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Educational and Sex Differentials in Life Expectancies and Disability-Free Life Expectancies in São Paulo, Brazil, and Urban Areas in Mexico

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Abstract

Objectives: To estimate transition probabilities between disability states, total life expectancy, and the latter's decomposition into years spent disabled and disability-free by age, sex, and education among older adults in São Paulo, Brazil, and urban areas in Mexico. **Methods:** Applied a micro-simulation method (Interpolative Markov Chains) using longitudinal data. **Results:** We found large between-country educational differences in incidence of and recovery from disability with higher rates in Mexico than in São Paulo, but no differences in mortality. Older adults in Mexico spent longer time being disability-free than in São Paulo for both levels of education. Males and females in São Paulo spent a larger fraction of their remaining life disabled at every age than their counterparts in urban areas in Mexico. **Discussion:** There were educational differences in the prevalence of disability in São Paulo and urban areas in Mexico, and significant educational differences in disability incidence and recovery across sites.

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Introduction

Latin America is experiencing one of the fastest increases in the older adult population in the world. Aging in this region is occurring at a faster rate than that experienced in developed countries, with important consequences for these societies, given the lack of institutional resources and the unstable economies in the region (Palloni, Pinto-Aguirre, & Pelaez, 2002). Brazil and Mexico not only have the largest population of older adults in Latin America, but these countries are also experiencing very fast aging. Between 2000 and 2025, the proportion of the population aged 60 or older is expected to almost double for both Brazil (from 14.2 million, or 8.1%, to 35.6 million, or 16.6%) and Mexico (from 7.4 million people, or 7.5%, to 18.5 million, or 14.5%, United Nations Economic Commission for Latin America and the Caribbean (CELADE) Population Division, 2011).

In addition, both countries have experienced large gains in life expectancy among older adults in recent decades. Between 1980 to 1985 and 2000 to 2005, the probability of a 60-year-old man surviving to age 80 increased by 42% in Brazil and by 23% in Mexico (United Nations Economic Commission for Latin America and the Caribbean (CELADE) Population Division, 2007). The corresponding figures for women were 35% and 15%, respectively. Additional gains are expected, and life expectancy at birth is estimated to reach 74.0 years in Brazil and 77.2 years in Mexico for the 2010 to 2015 period (United Nations Economic Commission for Latin America and the Caribbean (CELADE) Population Division, 2007). Such increase in life expectancy has been the result of recent changes in demographic and epidemiologic profiles in Brazil and Mexico; we thus expect the disability process to vary by age, sex, and education, as these are important indicators of differential lifetime exposure to disease and morbidity in a changing demographic regime (Wong, Gerst, Michaels-Obregon, & Palloni, 2011). In this article, we compare educational differences in Nagi functional mobility status—herein called disability—between older individuals in São Paulo, Brazil, and those in urban areas with at least 100,000 people in Mexico.

Brazil and Mexico have not only made improvements in mortality and life expectancy, but they have also made progress in other social indicators. In particular, mean years of education have increased in both countries since 1980 (United Nations, 2011). For example, between 1980 and 2011, mean years of schooling increased from 2.6 to 7.2 in Brazil, and from 4.0 to 8.5 in Mexico (United Nations, 2011). Gross national income (GNI) per capita has also increased in both nations in the last 3 decades (by 39% in Brazil and by 31% in Mexico), with Mexico having a higher GNI in 2011, at US$13,245 dollars (vs. US$10,162 for Brazil). Additionally, the Human Development Index (HDI), a composite measure that includes health, schooling, and income, shows Brazil in third place among Latin American countries, ranking 84th out of 187 countries worldwide, while Mexico comes in as the leader in the region, ranking 57th in the world (United Nations, 2011). However, both countries are marked by high income inequalities, which are largely due to differences in socioeconomic status (Gasparini, Cruces, Tornarolli, & Marchionni, 2009). The Gini coefficient—a measure of income inequality ranging between 0 (complete equality) and 1 (complete inequality)—was 0.55 in Brazil in 2007 and 0.48 in Mexico in 2008 (World Bank database, 2012).

Earnings/income or occupation are often used as indicators of socioeconomic status (SES) in studies of health and health behaviors. For many people, particularly those in the lower income bracket and those working in the informal sector, income varies substantially from month to month and from year to year. It is, therefore, likely to be an unreliable indicator of long-term resource availability. Education, on the other hand, remains relatively fixed in early adulthood, allowing one to reduce the possibility of reverse causality. For instance, we can assume that education influences health at older ages, instead of in the other direction. We cannot make the same argument for income/wealth and occupation. For example, income/wealth at older ages reflects resource accumulation over the life cycle that highly depends on individual health experiences. A health problem may result in one using savings to cope with the disease, so it is not clear in what direction the link between income/wealth and health flows. Similarly, occupation appears to be a poor indictor of SES at older ages, as people after age 65 tend to be out of the labor force; and many women have never worked in countries like Brazil and Mexico. We thus assume that, relative to earnings/income or occupation, education is a better indicator of financial security and resource availability.

A large body of literature, based on data from developed countries, shows that individuals with lower SES have lower life expectancy and lower healthy life expectancy (for a review see Elo, 2009; Hummer & Lariscy, 2011). In particular, higher educational attainment has been associated with mortality compression in the United States (Brown et al., 2012). Low SES is often associated with detrimental environmental exposures, higher biological risks, poor health care access, and higher levels of psychosocial risks, all of which may lead to higher mortality and lower life expectancy (Elo, 2009).

To date, few studies have estimated the association between socioeconomic conditions, total life expectancy (TLE), and disability-free life expectancy (DFLE) in Latin America and the Caribbean. Because data, particularly longitudinal data pertaining to functional mobility and disability in Latin America and the Caribbean, have become available only relatively recently (Camargos, Machado, & Rodrigues, 2008), most of the existing studies have, by necessity, used available cross-sectional data and Sullivan methods (Sullivan, 1971) to estimate differentials in healthy life expectancy by socioeconomic conditions. Although important, these studies limit our understanding of the underlying mechanism associated with disability, particularly the likelihood of people becoming disabled and recovering from disability as they age. We hypothesize that differences in disability incidence, recovery, and death between people in São Paulo and urban areas in Mexico relate to age, sex, and education.

Previous research comparing Brazil and Mexico has been limited to the first wave of the Survey on Health, Well-Being, and Aging in Latin America and the Caribbean (SABE) in São Paulo and Mexico City in the year 2000 (Minicuci et al., 2011). Results indicated that educational levels were higher in Mexico City than in São Paulo (Minicuci et al., 2011). Using the Sullivan method and focusing on prevalence of functional limitations in activities of daily living (ADL), Minicuci and colleagues (2011) showed that TLE and DFLE were higher in Mexico City than in São Paulo. However, there were important differences by sex. For men, TLE and DFLE were higher in Mexico City than in São Paulo (Minicuci et al., 2011), while among women, TLE and DFLE were similar across these two sites. However, the authors did not explore the associations between SES and life expectancy. Another study, also using the baseline SABE data, showed that disability prevalence was highly associated with self-reported chronic conditions, poor overall health, and depressive symptoms (Menendez, Guevara, Diaz, Marin, & Alfonso, 2005).

At the country level, there is a large body of literature examining the link between disability and education in Brazil and Mexico, but few explore the link between education, disability, and life expectancy. Previous research in Brazil, based on cross-sectional data, showed important differences in disability prevalence and DFLE by education (Camargos, Machado, & Do Nascimento Rodrigues, 2007; Fiedler & Peres, 2008; Fillenbaum, Blay, Andreoli, & Gastal, 2010; Melzer & Parahyba, 2004; Parahyba, Stevens, Henley, Lang, & Melzer, 2009).Three studies, based on nationally representative data from the 1998, 2003, and 2008 National Household Survey, indicated that higher education among older adults was associated with less disability (Lima-Costa, De Oliveira, Macinko, & Marmot, 2012; Melzer & Parahyba, 2004; Parahyba et al., 2009). Based on the 2008 data, Lima-Costa and colleagues (2012) found that 6.1% of older adults (50+) with 12 or more years of schooling had at least one ADL limitation; which is half of the prevalence found among those with 0 to 8 years of schooling (12%). Other studies, based on regional data, confirmed that higher SES, in particular educational attainment, was associated with lower levels of disability (Fiedler & Peres, 2008; Fillenbaum et al., 2010; Santos, Koszuoski, Dias-da-Costa, & Pattussi, 2007). Chaves, Camozzato, Godinho, Piazenski, and Kaye (2009), using a small sample of urban residents of the southern region of Brazil, showed that higher income, but not education, was associated with successful aging among healthy elders of that area. Higher income has also been associated with higher rates of survival in Rio de Janeiro, where healthy life expectancy was found to be twice as high in the richest areas as compared to the slums (Szwarcwald, Corrêa da Mota, Damacena, & Sardinha Pereira, 2011). The only study that attempted to compare educational differences in disability and life expectancy in Brazil was based on the baseline data of the SABE in São Paulo (Camargos et al., 2007). This study showed that older adults with 5 or more years of schooling spent a lower proportion of their lives with disability than those with lower levels of educational attainment.

For Mexico, there are very few studies focusing on healthy life expectancy, and even fewer studies that have evaluated the impact of education on disability and life expectancy. The available evidence shows women to have both higher life expectancy and more time spent in disability relative to males (Reyes-Beaman et al., 2005; Rodríguez-Abrego, Escobedo De La Peña, Zurita, & De Jesús Ramírez, 2006). Other studies indicated that obesity and chronic diseases, such as diabetes, are associated with poor health status (Andrade, 2009, 2010; Palloni, Soldo, Wong, & McEniry, 2003; Wong, Espinoza, & Palloni, 2007). And still other studies showed that lower levels of education are linked to the higher prevalence and incidence of ADL disability (Gerst, Michaels-Obregon, & Wong, 2011; Smith & Goldman, 2007; Wong et al., 2011). Lower education has also been strongly associated with the prevalence of chronic conditions, such as diabetes, stroke, and heart disease, in Mexico (Albala et al., 2005; Menendez et al., 2005). In addition, Mexicans with little to no formal education experienced a higher probability of becoming ADL disabled between 2001 and 2003 than their Mexican counterparts who had at least some schooling (Wong et al., 2011).

Building on this literature, our paper assesses the relationship between age, sex, education, life expectancy, and disability-free life expectancy in the largest urban area in Brazil—São Paulo—as well as in urban areas in Mexico. We use a longitudinal sample of individuals aged 60 or older residing in São Paulo, Brazil, from the Survey on Health, Well-Being, and Aging in Latin America and the Caribbean (SABE) and a nationally representative sample of Mexicans aged 60 or older living in urban areas from the Mexican Health and Aging Study (MHAS). At this time, there is no nationally representative longitudinal study of the older adult population in Brazil; we thus focus on the largest city in the country, São Paulo. In addition, because the MHAS is not representative at the city level, we selected individuals residing in urban areas (places with at least 100,000 people) to make the sample more comparable to that of urban dwellers in São Paulo. We estimate incidence, recovery, and mortality rates for disabled and disabled-free individuals, and also estimate total life expectancy and decompose it into years spent disabled and free of disability. Given the differences between men and women in terms of life expectancy and disability, we disaggregate the comparisons between SABE and MHAS by age, sex, and education.

Method

Data

We used data from MHAS and SABE. These studies were approved by the Institutional Review Boards at the collaborating institutions (Palloni et al., 2002; Peláez, 2005; Wong, Peláez, Palloni, & Markides, 2006). Participants provided consent to have their data used for research purposes. In both surveys, participants provided information on functional mobility through Nagi measures, which were the same at baseline and at follow-up in both MHAS and SABE.

SABE is a multi-center survey with respondents in seven capital/major cities in selected Latin America and the Caribbean countries; its goal is to investigate the health and well-being of older adults (age 60 years and over) in these countries. In our study, we analyzed data from the 2000 and 2006 waves of SABE São Paulo, Brazil.

The baseline sample in São Paulo was obtained using two-stage stratified sampling based on the 1995 National Household Survey master sampling frame. Individuals aged 75 years and above were oversampled. At baseline, the response rates reached 84.6% in São Paulo. Additional characteristics of the baseline data collection process have been described elsewhere (Albala et al., 2005; Duarte, Lebrão, & Lima, 2005; Wong et al., 2006). In 2006, the São Paulo researchers conducted the first follow-up interviews to the 2000 baseline survey. To identify subjects who had died between 2000 and 2006, researchers used mortality data from the *Fundação Sistema Estadual de Análise de Dados* (SEADE foundation), which has relevant social, demographic, and economic data in the São Paulo state, and from the *Programa de Aprimoramento das Informações de Mortalidade*, which has collected and organized mortality data for the city of São Paulo. The search for mortality records of deceased respondents was based on the names, sex, dates of birth, and addresses listed in the 2000 database. Further details of the data collection are shown elsewhere (Lebrão & de Oliveira Duarte, 2008).

Of the 2,143 participants in the first wave of SABE São Paulo, 23 had missing data on education. Based on two-tailed *t*-test and differences in proportions, there were no age or sex differences for those with missing or complete data on education. One other participant had missing data on the baseline Nagi measure and was thus excluded from the analyses. The final analytical sample includes 2,119 participants, of which 1,720 had valid information on the follow-up survey. Among these, 1,103 were reinterviewed in 2006, and 617 had died between the baseline and the first follow-up. The remaining 399 had missing data in the 2006 follow-up interviews. Based on two-tailed *t*-test and differences in proportions, there were no age or sex differences between those with missing and complete data on disability status in the follow-up.

MHAS is a prospective two-wave panel study of a nationally representative cohort of Mexicans born prior to 1951 (age 50 and older). The survey has national and urban/rural representation. The baseline interview was conducted in the summer of 2001, with a response rate of 91.8%; the second wave of interviews was conducted during the summer of 2003, with a successful reinterview rate of 93%, resulting in an average 2-year interval between the waves (Wong et al., 2006). Mortality data (deaths and dates of death) were collected using next-to-kin questionnaires, and data were collected in collaboration with the National Institute of Statistics. The study was designed with a field protocol and content similar to the Health and Retirement Survey conducted in the United States. Detailed information on the MHAS is presented elsewhere (Wong et al., 2006).

MHAS recorded detailed information on individual health, migration history, SES, family transfers, kin availability and attributes, and household composition of Mexicans. In the first wave, a total of 15,186 complete interviews were obtained. For this analysis, we used the health section of the data, excluding proxy interviews, to determine disability status (n = 14,116); we restricted the data to people 60 years or older at baseline living in urban areas (n = 4,211). We excluded three people with missing values in education (n = 4,208); based on two-tailed *t*-test there were no significant differences in age between people with missing education and complete cases. We also did not find sex differences based on test of proportions between those with missing education and complete cases. In addition, we excluded one individual with missing information on the Nagi questions in both waves, leading to a final analytical sample of 4,207 people in both waves. Among these individuals, the follow-up interview in 2003 identified 215 deaths. There were 507 people with missing Nagi status at follow-up, who were, however, included in the analysis. These people were, on average, 1 year older than those with valid Nagi status at follow-up ($p < 0.006$, based on a *t*-test), but their prevalence of disability at baseline was not significantly different from those with complete data in both waves ($p = 0.30$, based on a test of proportions).

Measures

We use completed years of education as a measure of SES, and Nagi functional limitations as an indicator of disability. Completed years of education were aggregated into two categories: no schooling and 1 or more years of schooling, which we term "with schooling." Disability status is measured by Nagi functional limitations, which represent overall abilities of physical mobility (Verbrugge & Jette, 1994). Five activities were considered in the Nagi physical performance measures: lifting or carrying objects weighing 5 kg or more; lifting a coin; pulling or pushing a large object, such as a living room chair; stooping, kneeling, or crouching; and reaching or extending the arms above shoulder level. Individuals were classified as having Nagi disability if they reported having difficulty performing at least one Nagi activity, and they were classified as being free of Nagi disability if they had no Nagi difficulties. For simplicity in the description of the results, we use the term "disabled" to refer to those classified as Nagi disabled and the term "disability-free" to refer to those without any Nagi disabilities.

Method

First, we compared baseline characteristics between SABE and MHAS using a series of statistical tests. We used logistic regression for dichotomous outcomes (e.g., with schooling vs. no schooling and disabled vs. disability-free), including sampling weights and an indicator of survey to test for significant differences between sites; we also used linear regression for continuous variables (e.g., age). We employed as well a microsimulation method to estimate DFLE and disabled life expectancy (DLE), as well as transition probabilities between disability states. Micro-simulation methods explicitly model the random nature of a process, and permit two important sources of stochasticity to be readily calculated: the variability in state life expectancies as well as the sampling error attributable to the model's parameters (Laditka & Wolf, 1998). These methods complement and extend multivariate multistate life table methods by allowing for a fuller and more flexibly defined combination of outcome-state and covariate history; they also make it easier to incorporate covariates than in the macrosimulation methods (Lièvre, Brouard, & Christopher, 2003).

We used the 0.98g version of the Interpolative Markov Chain (IMaCh) software developed by Brouard and Lièvre (2006) to compute these transition probabilities, based on cross-longitudinal data from MHAS and SABE. IMaCh provides estimates of three transitions: incidence (disability-free to

Table 1. Descriptive Statistics for Those With Complete Data on Selected Variables at Baseline: Mexico-MHAS (2001) and São Paulo, Brazil-SABE (2000, Weighted).

	Total population		Males		Females	
	SABE	MHAS	SABE	MHAS	SABE	MHAS
Variables	*N* = 2,119	*N* = 4,207	*N* = 867	*N* = 1,856	*N* = 1,252	*N* = 2,351
Age, mean (*SD*)	69.4 (7.4)	69.1 (7.3)	68.9 (7.1)	69.1 (7.0)	69.7 (7.6)	69.1 (7.5)
Age groups, (%)						
60-64	32.3	32.6	34.3	29.5	30.9	35.2
65-69	26.8	25.9	27.8	28.0	26.1	24.2
70-74	18.8	19.7	18.6	21.0	18.9	18.7
75-79	11.2	12.0	10.5	12.9	11.7	11.2
80-84	6.2	4.9	4.8	5.0	7.2	4.8***
85+	4.6	4.9	3.9	3.6	5.2	6.0
Nagi disabled, (%)	59.4	55.9	46.9	43.9	68.1	65.6
No schooling, (%)	26.1	22.9***	21.4	20.7***	29.3	24.7***

Note: *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.
Significant results correspond to country comparisons from weighted ANOVA for mean age, and weighted logistic regressions for proportions in each age group, Nagi disability, and education.

disabled); recovery (disabled to disability-free); and mortality (disability-free to dead or disabled to dead, Laditka & Hayward, 2003). There are also two retention statuses, as people declare being healthy (disability-free) or disabled in both waves. The ability to incorporate improvements and declines in the health state brings incidence modes much closer to reality. Sample weights are used in the analysis. IMaCh also generates estimates of total and state-specific life expectancies and their standard errors, based on the methodology introduced by Laditka and Wolf (1998). The embedded Markov chain introduced by Laditka and Wolf (1998), which has been incorporated in the IMaCh software, applies the multistate life table model to shorter transition periods, which are embedded within the longer interval between surveys. This implies that IMaCh simulates and estimates transition probabilities and life expectancies for shorter periods of time, thereby allowing meaningful comparisons between survey designs of different follow-up times. In the current analysis, 2-year transitions were computed to make the results comparable between MHAS and SABE-Brazil.

Results

Weighted descriptive estimates for São Paulo (Brazil) and the urban areas in Mexico are shown in Table 1. Comparisons across sites show similar mean age in both samples and comparable age distributions, except at older ages, where there is significantly higher proportion of females aged 80 to 84 in São Paulo than in Mexico. There are no statistical differences in the prevalence of disability across sites, but São Paulo has a significantly higher proportion of people with no schooling than urban areas in Mexico.

Observed disability transitions between baseline and follow-up interviews are shown in Table 2. Given the difference in the interval between the first and second waves in SABE (6 years) and MHAS (2 years), there was a higher proportion of individuals dying between waves in São Paulo than in Mexico, and a higher incidence of and lower recovery from disability in São Paulo. Losses at follow-up are also higher in São Paulo than in Mexico, and most individuals in São Paulo faced disability transitions over the 6 years between waves. However, in Mexico, most disability transitions between baseline and follow-up occurred among individuals with disability, whereas the large majority of those without disability remained in the same status by 2003.

In both study sites, a higher percentage of men and women with no schooling developed disability and died between waves than among those with schooling. Among men and women with disability at baseline, recovery rates were lower among those with no schooling than among those with schooling, particularly in São Paulo.

Disability Transitions in Mexico and São Paulo

Two-year transition probabilities from disability-free to disabled, disabled to disability-free, and disabled to death provide important insights into the dynamics determining the length of time spent in each state (Figure 1). Results show significant differences in transition probabilities between urban areas in Mexico and São Paulo for males and females. For example, males in urban areas in Mexico showed significantly higher incidence of disability than their counterparts in São Paulo for both levels of education (except at ages older than 85), but they also experienced significantly higher probability of recovery from disability at all ages. Among women, Mexicans faced significantly higher recovery from disability across all ages than women in São Paulo for both levels of education, but we found no differences in incidence of disability between women in Mexico and those in São Paulo. Within-country comparisons showed that in São Paulo there are no educational differences in the likelihood of becoming and recovering from disability among males and females. In Mexico, males and females with no schooling tended to have higher disability incidence and lower recovery from disability, albeit not significantly so.

Table 2. Disability Transitions for Older Adults by Sex and Education for Urban Mexico and São Paulo, Brazil: Mexico-MHAS (2001-2003) and São Paulo-SABE (2000-2006, Percentage).

	Total population			Males			Females		
Sample State in Wave 1 and Wave 2	All	No schooling	With schooling	All	No schooling	With schooling	All	No schooling	With schooling
				SABE (*N* = 2,119)					
Nagi disabled at baseline	65.2	74.2	61.2	53.4	61.3	50.5	73.3	81.5	69.3
Remained disabled by Wave 2	43.0	45.2	38.9	48.6	28.5	33.5	32.0	43.4	51.6
Became active by Wave 2	5.4	6.6	3.3	4.7	4.2	8.2	6.9	2.9	5.7
Died by Wave 2	34.1	28.7	44.1	27.6	59.7	41.4	47.1	37.5	21.8
Lost to follow-up	17.5	19.5	13.7	19.2	7.6	16.9	14.0	16.2	20.9
No Nagi disability at baseline	34.8	25.8	38.8	46.6	38.7	49.5	26.7	18.5	34.8
Remained w/o disability by wave 2	27.8	29.3	22.6	24.6	22.0	32.9	16.6	23.4	24.9
Became disabled by wave 2	31.0	30.2	33.9	36.8	31.9	24.6	30.4	36.4	37.0
Died by wave 2	19.8	17.7	26.8	11.4	33.0	24.9	26.2	19.5	8.9
Lost to follow-up	21.4	22.8	16.7	27.2	13.2	17.6	26.7	20.8	29.2
				MHAS (*N* = 4,207)					
Nagi disabled at baseline	55.9	67.2	52.4	43.9	61.2	39.3	65.7	71.9	63.6
Remained disabled by wave 2	51.7	54.2	50.7	43.7	56.0	41.6	56.0	56.0	56.0
Became active by wave 2	29.2	26.9	30.2	34.7	26.4	36.8	26.3	26.4	26.3
Died by wave 2	7.5	8.6	7.0	9.3	7.4	8.6	6.5	7.4	6.1
Lost to follow-up	11.6	10.3	12.1	12.3	10.2	13.0	11.2	10.2	11.7
No Nagi disability at baseline	44.1	32.8	47.6	56.1	38.8	60.7	34.3	28.1	36.4
Remained w/o disability by wave 2	58.3	52.8	59.7	61.1	49.7	62.3	54.8	49.7	56.3
Became disabled by wave 2	26.9	32.2	25.5	22.5	35.8	21.0	32.5	35.8	31.5
Died by wave 2	2.2	3.3	1.9	2.7	4.7	2.8	1.6	4.7	0.6
Lost to follow-up	12.6	11.7	12.9	13.8	9.8	13.9	11.2	9.8	11.6

Note: Disability is defined as having difficulty with at least one Nagi activity.
Source: MHAS 2001-2003 and SABE 2000-2006.

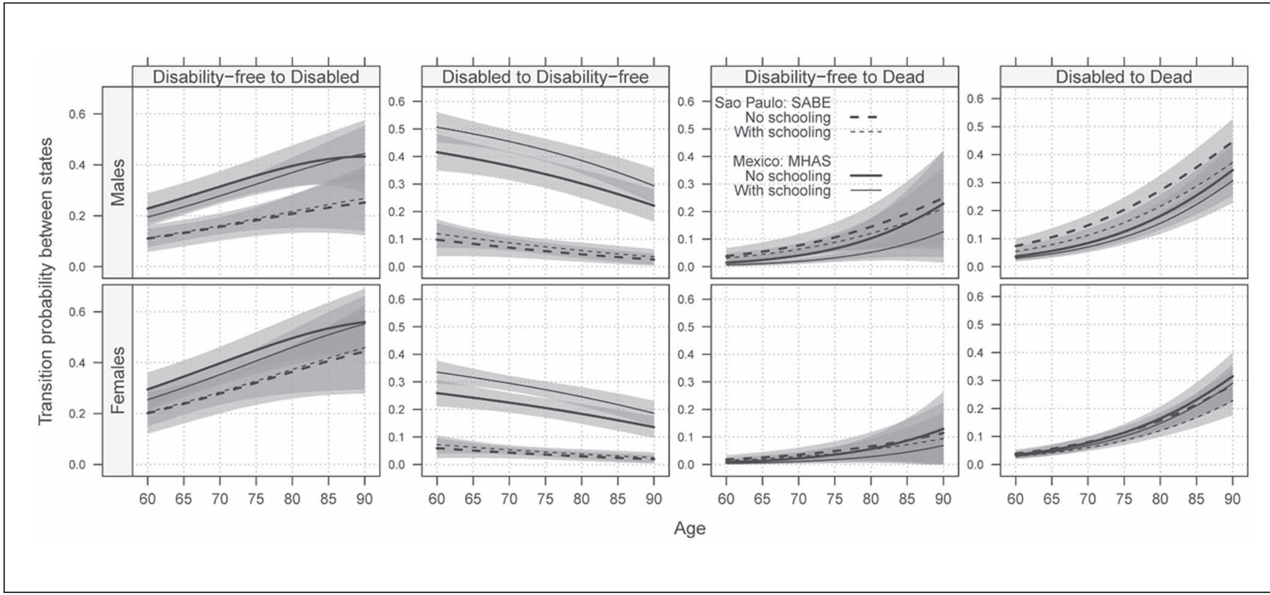

Figure 1. Estimated 2-year transition probabilities with 95% confidence intervals (shaded areas) between Nagi disability status and into death by age, gender, and education for São Paulo, Brazil, and Urban Mexico.
Source: Authors' calculations using IMaCh.

On the other hand, there were no significant differences in the risk of death between urban areas in Mexico and São Paulo for males and females by level of education. However, within-country comparisons showed that both males and females with no schooling had slightly higher mortality risks.

Population-Based Estimates of Total, Disability-Free, and Disabled Life Expectancy by Sex for Mexico and São Paulo

Population-based estimates from IMaCh for TLE, its decomposition into DFLE and DLE, and the proportion of remaining life disabled are shown in Figure 2 and Table 3. Estimates indicate that Mexicans in urban areas have higher TLE and spend more of those years disability-free than residents in São Paulo. Differences across sites in TLE are larger among men than among women. For example, among men with no schooling, TLE at age 60 was 20.7 years in Mexico versus 15.2 years in São Paulo, and among men with schooling, TLE at 60 reached 24.4 years in Mexico and only 17.4 years in São Paulo. In contrast, among women with no schooling, those aged 60 in Mexico were expected to live an additional 21.3 years, on average, whereas in São Paulo TLE was 19.5 years. Among females with schooling, the difference was somewhat smaller: 23.9 years in Mexico versus 22.2 years in São Paulo. DFLE was also higher in Mexico for both sexes and both educational levels than in São Paulo, which also led to men and women in São Paulo to spend a higher proportion of their remaining life disabled at each age than their counterparts in urban areas in Mexico. Among women, cross-site differences were larger for the proportion of remaining life with disability. Within-country comparisons show that estimates of TLE and DFLE in each study site were higher for those with schooling compared to those with no schooling.

Discussion

Even though there is some indication that education may be important in determining life expectancy and health in Mexico and Brazil (Parahyba et al., 2009), our study only partially supports this finding. We found that no schooling was associated with higher prevalence of disability in both sites, but there were no significant educational differences in transition probabilities (incidence and recovery from disability, and mortality) within São Paulo and urban areas in Mexico.

Our results showed different patterns of incidence of and recovery from disability between urban areas in both sites. At younger ages, incidence of disability was higher in Mexico, and significantly so among males. However, Mexicans recovered from disability at much higher rates than people in São

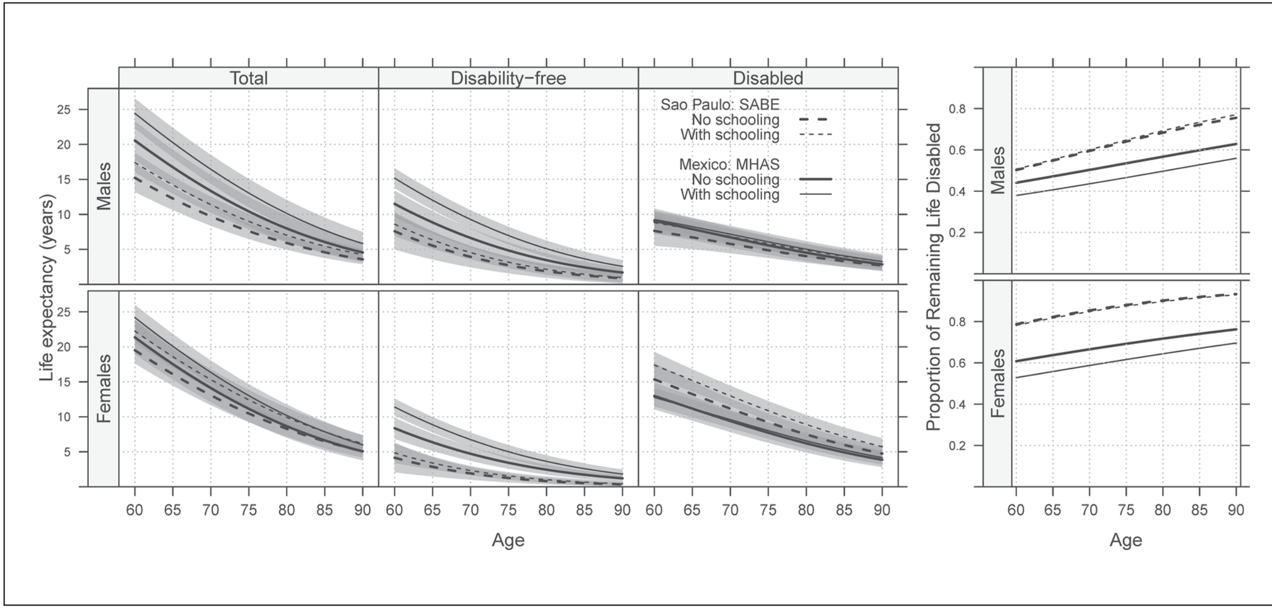

Figure 2. Estimated life expectancy with 95% confidence intervals (shaded areas) by nagi disability status and proportion of remaining life with Nagi disability by age, gender, and education estimated from 2-year transition probabilities for São Paulo, Brazil, and Urban Mexico.
Source: Author's calculations using IMaCh.

Table 3. Total Life Expectancy, Disability-Free Life Expectancy, and Disabled Life Expectancy by Age, Sex and Level of Education for São Paulo, Brazil and Urban Mexico Estimated from 2-Year Transition Probabilities: MHAS 2001-2003 and SABE 2000–2006. (Mean ± standard error.)

	No schooling				With schooling			
	Males		Females		Males		Females	
	São Paulo	Mexico	São Paulo	Mexico	São Paulo	Mexico	São Paulo	Mexico
Age 60								
TLE	15.2 ± 1.0	20.7 ± 1.4	19.5 ± 1.0	21.3 ± 1.2	17.4 ± 0.7	24.4 ± 1.1	22.2 ± 0.8	23.9 ± 0.9
DFLE	7.6 ± 1.3	11.5 ± 1.0	4.2 ± 1.1	8.3 ± 0.8	8.6 ± 0.9	15.2 ± 0.7	4.8 ± 0.7	11.4 ± 0.6
DLE	7.6 ± 1.1	9.1 ± 0.9	15.4 ± 1.2	12.9 ± 1.0	8.8 ± 0.8	9.2 ± 0.6	17.4 ± 1.0	12.6 ± 0.6
DFLE/TLE (%)	50.2	44.2	78.7	60.8	50.7	37.8	78.2	52.5
Age 70								
TLE	9.7 ± 0.7	13.3 ± 1.1	13.1 ± 0.7	13.9 ± 1.0	11.4 ± 0.6	16.3 ± 1.0	15.3 ± 0.8	16.0 ± 0.8
DFLE	3.9 ± 0.8	6.6 ± 0.7	1.9 ± 0.5	4.7 ± 0.5	4.5 ± 0.5	9.3 ± 0.7	2.3 ± 0.3	6.7 ± 0.5
DLE	5.8 ± 0.7	6.7 ± 0.7	11.2 ± 0.7	9.2 ± 0.8	6.8 ± 0.5	7.0 ± 0.6	13.0 ± 0.7	9.3 ± 0.6
DFLE/TLE (%)	59.5	50.2	85.4	66.2	60.1	43.2	84.8	58.1
Age 80								
TLE	5.9 ± 0.5	7.9 ± 0.9	8.3 ± 0.6	8.4 ± 0.8	7.0 ± 0.5	9.9 ± 1.0	9.9 ± 0.7	9.9 ± 0.8
DFLE	1.9 ± 0.5	3.4 ± 0.5	0.8 ± 0.2	2.4 ± 0.4	2.2 ± 0.4	5.1 ± 0.6	1.0 ± 0.2	3.6 ± 0.4
DLE	4.0 ± 0.5	4.4 ± 0.6	7.5 ± 0.6	6.0 ± 0.6	4.9 ± 0.5	4.9 ± 0.6	8.9 ± 0.7	6.3 ± 0.5
DFLE/TLE (%)	68.3	56.2	90.2	71.0	69.3	49.0	89.7	63.5

Note: Disability is defined as having difficulty with at least one Nagi activity. TLE stands for total life expectancy, DFLE and DLE correspond to disability-free and disabled life expectancy, respectively.
Source: Authors' calculations using IMaCh.

Paulo, leading to higher TLE and DFLE among Mexicans at both levels of education; DFLE for females in Mexico was significantly higher relative to those in São Paulo. These findings confirm previous studies that show higher life expectancy in Mexico than in Brazil (United Nations Economic Commission for Latin America and the Caribbean (CELADE) Population Division, 2007), which may be due to Mexico's lower levels of inequality, better socioeconomic conditions—such as more educational opportunities—as well as higher GNI and HDI (World Bank database, 2012). Minicuci and colleagues (2011) have also found higher DFLE in Mexico City than in São Paulo, particularly among men. In our study, we found higher TLE and DFLE in urban Mexico than in São Paulo for both men and women. This may indicate larger differences among women in São Paulo and in urban areas in Mexico than those reported in Mexico City (Minicuci et al., 2011), although differences in methodology may also play a role. Nevertheless, these findings should be interpreted with caution, given that we are inferring a 2-year transition probability from a larger follow-up in SABE to make it comparable with MHAS.

Our findings are consistent with previous research in each country. For instance, studies based on cross-sectional data from Brazil indicate that higher SES, in particular higher educational attainment, is associated with lower disability (Camargos et al., 2007; Fiedler & Peres, 2008; Melzer & Parahyba, 2004; Parahyba et al., 2009); as a result, those with higher education live fewer years of their lives with disability and more years disability-free compared to those with less education (Camargos et al., 2007). There is some evidence that prevalence of disability among older adults is decreasing in Brazil (Parahyba et al., 2009), and this appears to be true for all income groups (Parahyba & Veras, 2008). Our results showed that in São Paulo there were no significant differences by level of education among men and women in the disability-transition probabilities (Figure 1) or life expectancy by health status (Figure 2). However, women were more likely than men to become disabled, even though recovery from disability occurs at about the same rate for both men and women (Figure 1). In addition, results indicated that individuals who were disabled at baseline were more likely to die, particularly those with no education at older ages. This finding is consistent with results from a longitudinal study conducted in São Paulo during 1991 to 1995, in which disability was positively associated with higher mortality at follow-up (Ramos, Simoes, & Albert, 2001). Education, however, was only marginally associated with the probability of dying (Ramos et al., 2001); our results suggested no significant educational differences in the probability of death for men and women in São Paulo.

Similarly, our findings provided additional evidence for understanding the high disability life expectancy reported in previous studies in Mexico. For example, research in Mexico shows that, in the early-2000s, men spent fewer years after age 60 with no disability relative to women, but women experienced both higher life expectancy and more years with disability after age 60 (Reyes-Beaman et al., 2005; Rodríguez-Abrego et al., 2006). Our findings showed that these results may be driven by higher incidence of disability and much lower recovery rates among females. For instance, females with no schooling were significantly more likely to become disabled than males at both levels of education. Other research suggests that higher prevalence of ADL is not statistically linked to education, but it is strongly associated with chronic conditions, such as diabetes, stroke, and heart disease (Albala et al., 2005; Barrantes-Monge, García-Mayo, Gutiérrez-Robledo, & Miguel-Jaimes, 2007; Patel, Peek, Wong, & Markides, 2006). However, our results showed statistically significant differences in TLE and DFLE between ages 60 and 70 among men and women. It is thus possible that major chronic conditions after age 70 become more important than education.

Previous research has documented a negative impact of disability on the health of older adults, with a stronger effect among women, given their higher DLE (Gispert, Ruíz-Ramos, Barés, Viciana, & Clot-Razquin, 2007). For example, it has been shown that while women live longer (Verbrugge, 1989), they also spend a larger part of their remaining years with disability compared to men (Camargos et al., 2007; Crimmins & Saito, 2001; Reyes-Ortiz, Ostir, Pelaez, & Ottenbacher, 2006). Our results are consistent with these studies. While women in São Paulo and urban Mexico showed higher life expectancy than their male counterparts, they are also expected to live a higher proportion of their lives with disability (Table 3). Other studies suggest that socioeconomic and health factors over the life course may be the driving mechanisms leading to gender differences in health and functional status in Latin America (Alvarado, Guerra, & Zunzunegui, 2007; Zunzunegui, Alvarado, Béland, & Vissandjee, 2009). For instance, it has been shown that exposure to hunger during childhood was related to lower extremity limitations experienced by women, but not men, later in life (Alvarado et al., 2007). However, the evidence is mixed. Zunzunegui and colleagues (2009) found that differences in conditions throughout the life course (childhood, adulthood, and current conditions) did not fully explain the higher prevalence of mobility limitations, ADL, and instrumental activities of daily living disabilities among women in Latin America (Zunzunegui et al., 2009).

Strengths and Limitations

This study has some limitations. The data on disability used in the study were self-reported. Although this could be a possible source of bias, methodological studies have shown that self-reported data on functional disability have been consistent with medical diagnoses (Samper-Ternent, Michaels-Obregon, & Wong, 2012). Data were limited to older adults, and socioeconomic differentials tend to decrease with age (Crimmins, Kim, & Seeman, 2009). We limit our analyses to educational differentials, which may not adequately capture all the multifaceted dimensions of social class (Elo, 2009). In addition, even at the same level of education, there may be different socioeconomic implications in Brazil and Mexico. It is also possible that education influences the presence of chronic conditions, which can be more important as intervening on disability and mortality. Another limitation arises from differences in the ascertainment of respondents' vital status between the surveys. Mortality data in SABE was obtained using vital statistics, whereas in MHAS it was obtained through next-to-kin questionnaires. Therefore, it is possible that mortality in Mexico is underestimated, which might lead to differences between São Paulo and Mexico being overestimated. More importantly, there are marked differences in follow-up time between the two studies (6 years in SABE and 2 years in MHAS) and in their corresponding attrition rates. We addressed differences in follow-up time by using a simulation technique (IMaCh) to estimate comparable transition probabilities, over a 2-year period, and their corresponding life expectancies. We thus expect these results to be fairly comparable between the two samples regardless of total follow-up time (Lièvre et al., 2003).

In terms of attrition, a larger percentage of the Brazilian sample was lost to follow-up than in the Mexican sample. However, statistical analyses (not shown) in SABE indicated no significant difference in age, sex, education, or disability at baseline between those lost and interviewed at follow-up. In MHAS, people lost to follow-up were not significantly different in age or sex, but had significantly higher average education (about 2 more years) and lower Nagi disability at baseline than those interviewed at follow-up. In addition, our estimates of disability transitions and life expectancy may be biased because institutionalized respondents were not included in both studies. However, the institutionalized population in Brazil and Mexico is relatively small, as families remain the main source of care at older ages (Camarano & Kanso, 2010; Wong & Gonzalez-Gonzalez, 2010); therefore, this bias is likely to be small. Moreover, in São Paulo, the 75-and-older population was oversampled, but this was not the case in Mexico; we used sample weights to address this limitation and correct the probability estimates and life expectancy calculations. Other limitations may stem from the empirical application of multistate methods (for a detailed discussion of the drawbacks of this method, see Laditka & Hayward, 2003). For instance, the estimation of the DFLE was subject to more errors and larger variances than the traditional estimates of life expectancies, because the DFLE estimates were based on survey data rather than vital statistics. In other words, because sample sizes in the data used for these estimates were smaller, the variances were larger (Laditka & Hayward, 2003). However, an important strength of this research lies in its use of two longitudinal datasets that allow us to study incidence and recovery from disability, and to more closely represent the dynamics underlying the disability process at the population level.

Final Remarks

Using longitudinal data from São Paulo, Brazil, and urban areas in Mexico, this study found significant educational differences in transition probabilities (incidence and recovery from disability) across sites, but no differences in the risk of death. The main difference across sites was found on the incidence of and recovery from disability, with higher rates in urban areas in Mexico. This leads to the older adults in urban areas in Mexico having significantly more years of their lives spent free of disability. Although women in both sites had higher total life expectancy than men, they also spent more of those years in disability. Because older females in São Paulo and Mexico experienced higher prevalence of disability and more years of their remaining life disabled, it is thus possible that they may also face more social and economic marginalization than males, marginalization that is tied to the stigma associated with disability (Filmer, 2008; Robb, Small, & Haley, 2008).

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