic Regression Models Predicting Cardiovascular Health among Adults Aged 55 - 79, Mexico

	Obesity		High girth		Ever hypertensive		Diabetes		Metabolic Syndrome		Ever smoke	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Years of Education (ref = 7+ years)												
No formal education	0.037	-0.110	-0.022	-0.160	-0.026	0.189~	0.028	0.061	-0.119	-0.115	-0.064	0.148
	(0.091)	(0.125)	(0.072)	(0.108)	(0.086)	(0.105)	(0.090)	(0.103)	(0.080)	(0.107)	(0.065)	(0.110)
1 - 5 years	0.088	0.053	0.061	-0.009	0.017	0.131	0.127	0.177*	0.003	0.038	-0.105~	0.029
	(0.079)	(0.097)	(0.074)	(0.096)	(0.081)	(0.089)	(0.078)	(0.084)	(0.078)	(0.090)	(0.061)	(0.091)
6 years	0.057	0.148~	0.047	0.035	0.045	0.070	0.058	0.109	0.068	0.038	-0.101	-0.077
	(0.083)	(0.088)	(0.080)	(0.097)	(0.078)	(0.090)	(0.085)	(0.086)	(0.078)	(0.088)	(0.065)	(0.088)
N	652	543	652	547	664	552	654	538	639	530	666	554

Source: Mexican Health and Aging Study

Notes: Standard errors in parentheses. Data are weighted. Models control for age and urbanicity. *** p<0.001, ** p<0.01, * p<0.05, ~ p<0.1

Table 3. Marginal Effects from Logistic Regression Models Predicting Cardiovascular Health, Costa Rica and Mexico

	Obesity		High girth		Ever hypertensive		Diabetes		Metabolic syndrome		Ever smoke	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Years of Education												
No formal education	-0.103~	-0.038	-0.089~	-0.061	0.036	0.065	-0.027	0.010	-0.050	-0.087	-0.070	0.126*
	(0.053)	(0.049)	(0.048)	(0.054)	(0.048)	(0.064)	(0.051)	(0.056)	(0.053)	(0.062)	(0.043)	(0.063)
1 - 5 years	0.050	0.041	0.001	-0.012	0.029	0.074	0.074	0.066	0.035	0.022	-0.135**	0.028
	(0.045)	(0.037)	(0.046)	(0.045)	(0.043)	(0.054)	(0.046)	(0.046)	(0.050)	(0.050)	(0.041)	(0.051)
6 years	0.077	0.046	0.010	-0.015	0.006	0.020	0.036	0.101*	0.057	0.030	-0.120**	-0.009
	(0.049)	(0.038)	(0.051)	(0.046)	(0.047)	(0.055)	(0.051)	(0.047)	(0.056)	(0.053)	(0.045)	(0.053)
Costa Rica	-0.038	0.001	-0.041	-0.114**	0.003	0.001	-0.140***	-0.047	-0.069~	-0.068	-0.059~	0.020
	(0.038)	(0.031)	(0.039)	(0.037)	(0.036)	(0.043)	(0.040)	(0.040)	(0.041)	(0.042)	(0.032)	(0.042)
Country*Education Interactions												
No education*Costa Rica	0.071	-0.098	0.104~	-0.039	0.012	0.012	0.050	-0.045	0.087	0.034	0.121*	0.001
	(0.062)	(0.060)	(0.055)	(0.066)	(0.056)	(0.073)	(0.060)	(0.066)	(0.062)	(0.072)	(0.050)	(0.072)
1 - 5 years*Costa Rica	-0.043	-0.139**	0.031	-0.054	0.043	-0.039	-0.037	-0.070	0.030	-0.085	0.109*	0.045
	(0.050)	(0.043)	(0.051)	(0.052)	(0.048)	(0.060)	(0.052)	(0.053)	(0.055)	(0.057)	(0.046)	(0.057)
6 years*Costa Rica	-0.056	-0.055	0.029	-0.006	0.009	0.007	-0.029	-0.129*	-0.018	-0.076	0.073	0.036
	(0.055)	(0.045)	(0.057)	(0.055)	(0.053)	(0.063)	(0.058)	(0.056)	(0.062)	(0.061)	(0.051)	(0.061)
N	3329	2475	3220	2418	3392	2534	3250	2413	3193	2350	3403	2543

Source: Costa Rican Longevity and Healthy Aging Study; Mexican Health and Aging Study

Notes: Standard errors in parentheses. Models control for age and urbanicity. *** p<0.001, ** p<0.01, * p<0.05, ~ p<0.1