Longer Lives, Sicker Lives? Increased Longevity and Extended Disability Among Mexican-Origin Elders

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Abstract

This study employs growth mixture models and life table techniques to analyze patterns of decline in functional capacity measured by objective Performance Oriented Mobility Assessments (POMAs) in a cohort of 3,050 Mexican-origin elders who were initially interviewed in 1993-1994 and followed up at six points over the subsequent seventeen years. Our objectives are (1) to characterize patterns of physical decline, (2) to identify those factors associated with differences in patterns, and (3) to determine the proportion of life after age sixty-five in which an individual suffers from serious functional impairment. Results reveal three general patterns of decline (1) high initial functioning followed by stability or moderate decline (48% of the sample); (2) moderate initial functioning followed by significant decline (37.5% of the sample) and (3) poor initial functioning followed by continuing poor functioning or slight improvement (14.5% of the sample). On average, members of this cohort spent more than half of the period after sixty-five and before death or censoring with significant limitations in physical functioning. Significant gender and nativity differences emerge. In general, the data show that although Mexican-origin individuals live long lives much of the period after age sixty-five is characterized by serious functional impairment. Implications of an increased period of morbidity associated with increases in life expectancy for the health and economic well-being of older Mexican Americans and their families, as well as for health and long-term care policy, are discussed.

235 words

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Although malnutrition, disease, and political upheaval continue to plague humanity, since the nineteenth century improvements in living standards and better medical care have resulted in increased global life expectancy (Bharmal et al. 2012; Elo 2009; Morbidity and Mortality Weekly Report 1999; Preston 1996; Wilmoth 1998). Although significant differentials between developed and developing nations remain, even the poorest nations have seen improvements (Easterlin 2000; United Nations 2011). In 1955 global life expectancy at birth was approximately forty-seven; by 2005 it had increased to sixty-six (Easterlin 2000; United Nations 2011). In the United States life expectancy at birth increased from 70.8 in 1970 to 78.5 in 2009 (National Center for Health Statistics 2011), and at age sixty-five remaining life expectancy rose from 15.2 years to 19.2 years over the same time period (National Center for Health Statistics 2011). Among the elderly the fastest growing segment consists of those above eighty (Werner 2011).

These increases in life expectancy raise vital questions for both developed and developing nations. Although longer life is desirable for its own sake, the possibility of an increased number of years characterized by poor health and dependency pose potentially serious economic, social, and political problems related the care of a large dependent elderly population (Manton and Stallard 1991). A long and healthy life is everyone's desire, but a long life is not synonymous with high-quality life or a high level of functioning. For groups with low levels of education, low rates of health insurance coverage, low incomes, and little wealth longer life may bring protracted periods of poor functioning and dependency.

In this paper we address issues related to the social, political, and economic implications of increasing life spans generally and we focus specifically on Mexican-origin elders, the largest segment of the growing Hispanic population. This focus is motivated by the fact that this population has on average extremely low levels of education, health insurance, income, and wealth, and it suffers from high rates of diabetes, hypertension, and disability (Angel and Angel 2009; Hummer, Benjamins and Rogers 2004; Palloni 2007; Wu et al. 2003). Yet compared to African-Americans and even non-Hispanic whites its mortality experience is remarkably favorable ((Markides and Eschbach 2005). In 2006, life expectancy at birth for Hispanics, the majority of whom are of Mexican origin (64.5 percent), was 80.6 compared to 78.1 for non-Hispanic whites (Arias 2010). By contrast life expectancy at birth for African-Americans was only 72.9 years(Arias 2010). By age sixty-five, life expectancy for Hispanic men and women was 84 years and 86.7 years respectively, while for non-Hispanic white men and women it was 82.1 and 84.7 and for African-American men and women it was 80 and 83.4.

These differences raise many salient theoretical and practical questions, both for the Mexican origin population, given its high rate of poverty at age sixty-five and above, and for the nation as a whole, given projected deficits in Medicare. To help frame the potential positive and negative aspects of increasing life spans we employ the concept of the compression of morbidity, first proposed by Dr. James Fries (Fries 1989). Dr. Fries noted that chronic illness is the major threat to health in old age and he proposed that if the onset of chronic illness could be delayed one's lifetime illness burden could be minimized and one's healthy and active life maximized. Clearly most of us would wish for to live an active and productive life free of disease and functional limitations and die peacefully and suddenly on the eve of our hundredth birthday. Few of us, though, will be that lucky.

The alternative to this compression of morbidity we might refer to as the extension of morbidity, in which one might live a long life, but spend a large fraction of the additional years in poor health and dependent upon others.

These two scenarios, the compression and extension of morbidity, have clear and profoundly different implications for public policy, at the federal and state levels, as well as individual and family finances and welfare. A long and healthy life gives one the opportunity to contribute to community life while not becoming a burden on one's family or on society (Goldman et al. 2005; Spillman 2004). A long but unhealthy life implies the opposite, a potentially long period of dependency and medical care use, and potentially crushing financial and care-giving burdens for families and the state. Since a large fraction, if not most of the medical care that individuals consume in their lives, is consumed during the last two years of life (Cohen and Yu 2012) and Yu, 2006). In the absence of significant rationing, the extension of morbidity would almost inevitable increase the aggregate consumption of expensive medical services.

Our study contributes to previous work in several ways. Over the past two decades, research has moved beyond static measures of disability toward conceptualizing the concept as a dynamic process across the late-life course. This research documents important trends in disability and how disability prevalence increases with age (Crimmins and Beltran-Sanchez 2011; Crimmins et al. 2009). Even so, most disability studies use self-report measures (e.g., ADL and I-ADL assessments). A unique aspect of the current research design is the detailed measurement of mobility and ambulation. The Performance-Oriented Mobility Assessment (POMA) instrument is widely used in clinical settings to provide an objective evaluation of balance and gait abilities (Guralnik, Simonsick and Ferrucci 1994). It is most often used clinically to determine the mobility status of older adults or to evaluate changes over time (Faber, Boscher and Wieringen 2006). Research along these lines has also examined the heterogeneity of the transition to disabling status and in particular the ways in which they affect people over time (Crimmins, Hayward and Seeman 2004; Taylor and Lynch 2004; Taylor and Lynch 2011) and across different racial groups (Hill, Angel and Balistreri 2012; Taylor 2008). But most of these pattern studies focus on a single average disability pattern in non-Hispanic populations.

Our objective in what follows is to examine patterns of decline among older Mexican-origin individuals employing a unique and important longitudinal data set, the Hispanic Established Population for Epidemiologic Studies of the Elderly or H-EPESE (Markides et al. 1997) These data provide detailed information on risk factors for the mental, physical, and social well-being for a sample of 3,050 individuals of Mexican-origin in the United States who were sixty-five or older when they were first interviewed in 1993-94. At the first wave ages of the responded ranged from sixty-five to 100. This panel was re-contacted in 1995-96, 1998-99, 2000-01, 2004-05, 2007, and 2010. Our second objective is both to characterize the morbidity pattern and mortality experience of the original cohort over the subsequent 17 years, and to identify those factors associated with different physical performance patterns. Our ultimate objective is to estimate the proportion of the life course spent disabled prior to death.

Can Morbidity be Compressed?

Public health and preventive medicine have as a core objective the compression of morbidity. In the ideal case an individual lives a long life with high levels of functioning with only a brief period of incapacity and decline near the end. This we have sometimes referred to as “crash and burn”. The alternatives are (1) a rather short life with a short period of disability toward the end; (2) a short life with early-onset illness and a period of incapacity; and perhaps worst of all from a resource demand perspective (3) a long life with a protracted period of disability and dependency preceding death. This is basically what we find in the H-EPESE. A large fraction of our older respondents spend a large fraction of their lives after age sixty-five in a seriously compromised state.

This leads to a basic dilemma that we might term a “public health or prevention paradox.” If it is the case that we can increase life expectancy through medical interventions and behavioral risk reduction, but find that we are less successful at preventing or significantly postponing the onset of disabling disease, the inevitable result may be that longer lives mean more unavoidable disability. Think of it this way, there are diseases that will kill you fairly early on. Many of these are associated with behavioral factors like smoking, obesity, a lack of exercise, etc. If we reduce mortality from these causes we are still left with later onset diseases that do not immediately kill you, but that can result in protracted illness and the loss of functional independence. These diseases may be less amenable to prevention. They might be postponed a bit, but they may not be preventable. There may be fundamental causes associated with aging that mean that if one lives long enough one's risk of illness and disability is very high. In which case, we are caught in the paradox of extending live through interventions, only to inevitably increase the period of compromised functioning. If prevention is not possible, medical management and assistance may be the only option. This means that longer lives will certainly mean greatly increased expenditures associated with increased dependency.

Based on the compression of morbidity theory, then, the ideal-typical patterns that are possible are variations on the following: (1) stability, in which an individual's level of health, however measured, remains roughly the same over the study period; (2) a slow and protracted decline with significant functional limitations occurring long before death (extension of morbidity); (3) a long period of stability followed by a rapid decline shortly before death (compression of morbidity). A fourth possibility is instability with individuals experiencing morbidity, but then recovering, perhaps multiple times. A fifth logical possibility of course is continual improvement, but given the age of the sample and the nature of the aging process we are less concerned with examining this possibility.

Clearly, a rapid drop in health or functioning close to the end of life would result in a high fraction of quality of life years relative to years in an impaired state. Many studies have documented the impact of declining health on mortality and catastrophic falls (Ayis et al. 2006; Guralnik, Simonsick and Ferrucci 1994). The seriously impaired are not only at greater risk of death, but their need for assistance is typically high (Guralnik, Simonsick and Ferrucci 1994). If individuals do not receive the assistance they need, the quality of their lives can be seriously undermined (Tinetti et al. 2011). Because functional capacity is so central to the well-being of the elderly, its measurement is of major concern in social gerontology and in medical demography (Angel and Frisco 2001).

Understanding the social, cultural, and personal causes and consequences of differences in functional capacity, therefore, is as important as understanding the clinical pathology that gives rise to lower performance-based tests of physical function. With this in mind, in our analysis we focus primarily on the nature of the POMA patterns of decline in addition to estimating the fraction of remaining life at age sixty-five spent in poor health. In summary, the compression of morbidity concept can be approached from two different perspectives, that are clearly similar, but which examine slightly different issues. The first perspective, which is the major focus of our discussion, relates to the rate of decline in health or functional capacity after age sixty-five. As we have noted, from this perspective compression of morbidity consists of a rapid decline shortly before death. The second perspective or way of approaching the problem, relates to the proportion of time between a particular age, in this case sixty-five, and death spent in good health. A higher ratio of “quality life years” to years in poor health or disability reflects compression. Despite the serious health consequences of mobility performance in older adults the determinants of the pattern of functional status over time are poorly understood. In this study, we address this issue by employing a prospective research design of a population that enjoys a fairly favorable mortality experience.

DATA

The following analyses employ seven waves of data collected from the original cohort of the Hispanic Established Populations for the Epidemiologic Study of the Elderly (H-EPESE) (Markides 2009). The H-EPESE survey is based on a probability sample of 3,050 Mexican Americans aged sixty-five and older who reside in Texas, California, New Mexico, Arizona, and Colorado. Respondents ranged in age from sixty-five to 107. The panel was recontacted six more times in 1995−96, 1998−99, 2000−01, 2004−05, 2007, and 2010-11. The response rate at baseline was 86%. The surveys included detailed information on health and disability, immigration history, and demographic characteristics. Due to non-response over the seven waves, our final analytic sample includes 2,455 respondents. Appendix A provides vital statistics data across the seven waves, including sample attrition due to death, lost-to-follow up, and non-response. Table 1 presents the characteristics of the longitudinal sample.

<TABLE 1 ABOUT HERE>

MEASURES

Physical Mobility

A unique aspect of the H-epese research design is the detailed measurement of mobility and ambulation. We used the performance-oriented mobility assessment (POMA) to assess functional mobility. The Performance-Oriented Mobility Assessment (POMA) instrument is widely used in clinical settings to provide an objective evaluation of balance and gait abilities (Guralnik et al. 1995). It is most often used clinically to determine the mobility status of older adults or to evaluate changes over time (Faber, Boscher and Wieringen 2006). The POMA is based on three tasks: standing balance (semi-tandem and side by side), a timed 8-ft walk at a normal pace (gait speed), and a timed test of five repetitions of rising from a chair and sitting down (Guralnik et al. 1995). Following the work of Markides and colleagues (Markides et al. 2001), each assessment was coded (0) unable to complete task, (1) poor, (2) moderate, (3) good, and (4) best. Respondents who received a score of (0) included those who tried but were unable to complete the task and those who did not attempt the task for safety reasons. Original POMA scores range from (0) to (12).

Mental and Physical Health

To assess depressive symptoms, we used the Center for Epidemiologic Studies Depression scale (CES-D). The CES-D measures responses to 20 items (Radloff 1977). Respondents were asked to indicate the frequency of depressive symptoms experienced in the past week. We coded the original response categories for these items as (1) rarely or none of the time, (2) some of the time, (3) occasionally, and (4) most or all of the time. The final CES-D measure represents a summed index of the 20 items.

We used the Mini-Mental State Examination (MMSE) to measure cognitive functioning. The MMSE is one of the most commonly used cognitive screening devices in studies of older adults. It represents a brief, standardized method by which to grade cognitive status (Folstein, Folstein and McHugh 1974). It measures responses to a standard battery of memory and reasoning items and assesses orientation, attention, immediate and short-term recall, language, and the ability to follow simple verbal and written commands. We acknowledge that studies often make use of conventional thresholds in the measurement of cognitive functioning. For example, Black and colleagues (Black et al. 1999) used MMSE scores below 18 and between 18 and 23 to reflect severe cognitive impairment and mild cognitive impairment, respectively. However, following recent research (Hill, Angel and Balistreri 2012; Hill et al. 2006), we used the continuous specification of MMSE.

We assessed a number of chronic conditions, including diabetes, hypertension, stroke, and heart attack. Our measures of diabetes, stroke and heart attack conditions are based on self-reports. Respondents were asked to indicate whether they had ever been told by a doctor that they had any of the aforementioned conditions. We coded response categories for these items as (1) for yes and as (0) otherwise. Blood pressure was directly measured by standard mercury sphygmomanometer. Two readings were taken for each respondent, and an average systolic and diastolic blood pressure was calculated. We coded respondents as positive for hypertension if their average systolic reading was 140 mmHg or higher or their average diastolic reading was 90 mmHg or higher (Chobanian et al. 2003).

Health Behavior and Body Mass

Our measurement of health behavior includes smoking and drinking. We measured smoking behavior with a single item. Respondents were asked, ‘‘Do you smoke cigarettes now?’’ We also measured drinking behavior with a single item. Respondents were asked, “In the past month, have you had any beer, wine, or liquor?” We coded response categories for these items as (1) for yes and as (0) otherwise. Anthropometric measurements of height and weight were collected in the respondent’s home. Using the standard formula and documented thresholds provided by the Centers for Disease Control, we coded respondents as (1) for obese (BMI $\geq$ 35) and as (0) otherwise.

Nativity and Age at Migration

Following previous research (Angel, Angel and Hill 2008; Angel, Angel and Hill 2009; Angel et al. 2010; Hill, Angel and Balistreri 2012; Hill et al. 2012), we created four nativity status and age at migration groups of Mexican Americans. Group 1 represents those who were born in the U.S., Group 2 represents those who were born in Mexico and migrated to the U.S. before the age of 20, Group 3 represents those who were born in Mexico and migrated to the U.S. between the ages of 20 and 49 years, and Group 4 represents those who were born in Mexico and migrated to the U.S. between the ages of 50 and 90 years. In our main analysis, U.S.-born Mexican Americans (Group 1) serve as the reference category against which the Mexico-born groups (Groups 2-4) are compared.

Background Factors

Our multivariate analyses include controls for age, gender, education, financial strain, marital status, living arrangements, monthly contact with family and friends, and perceived social support. Age is a continuous variable, ranging from (sixty-five) to (107). Education is coded as (1) for high school diploma or greater and as (0) otherwise. Financial strain was measured with two items. Respondents were asked, “How much difficulty do you have in meeting monthly payments on your bills?” Response categories for this item were coded (1) none, (2) a little, (3) some, and (4) a great deal. Respondents were also asked, “At the end of the month, do you usually end up with some money left over, just enough to make ends meet, or not enough to make ends meet?” Response categories for this item were coded (1) some money left over, (2) just enough to make ends meet, and (3) not enough money to make ends meet. We measured financial strain as the mean response to these two items. These items were standardized to account for metric differences. We coded marital status as (1) for unmarried and as (0) otherwise. We coded monthly contact as (1) for no monthly contact and as (0) otherwise. We coded living arrangements as (1) for living alone and as (0) otherwise. Our measurement of social support is the mean response to two items. Respondents were asked, ‘‘In times of trouble, can you count on at least some of your family or friends?’’ Respondents were also asked, ‘‘Can you talk about your deepest problems with at least some of your family or friends?’’ Response categories for these items were coded (0) hardly ever, (1) some of the time, or (2) most of the time.

STATISTICAL PROCEDURES

Our analyses were conducted in three stages. We first used the growth mixture modeling (GMM) application in Mplus 6.12 to estimate classes of POMA patterns across the seven waves of data (Figure 1). While conventional growth curve modeling assumes that a given population can be sufficiently described by single average growth pattern, GMM allows for the identification of multiple latent subpopulations of longitudinal change (Jung and Wickrama 2008; Ram and Grimm 2009). Ram and Grimm (2009) explain that “the objective of the growth mixture model is to describe differences in how longitudinal change proceeds in subsamples within the data” (pg. 566). The key question driving this analysis is whether the data are more accurately represented by a single POMA pattern or multiple POMA patterns.

Once we established that multiple latent subpopulations existed in the data, we sought to describe the POMA pattern classes in greater detail. To accomplish this, we employed series pair-wise t-tests to assess unadjusted mean differences in our focal variables across the POMA pattern classes (Table 2). We then estimated a series of multinomial logistic regression models to predict the odds of membership in the POMA pattern classes. These two sets of analyses are intended to answer the following question: Which groups of respondents tend to belong to which POMA patterns?

Third, the study integrates age-specific mortality rates with age-specific prevalence of POMA limitations to calculate Sullivan-based multistate life table models of POMA limitations free and life expectancy with POMA limitations for each group (Sullivan 1971). This is a prevalence-based method of estimating healthy life expectancy. This method divides total life expectancy into the different health states based on the age-specific prevalence of healthy (POMA limitations free) /unhealthy (with POMA limitations) states. A respondent's score of 0 means the test cannot be performed, or 1, extremely low functioning, on any of the three tests they are considered unhealthy. Healthy is defined as having no POMA scores of 1 or lower. Deaths are determined via mortality link and proxy reports.

To estimate mortality rates, the Gompertz models of the following form stratified by sex and nativity are used.

$$\ln m(x) = \beta_0 + \beta_1 \cdot age \quad (1)$$

where, *x* is age.

To estimate prevalence probability, the logistic regressions of the following form stratified by sex and nativity are fitted.

$$\ln\left(\frac{\pi}{1-\pi}\right) = \beta_0 + \beta_1 \cdot age \quad (2)$$

where, π is the prevalence probability.

By using equation (1), age-specific mortality rates can be estimated and total life expectancy can be obtained. From equation (2), the age-specific prevalence of POMA limitations can be obtained. The estimated prevalence is used to divide total life expectancy into the different health states based on the age-specific prevalence of healthy (POMA limitations free) /unhealthy (with POMA limitations) states. For the detail, please refer to Jagger et al. (2006). The unhealthy life expectancies are estimated using logistic regression to predict the age specific prevalence rates for POMA disability.

Finally, a bootstrapping technique is used here to obtain standard errors for the total life expectancy, healthy life expectancy and unhealthy life expectancy. Bootstrapping generates repeated estimates of the healthy life expectancy by randomly drawing a series of bootstrap samples from the analytic samples. Repeating this approach for 300 times and distributions of the total life expectancy, healthy life expectancy and unhealthy life expectancy are obtained, which allow us to estimate sampling variability for the total life expectancy, healthy life expectancy and unhealthy life expectancy. Based on the 300 life tables for a given group, 95% confidence intervals were obtained for the distributions of the total life expectancy, healthy life expectancy and unhealthy life expectancy for that group. Statistical significant tests can be performed according to the 95% confidence intervals.

RESULTS

GMM Analysis

To determine the appropriate number of POMA pattern classes, we fitted three consecutive GMM models which included adjustments for age, gender, education, financial strain, marital status, nativity/migration age, body mass and chronic conditions. These models include the dead and produce full information estimates of class patterns based on the existing data for all individuals in the sample.

Our first model specified two POMA pattern classes and resulted in a Bayesian Information Criterion (BIC) of 50143.54 and a LO-MENDELL-RUBIN ADJUSTED LRT TEST (LMR-LRT) of 481.886 ($p<0.001$). The statistically significant LMR-LRT suggested that the two-pattern model fitted the data better than the one-pattern model. Our second model specified three POMA pattern classes and resulted in a BIC of 50119.55 and a LMR-LRT of 88.137 ($p<0.05$). Again, the statistically significant LMR-LRT suggested that the three-pattern model fitted the data better than the initial two-pattern model. Our final model specified four POMA pattern classes and resulted in a BIC of 50360.98 and a LMR-LRT of 85.532 ($p<0.10$). In the end, we selected the three-pattern model because it resulted in the lowest BIC, and the LMR-LRT for the four-pattern model was not statistically significant at conventional levels (suggesting no improvement in model fit over the three-pattern model).

Figure 1 presents a graphical illustration of the three POMA patterns. The threshold for poor performance on the POMAs is indicated by the horizontal dark line in the middle of the figure. The first pattern (good functioning), characterized by initially high functioning followed by decline, includes 48% of the sample. Even though most declined somewhat given their age at baseline, over the study period (approximately 17 years), respondents in this group remained above the threshold for poor functioning. The second pattern, initial fair functioning followed by significant decline, includes 37.5% of the sample. These individuals were above the threshold at baseline, but sank below the threshold by the final interview. On average, they remained above the threshold for poor functioning over the first five waves (approximately 11 years), but sank below the threshold by the time of the final two waves. The third pattern, initial poor functioning followed by little change or even slight improvement, includes 14.5% of the sample. These individuals remained below the functional impairment threshold throughout the study. Despite some moderate improvement they stayed below the threshold for poor functioning over the seven waves.

<FIGURE 1 ABOUT HERE>

Bivariate Analysis

Table 2 presents samples means for all study variables across the POMA pattern classes. On average, respondents in the first class are younger, more highly educated, and more financially stable than respondents in the second and third classes. Respondents in the first class are more likely to have immigrated during middle-life than respondents in the second and third classes. They are also more likely to have immigrated during late-life than respondents in the second class. With respect to health behavior and body mass, respondents in the first class are more likely to smoke and drink, but less likely to be obese, than respondents in the second and third classes. In terms of mental and physical health, respondents in the first class have higher cognitive and physical functioning than respondents in the second and third classes. Respondents in the first class also have lower rates of hypertension than respondents in the second class and lower rates of stroke and diabetes than respondents in the third class.

<TABLE 2 ABOUT HERE>

Multivariate Analysis

Table 3 provides the multinomial logistic regression results predicting the odds of POMA class membership. In model 1 the odds of class one membership versus class three membership are lower for older adults, women, and respondents with higher levels of financial strain. Model 1 also indicates that the odds of being in class one versus being in class three is higher for respondents who immigrated during middle- and late-life than for the native-born or those who immigrated early in life.

Model 2 adjusts for health behavior, body mass, and health. The odds of class one membership versus class three membership are lower for obese respondents, but higher for respondents with better physical functioning at baseline. The age differences in Model one are presumably explained away by differences in baseline physical functioning. With the addition of the health-related covariates in Model 2, the odds of class one membership versus class three membership are now higher for women, indicating a strong distortion pattern or a form of suppression. This means that a third variable, i.e., health, changes the direction of the significant effect of gender on performance.

Model 3 reveals that the odds of class two membership versus class three membership are lower for older adults and respondents with at least a high school education than for younger adults and those with less education. With the addition of health-related covariates in Model 4, the odds of class two membership versus class three membership are higher for women, respondents who immigrated in late-life, and those with higher baseline physical functioning. Significant differences in age and education revealed in previous models are explained away with the introduction of the health covariates in Model 4. Gender differences that were suppressed in Model 3 reemerge in Model 4 suggesting a suppressor effect associated with health.

Model 5 indicates that the odds of class one membership versus class two membership are lower for older adults, women, and those respondents with higher levels of financial strain. The odds of class one membership versus class two membership are also higher for those with at least a high school education and for those respondents who immigrated in middle- and late-life. Model 6 reveals that the odds of class one membership versus class two membership are lower for obese respondents, but higher for those respondents with a history of heart attack and higher baseline physical functioning. Once again, age differences are explained away and distorted gender differences are revealed.

<TABLE 3 ABOUT HERE>

In sum, the results reveal three general patterns of decline (1) high initial functioning followed by decline (48% of the sample); (2) moderate initial functioning followed by decline (37.5% of the sample) and (3) poor initial functioning followed by continuing poor functioning or slight improvement (14.5% of the sample). Individuals with the most seriously impaired physical functioning tended to be older, more poorly educated, and less financially stable than respondents with better functioning or less decline.

<TABLE 4 ABOUT HERE>

Table four presents point estimates of life expectancy separately for foreign born Mexican women and men. The POMA, ALE are higher for both men and women, though they are only significantly different for foreign born men relative to U.S. born men. Women, both foreign born and U.S. born, spend a significantly larger proportion of their life expectancy in poor health relative to men. There are small differences in healthy life expectancy between U.S. born men and women, but foreign born men have significantly larger health life expectancies compared to foreign born women. Foreign born women experience the largest proportion of their life expectancy in poor health of the four groups.

Discussion

Our initial objective was to characterize patterns of decline based on a unique data set with a very long follow-up. These analyses suggest great complexity in the pace and pattern of decline in objectively measured physical functioning among older Mexican-origin individuals. Using growth curve modeling we identified three ideal-typical patterns of initial functioning and subsequent decline: (1) high initial functioning followed by stability or moderate decline; (2) moderate initial functioning followed by serious decline; and (3) low initial functioning followed by no change or slight improvement. Clearly, age is a major predictor of low initial functioning and declines over the study period. Results not reported here reveal that older individuals and those with initially low levels of functioning were are elevated risk of death.

These data reveal, then, that among older Mexican-origin individuals many remained high functioning for a long period, yet a large fraction declined or were in poor health to begin with. Those respondents who were sixty-five at baseline were over eighty by the time of the final follow-up. Those who were older at baseline were even older by the end. Clearly many had died. Those who were older at baseline were clearly at elevated risk of both death and functional decline and our analyses clearly reveal their risk of dependency. Other factors were also predictive of the extent of functional decline. In bivariate analyses, respondents with more education and greater financial stability were more likely to be in the first class than the second or third. They also had lower rates of hypertension and lower rates of stroke and diabetes at baseline. By definition, those in the first class had higher physical and cognitive scores than those in the second or third class at baseline.

We were particularly interested in the association of nativity and age at migration on class membership. As in previous research our findings reveal that those who immigrated in mid- or late-life are more likely to be members of class one than of the lower two classes. These late life migrants are no doubt selected for better health, and it appears that their levels of functional decline remain lower than those of the native-born or those who arrived early in life.

In the multiple decrement analyses we directly estimated the ratio of disability-free years to those with functional impairment by nativity. Those detailed analyses show that the differences in life expectancies between U.S. Born and foreign born populations are consistent with previous research (Arias et al. 2010). On average, Mexican origin elderly live more than half of their years after age sixty-five with significant functional limitations. The data also reveal that gender and nativity interact such that life expectancy at sixty-five is highest for foreign-born Mexican-origin women and lowest for native-born males. Regardless of nativity, men spend approximately half of the years after age sixty-five in an impaired state; foreign-born women live nearly two-thirds of the additional years in a seriously impaired state.

The association among socioeconomic, demographic, health, migration, and other factors on the extent and pace of decline in physical functioning is clearly complex. It is also clear that there is much variation in these patterns and that while many individuals remain functionally sound, others spend some period with poor functioning. These individuals are unlikely to be able to care for themselves without assistance. Family members or formal caregivers are a necessity. Although the present analysis identifies various factors associated with different patterns of differential decline in functioning, further research is required to better identify those at highest risk and to examine how different sources of assistance affect subsequent health and longevity. Further research is required to better identify those at highest risk of functional decline and to examine how different sources of assistance affect subsequent health and longevity.

References

Angel, Ronald J., and Jacqueline L. Angel. 2009. *Hispanic Families at Risk: The New Economy, Work, and the Welfare State*. New York, NY: Springer Sciences.

Angel, Ronald J., Jacqueline L. Angel, and Terrence Hill. 2008. "A comparison of the health of older Hispanics in the United States and Mexico: Methodological challenges." *Journal of Aging and Health* 20:3–31.

—. 2009. " Subjective control and health among Mexican-origin elders in Mexico and the United States: Structural considerations in comparative research." *Journal of Gerontology: Social Sciences* 64B:390-S401.

Angel, Ronald J., and Michelle Frisco. 2001. "Self-Assessments of Health and Functional Capacity among Older Adults." *Journal of Mental Health and Aging* 7( ):119-35

Angel, Ronald L., Jacqueline L. Angel, Carlos Díaz-Venegas, and Claude Bonazzo. 2010. "Shorter stay, longer life: Age at migration and mortality among the older Mexican-origin population." *Journal of Aging and Health* (22):914–31.

Arias, Elizabeth. 2010. "United States Life Tables by Hispanic Origin." Pp. Table G in *Vital and Health Statistics*. Hyattesville, MD: National Center for Health Statistics.

Arias, Elizabeth, Karl E. Eschbach, William S. Schauman, Eric L. Backlund, and Paul D. Sorlie. 2010. "The Hispanic Mortality Advantage and Ethnic Misclassification on US Death Certificates." *American Journal of Public Health* 100(April):S171-S77.

Ayis, S., R. Gooberman-Hill, A. Bowling, and S. Ebrahim. 2006. "Predicting catastrophic decline among older people." *Age and Ageing* 35:382-87.

Bharmal, Nazleen, Chi-Hong Tseng, Robert Kaplan, and Mitchell D. Wong. 2012. "State-Level Variations in Racial Disparities in Life Expectancy." *Health Services Research* 47(1pt2):544-55.

Black, Sandra, David Espino, Richard Mahurin, Michael Lichtenstein, Helen Hazuda, Dennis Fabrizio, and Kyriakos Markides. 1999. "The influence of noncognitive factors on the Mini-Mental State Examination in older Mexican-Americans: Findings from the Hispanic EPESE." *Journal of Clinical Epidemiology* 52:1095–102.

Chobanian, A., G. Bakris, H. Black, W. Cushman, L. Green, J J. Izzo, and E. Roccella. 2003. "Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Hypertension, 42, 1206–1252." *Hypertension* 42:1206–52.

Cohen, Steven B., and William Yu. 2012. "The Concentration and Persistence in the Level of Health Expenditures over Time: Estimates for the U.S. Population, 2008-2009." in *MEPS Statistical Brief*. Rockville, MD: Agency for Healthcare Research and Quality.

Crimmins, Eileen M., and Hiram Beltran-Sanchez. 2011. "Mortality and Morbidity Trends: Is There Compression of Morbidity? ." *Journals of Gerontology Series B-Psychological Sciences and Social Sciences* 66(1):75-86.

Crimmins, Eileen M., Mark D. Hayward, A. Hagedorn, Y. Saito, and N. Brouard. 2009. "Changes in Disability-Free Life Expectancy for Americans 70 Years and Older." *Demogrraphy* 46(3):627-46.

Crimmins, Eileen M., Mark D. Hayward, and Teresa E. Seeman. 2004. "Race/Ethnicity, Socioeconomic Status, and Health." Pp. 310-52 in *Critical Perspectives on Racial and Ethnic Differences in Health in Late Life*, edited by Norman. B. Anderson, Randy A. Bulatao, and Barney Cohen. Washington, DC: National Academy Press.

Easterlin, Richard A. 2000. "The Worldwide Standard of Living since 1800." *The Journal of Economic Perspectives* 14(1):7-26.

Elo, I. T. 2009. "Social Class Differentials in Health and Mortality: Patterns and Explanations in Comparative Perspective." Pp. 553-72 in *Annual Review of Sociology*. Palo Alto: Annual Reviews.

Faber, M.J., R.J. Boscher, and P.C.W. van Wieringen. 2006. "Clinimetric Properties of the Performance-Oriented Mobility Assessment Physical Therapy." *Physical Therapy* 86(7):944-54.

Folstein, M., S. Folstein, and P. McHugh. 1974. "Folstein, M., Folstein, S., & McHugh, P. (1975). Mini-Mental State: A practical method for grading the state of patients for the clinician." *Journal of Psychiatric Research* 12:189–98.

Fries, James F. 1989. "Aging, Natural Death, and the Compression of Morbidity." *New England Journalof Medicinne* 330:130-35.

Goldman, Dana P., Baoping shang, Jayanta Bhattacharya, Alan M. Garber, Micahel Hurd, Geoffrey F. Joyce, Darius N. Lakdawalla, Constantijin Pania, and Paul G. Shekelle. 2005. "Consequences of Health Trends and Medical Innovation for the Future Elderly." *Health Affairs* W5:R5-R17.

Guralnik, Jack, Luigi Ferrucci, E. Simonsick, M. Salive, and Robert Wallace. 1995. "Lower-extremity function in persons over the age of 70 years as a predictor of subsequent disability." *New England Journal of Medicine* 332:556-62.

Guralnik, Jack M., E.M. Simonsick, and Luigi Ferrucci. 1994. "A short physical performance battery assessing lower extremity function: Association with self-reported disability and prediction of mortality and nursing home admission." *Journal of Gerontology: Medical Sciences* 49:M85-M94.

Hill, Terrence, Jacqueline Angel, and Kelly Balistreri. 2012. "Does the Healthy Immigrant Effect Extend to Cognitive Aging? ." Pp. 19-33 in *Aging, health, and longevity in the Mexican-origin population (pp. 19−33). New York: Springer Publishing Company.*, edited by Jacqueline L. Angel, Fernando Torres-Gil, and Kyriakos Markides. New York, NY: Springer Publishing Company.

Hill, Terrence, Jacqueline Angel, Kelly Balistreri, and Angelica Herrera. 2012. "Immigration Status and Cognitive Functioning in Late Life: An Examination of Gender Variations in the Healthy Immigrant Effect." *Social Science & Medicine* 75:2076−84.

Hill, Terrence, Amy Burdette, Jacqueline L. Angel, and Ronald J. Angel. 2006. "Religious attendance and cognitive functioning among older Mexican Americans." *Journal of Gerontology: Psychological Sciences* 61B:P3–P9.

Hummer, Robert M., Maureen Benjamins, and Richard Rogers (Eds.). 2004. *Race/Ethnic Disparities in Health and Mortality among the Elderly: A Documentation and Examination of Social Factors*. Washington, DC: National Academies Press.

Jagger, Carol, Bianca Cox, Sophie Le Roy, and EHEMU. 2006. "Health Expectancy Calculation by the Sullivan Method." in *EHEMU Technical Report September 2006*.

Jung, T., and A. Wickrama. 2008. "An introduction to latent class growth analysis and growth mixture modeling." *Social and Personality Psychology Compass* 2:302–17.

Manton, Kenneth G., and Eric Stallard. 1991. "Cross-sectional Estimates of Active Life Expectancy for th U.S. Elderly and Oldest-Old Populations." *Journal of Gerontology: Social Sciences* 46:S170-S82.

Markides, Kyriakos. 2009. "Hispanic Established Populations for the Epidemiologic Studies of the Elderly, 1993-1994: [Arizona, California, Colorado, New Mexico, and Texas] (ICPSR 2851)." The University of Michigan: Ann Arbor, MI : Inter-university Consortium for Political and Social Research.

Markides, Kyriakos, S., Sandra A. Black, Glenn V. Ostir, Ronald J. Angel, Jack M. Guralnik, and Michael Lichtenstein. 2001. "Lower Body Function and Mortality in Mexican American Elderly People." *Journals of Gerontology Series A: Biological Sciences and Medical Sciences* 56:M243-M47.

Markides, Kyriakos S., and Karl Eschbach. 2005. "Aging, Migration, and Mortality: Current Status of Research on the Hispanic Paradox." *Journal of Gerontology: Social Sciences* 60(October):S68-S75.
Markides, Kyriakos S., Laura Rudkin, Ronald J. Angel, and David Espino. 1997. "Health Status of Hispanic Elderly." in *Racial and Ethnic Differences in the Health of Older Americans*, edited by Linda G. Martin and Beth J. Soldo. Washington, DC: National Academy Press.
Morbidity and Mortality Weekly Report. 1999. "Ten Great Public Health Achievements—United States, 1900-1999." *JAMA: The Journal of the American Medical Association* 281(16):1481.
National Center for Health Statistics. 2011. "Life expectancy at birth, at sixty-five years of age, and at 75 years of age, by sex, race, and Hispanic origin: United States, selected years 1900–2009." edited by United States: 2011 Health. Atlanta, GA: Centers for Disease Control,.
Palloni, Alberto. 2007. "Health Status of Elderly Hispanics in the United States." Pp. 1-14 in *The Health of Aging Hispanics: The Mexican-origin Population*, edited by Jacqueline L. Angel and Keith E. Whitfield. New York: Springer.
Preston, Samuel H. 1996. "American Longevity: Past, Present, and Future." Syracuse, New York: Syracuse University, Maxwell School of Citizenship and Public Affiars, Policy Research Paper 36.
Radloff, L.S. 1977. "The CES-D scale: A Self-report Depression Scale for Research in the General Population." *Journal of Applied Psychological Measurement* 1:385-401.
Ram, N., and Kevin Grimm. 2009. "Growth mixture modeling: A method for identifying differences in longitudinal change among unobserved groups." *International Journal of Behavioral Development* 33:5sixty-five-76.
Spillman, Brenda. 2004. "Changes in Elderly Disabilty Rates and the Implications for Health Care Utilization and Cost." *The Milbank Quarterly* 82:1570194.
Sullivan, D. F. 1971. "A Single Index of Mortality and Morbidity." *HSMHA Health Reports* 86(4):347-54.
Taylor, Miles G. 2008. "Timing, Accumulation, and the Black/White Disability Gap in Later Life: A Test of Weathering." *Research on Aging: Special Issue on Race, SES, and Health,* 30:226-50.
Taylor, Miles G., and Scott M. Lynch. 2004. "Patterns of Impairment, Social Support, and Depressive Symptoms in Later Life." *The Journals of Gerontology: Social Sciences* 59B(4):S238-46.
—. 2011. "Cohort Differences and Chronic Disease Profiles of Differential Disability Patterns." *Journals of Gerontology Series B-Psychological Sciences and Social Sciences* 66:729-38.
Tinetti, Mary E., G. McAvay, S.S. Change, A.B. Newman, Y. Ning, T.R. Fried, K. Yaffe, A.L. Fitzpatrick, T. Harris, S. Satterfield, and P. Peduzzi. 2011. "Effect of chronic diseases and disease-related symptoms and impairments on universal health outcomes in older adults." *Journal of the American Geriatrics Society* 59:1618-27.
United Nations. 2011. "World Mortality Report 2007." New York: United Nations, Department of Economic and Social Affairs, Population Division. Accessed February 5, 2010 from http://www.un.org/esa/population/publications/worldmortalityreport2007/WORLD%20MORTALITY%20REPORT.PDF.
Werner, Carrie A. 2011. "The Older Population: 2010." Pp. 1-19 in *2010 Census Briefs*.
Wilmoth, John R. 1998. "The future of human longevity: A demographer's perspective." *Science* 280(5362):395.

Wu, Jasmanda H., Mary N. Haan, Jersey Liang, Debashis Ghosh, Hector M. Gonzales, and William H. Herman. 2003. "Diabetes as a predictor of change in functional status among older Mexican Americans. Diabetes Care." *Diabetes Care* 26:314-19.

Table 1: Baseline Descriptive Statistics for the full Sample (H-EPESE, 1993)

	Range	Mean	SD
Age	sixty-five−107	70.07	6.79
Female	0−1	.58	
Education (≥ HS)	0−1	.10	
Financial Strain	-1.51−1.51	.00	.51
Unmarried	0−1	.58	
Lives Alone	0−1	.58	
No Contact w/Family & Friends	0−1	.58	
Social Support	0−2	1.63	.62
U.S.-born	0−1	.56	
Immigrant (1-19)	0−1	.14	
Immigrant (20-49)	0−1	.21	
Immigrant (50+)	0−1	.09	
CES-D	0−54	14.91	7.58
MMSE	13−30	24.69	4.70
Smoker	0−1	.12	
Drinker	0−1	.16	
Obese	0−1	.30	
Diabetic	0−1	.28	
Hypertensive	0−1	.43	
History of Heart Attack	0−1	.11	
History of Stroke	0−1	.07	
POMA	0−12	6.48	3.52

Notes: H-EPESE = Hispanic Established Populations for the Epidemiologic Study of the Elderly. n = 2455. HS = high school. CES-D = Center for Epidemiologic-Depression Scale. MMSE = Mini-Mental State Exam. POMA = Performance Oriented Mobility Assessment.

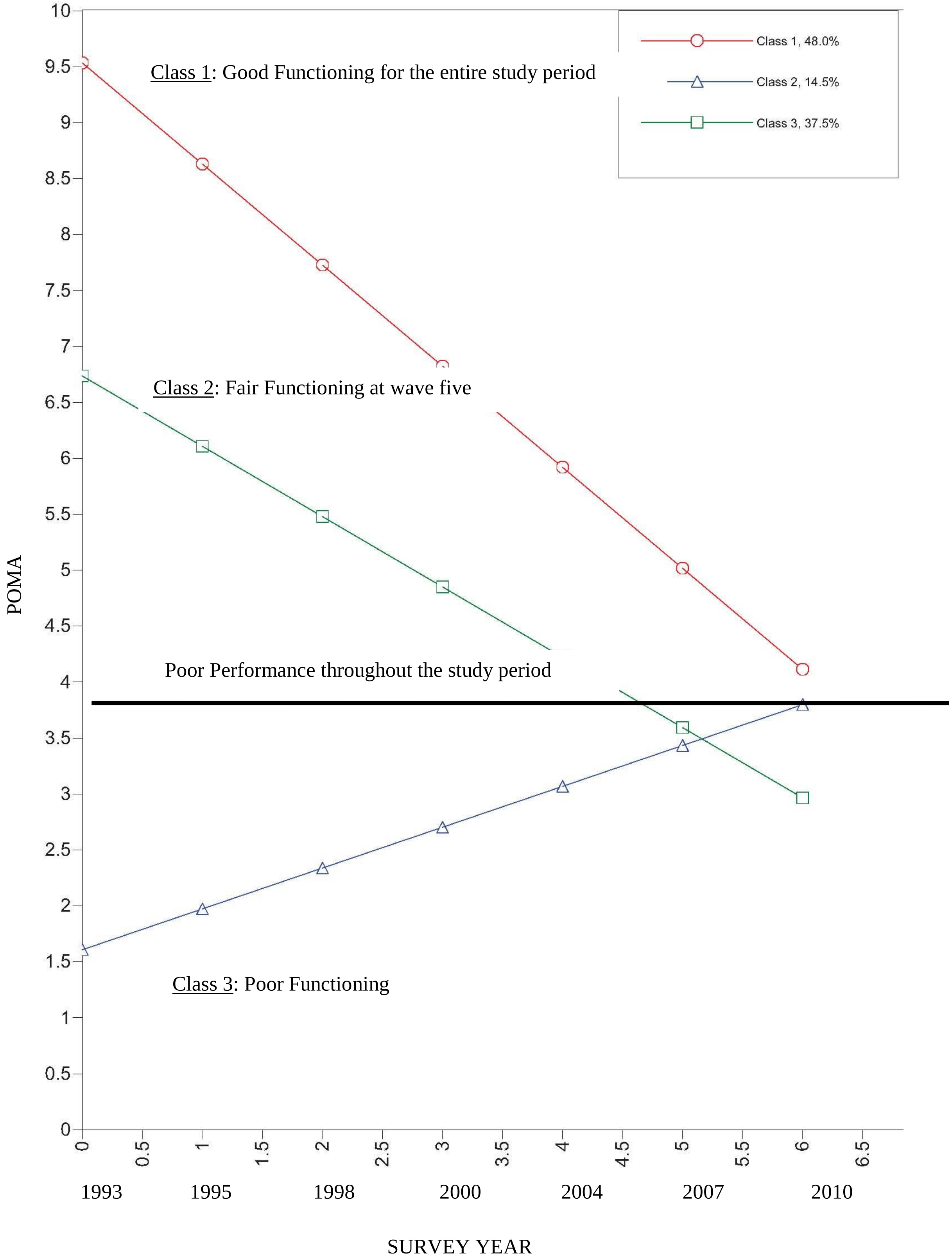

Figure 1: POMA Trajectory Classes (H-EPESE, 1993-2010)

Table 2: Baseline Sample Means by POMA Trajectory Classes (H-EPESE, 1993)

	Class 1 (n = 1178)	Class 2[a] (n = 911)	Class 3[b] (n = 356)
Age	71.34[a,b]	71.89[b]	75.24
Female	.46[a]	.54	.53
Education (≥ HS)	.16[a,b]	.06	.09
Financial Strain	-.11[a,b]	.11	.08
Unmarried	.37[b]	.40	.48
Lives Alone	.21	.23	.28
No Contact w/Family & Friends	.15	.13	.19
Social Support	1.62	1.63	1.56
U.S.-born	.57[a]	.63	.59
Immigrant (1-19)	.08[a,b]	.15	.18
Immigrant (20-49)	.25[a,b]	.17	.17
Immigrant (50+)	.09[a]	.05	.06
CES-D	14.43[b]	14.16[b]	17.53
MMSE	26.18[a,b]	25.36[b]	24.11
Smoker	.17[a,b]	.12	.10
Drinker	.25[a,b]	.14	.07
Obese	.23[a,b]	.35	.37
Diabetic	.24[b]	.28[b]	.37
Hypertensive	.39[a]	.50	.43
History of Heart Attack	.09	.10	.12
History of Stroke	.04[b]	.05[b]	.10
POMA	9.51[a,b]	6.36[b]	1.09

Notes: H-EPESE = Hispanic Established Populations for the Epidemiologic Study of the Elderly. n = 2455.
Superscripts identify significant mean differences between designated classes (two-tailed t-tests, $p < 0.05$). HS = high school. CES-D = Center for Epidemiologic-Depression Scale. MMSE = Mini-Mental State Exam. POMA = Performance Oriented Mobility Assessment.

Table 3: Multinomial Logistic Regression Predicting the Odds of POMA Class Membership

	Class 1 vs. Class 3		Class 2 vs. Class 3		Class 1 vs. Class 2	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Age	.90*** (.88, .92)	1.01 (.92, 1.1)	.92*** (.90, .94)	0.97 (.90, 1.1)	.97** (.96, .99)	1.03 (.99, 1.1)
Female	.65** (.50, .86)	6.92** (2.1, 22.2)	1.02 (.77, 1.3)	4.00* (1.4, 11.7)	.64*** (.53, .78)	1.73* (1.1, 2.7)
Education (≥ HS)	1.54 (.99, 2.4)	1.02 (.18, 5.7)	.54* (.33, .88)	.21 (.04, 1.0)	2.87*** (2.0, 4.0)	4.76*** (2.3, 9.9)
Financial Strain	.43*** (.34, .56)	.24** (.09, .65)	.96 (.76, 1.2)	.63 (.25, 1.6)	.45*** (.38, .54)	.38*** (.26, .56)
Unmarried	.97 (.69, 1.4)	1.18 (.33, 4.3)	.98 (.69, 1.4)	.73 (.22, 2.4)	.99 (.78, 1.27)	1.61 (.97, 2.7)
Lives Alone	.95 (.66, 1.3)	1.54 (.37, 6.3)	.95 (.66, 1.3)	1.76 (.48, 6.4)	1.00 (.76, 1.31)	.88 (.49, 1.6)
No Contact w/Family & Friends	.89 (.63, 1.3)	.79 (.18, 3.4)	.70 (.48, 1.0)	.67 (.18, 2.6)	1.28 (.97, 1.70)	1.18 (.67, 2.1)
Social Support	.98 (.79, 1.2)	.52 (.22, 1.2)	.98 (.79, 1.2)	.48 (.22, 1.0)	1.00 (.86, 1.17)	1.07 (.78, 1.5)
Immigrant (1-19)	.88 (.60, 1.3)	.44 (.09, 2.2)	1.05 (.72, 1.5)	.82 (.19, 3.6)	.84 (.62, 1.13)	.54* (.29, .98)
Immigrant (20-49)	1.76** (1.3, 2.4)	3.05 (.71, 13.2)	1.03 (.73, 1.4)	1.53 (.39, 6.1)	1.70*** (1.4, 2.1)	1.99* (1.2, 3.3)
Immigrant (50+)	2.67*** (1.6, 4.4)	77.26*** (12.4, 481)	1.01 (.59, 1.7)	7.26* (1.4, 38.6)	2.64*** (1.8, 3.7)	10.64*** (5.1, 22.3)
CES-D		.94 (.88, 1.0)		.96 (.91, 1.0)		.98 (.96, 1.0)
MMSE		1.00 (.87, 1.1)		.96 (.84, 1.1)		1.04 (.99, 1.1)

Smoker	.34	.43	.78
	(.07, 1.7)	(.09, 2.0)	(.45, 1.4)
Drinker	2.61	2.18	1.19
	(.48, 14.1)	(.45, 10.1)	(.68, 2.1)
Obese	.07***	.36*	.19***
	(.02, .20)	(.14, .97)	(.12, .29)
Diabetic	2.01	1.18	1.70*
	(.62, 6.5)	(.40, 3.5)	(1.1, 2.6)
Hypertensive	.98	.71	1.38
	(.35, 2.8)	(.27, 1.9)	(.92, 2.1)
History of Heart Attack	6.24	3.16	1.97*
	(.84, 46.2)	(.47, 21.2)	(1.05, 3.7)
History of Stroke	1.35	0.91	1.48
	(.21, 8.5)	(.18, 4.5)	(.61, 3.6)
POMA	159.8***	11.78***	13.65***
	(90.3, 282)	(7.16, 19.4)	(10.3, 18)

Notes: H-EPESE = Hispanic Established Populations for the Epidemiologic Study of the Elderly. *n* = 2455. Shown are odds ratios and 96% CIs. *p < .05, **p < .01, ***p < .001. HS = high school. CES-D = Center for Epidemiologic Studies Depression Scale. MMSE = Mini-Mental State Exam. POMA = Performance Oriented Mobility Assessment.

Table 4- POMA Life Expectancy at Age 65 by Nativity and Gender

	Native Born			Foreign Born		
Females	**Years (SE)**	**95% CI**		**Years (SE)**	**95% CI**	
Total Life Expectancy	17.4 (0.36)	16.70	18.14	18.1 (0.43)	17.30	18.98
Health Life Expectancy	6.8 (0.25)	6.27	7.23	6.5 (0.24)	5.97	6.89
Unhealthy Life Expectancy	10.7 (0.26)	10.16	11.21	11.7 (0.35)*	10.88	12.34
Ratio of Healthy to Total	0.39 (0.01)	0.37	0.41	0.36 (0.01)	0.33	0.38
Males						
Total Life Expectancy	14.5 (0.35)	13.83	15.23	16.2 (0.43)**	15.52	17.04
Health Life Expectancy	6.8 (0.27)	6.25	7.34	7.8 (0.28)*	7.25	8.39
Unhealthy Life Expectancy	7.8 (0.25)	7.27	8.29	8.4 (0.33)	7.81	9.16
Ratio of Healthy to Total	0.47 (0.01)	0.44	0.49	0.48 (0.01)	0.45	0.51

Source: HEPESE Wave 1-7

*$p \leq 0.05$; **$p \leq 0.01$

Appendix A. Overview of interviews by wave in the H-EPESE

	Wave	Total N	New Interviews	Survivors	Loss to Follow-up	Deceased
1993–94	1	3,050	3,050			
1995–96	2	3,050	0	2,439	370	241
1997–98	3	3,050	0	1,981	396	673
2000–01	4	3,050	0	1,682	405	963
2004–05	5	3,952	902* (new cohort)	1,167	416	1,467
2006–08	6	3,952	0	1,542	528	1,882
2010	7	3,952	925 informants	1,078	557	2,314