Predictors of Exceptional Longevity among Older U.S. Adults

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Abstract: The U.S. population is aging rapidly and there has been significant growth in the population of older adults who live to exceptional old age. However, there is still little research to date on the factors that contribute to exceptional longevity among older U.S. adults. Using data from the Health and Retirement Study, we focus on older adults who had the potential to survive to, or live beyond, 90 years of age over 17 years of follow-up in order to determine how exceptional survivors differ from nonsurvivors in their sociodemographic characteristics, health behaviors, and physical health status. We found that older black adults are less likely to survive to age 90, even after adjustment for individual education, health behaviors, and physical health. In addition, older adults who smoke or have a history of smoking were less likely to survive to age 90. Predictors of longevity were largely consistent across cohorts.

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INTRODUCTION

Reaching advanced old age is becoming an increasingly common experience in the United States. For instance, the number of individuals surviving to age 90 increased from 4.8% of men and 14.4% of women in the 1900 birth cohort, to 8.6% of men and 19.6% of women in the 1920 birth cohort (Bell and Miller 2005). And among those born in 1920, who reached age 70, 16% of men and 30% of women survived to age 90. As a result of gains in life expectancy at older ages, a growing segment of the U.S. population is experiencing exceptional longevity, surviving to ages that exceed average life spans (U.S. Census 2008; U.S. Census 2010). Despite significant interest from public health researchers, policymakers, and the general public in understanding how people achieve long lives, there has been very little research to date on the factors that contribute to exceptional longevity among older U.S. adults.

Evidence from prior research on mortality in U.S. older suggests the strongest predictors of old-age survival are individual sociodemographic characteristics, such as sex and education, health behaviors, such as smoking and drinking, and chronic conditions and diseases (Fried et al. 1998; Kaplan et al. 1987; Terry et al. 2008; Yates 2008; Willcox et al. 2006). However, prior studies have examined mortality risks in select elderly populations living in specific U.S. communities (Fried et al. 1998; Kaplan et al. 1987; Terry et al. 2008) or only in elderly men (Yates 2008; Willcox et al. 2006), and it is unclear if the factors associated with longevity that have been identified in prior studies would apply to the broader older adult population. Furthermore, studies typically have had short follow-up periods for assessing mortality risk (e.g., 5 to 10 years) and have focused on survival only to age 85 (Fried et al. 1998; Terry et al. 2008; Willcox et al. 2006).

The current study uses data on older men and women in the Health and Retirement Study (HRS) who had the potential to survive to, or live beyond, 90 years of age during a 17-year follow-up period to examine: 1) differences in sociodemographic, health behavior, and physical health characteristics between survivors to age 90 and nonsurvivors; 2) predictors of survival to age 90 among older U.S. adults; and 3) cohort differences in predictors of longevity.

METHODS

Data

We use data from ten waves of the ongoing, nationally representative HRS (Wallace and Herzog 1995). We focus on the portion of the HRS sample that began as the study of Asset and Health Dynamics Among the Oldest Old (AHEAD), which was designed to provide a representative sample of the community-based U.S. resident population ages 70 or older (i.e. born in 1923 or earlier) in 1993. The HRS has followed respondents over 17 years, including mortality tracking. With its large sample size and extensive on-going follow-up, AHEAD provides an ideal opportunity to gain insights into differences in U.S. adults who reach very old age and answer questions about what keeps older adults alive.

The analytic sample consists of 5,914 respondents who were born before 1921 and thus could have survived to age 90 during the study period (we excluded those who were already age 90 at the baseline interview). The analytic sample consists of 3,785 *non-survivors* who died before reaching age 90 and 2,162 *survivors* who reached age 90 during the study period (we excluded a small number of respondents who were lost to follow-up before they could have been observed to reach age 90). The mean age at death was 84.0 (range: 71.3-89.9) among non-survivors and 93.9 (range: 90.0-111.3) among survivors.

We determined age at death from respondent reported birth year and survey tracking of year of death. Birth year is self-reported in the baseline interview by the respondent or their proxy. Birth year was reported by proxies for n=70 of those who could have survived to age 90 or older. Age validation is an important issue in studies of extreme longevity because age misreporting escalates in older cohorts. Age misreporting is more likely to occur among the very old due to lack of birth records documenting year of birth (Elo et al. 2004; Elo and Preston 1994). However, this study largely consisted of individuals born after 1900, who are more likely to be able to accurately report their birth year (Kestenbaum 1992; Preston et al. 1996). Furthermore, birth year was reported accurately by 90% of those who were 75 years of age at

baseline and 87% of those who were 85 years of age at baseline according to Medicare data, a reliable administrative source of birth year information (Kestenbaum and Ferguson 2002).

Measures

We use baseline sociodemographic information to characterize the sample and predict survival. Age is measured in years, cohort is a two category variable identifying individuals born 1904-1912 and 1913-1921, female gender is a dichotomous variable, race/ethnicity is a four category variable for white, black, Hispanic, and other race/ethnicity, education is a categorical variable distinguishing those with more than 12 years of education from those with 12 years and less than 12 years of education measured in years of completed schooling, and marital status is represented with four categories that distinguish between those who are married/partnered, divorced/separated, widowed, and have never been married.

Health behaviors include smoking and drinking status. Smoking status is categorized to distinguish those who never smoked from former and current smokers. Drinking status is categorized to distinguish between those who do not drink alcoholic beverages and those who are light drinkers, who have one drink or less per day, and moderate to heavy drinkers, who have three or more drinks per day.

Physical health includes measures of disease and disability. Chronic diseases are measured as the number of six doctor diagnosed diseases and conditions respondents have ever had. The diseases include high blood pressure or hypertension, diabetes, cancer of any kind except skin cancer, chronic lung disease, such as chronic bronchitis or emphysema (excluding asthma), heart problems such as heart attack, coronary heart disease, angina, and congestive heart failure, and stroke. We measure disability as limitations in Activities of Daily Living (ADLs). ADL limitations were assessed as the number of six basic everyday activities the respondent had some difficulty performing. The ADLs include walking across a room; dressing; bathing; eating; getting in and out of bed; and using the toilet.

Analytic Strategy

We first examine baseline differences in sociodemographic characteristics, health behaviors, and physical health status between survivors and nonsurvivors. We then examine predictors of survival using an exponential survival model, first for the full sample and then by cohort. Analyses were weighted using baseline sample weights that correct for differential probability of household selection and non-response and that make adjustment to the 1990 sex and age distribution of the U.S. All analyses were performed using Stata software version 12. The survival analysis was performed using Stata's –streg– command.

PRELIMINARY RESULTS

Table 1 shows baseline characteristics by survivorship. On average, survivors are about three years older than nonsurvivors, likely reflecting the higher probability of survival among those who have already reached older ages. Survivors consist of more women, more whites, and fewer blacks than nonsurvivors. Survivors also have more years of education. Survivors consist of more widows than nonsurvivors, which is most likely attributed to gender differences between the two groups. Survivors are more likely to have never smoked, less likely to be current smokers, and more likely to be light drinkers. Compared to nonsurvivors, survivors have fewer diseases at baseline.

[Insert Table 1 Here]

Multivariate adjusted models of survival to age 90 are shown in Table 2. Hazard ratios and standard errors (in parentheses) are presented. Results for the full sample are presented first. Members of the younger 1913-1921 cohort are nearly 70% less likely to survive to age 90 as members of the older 1904-1912 cohort, confirming age differences observed in the bivariate associations presented in Table 1. In the full sample gender and education do not predict survival. Blacks are about 10% less likely to survive to age 90 and widows are more likely to be survivors. Current smokers are about 30% less likely to survive to 90 and former smokers are about 10% less likely to reach age 90. Light drinkers are more likely to survive to 90. As the number of disease increases survival to age 90 decreases. Obesity and disability are not associated with survival.

[Insert Table 2 Here]

There are large cohort differences in survival and we were interested in whether predictors of longevity differed by cohort. The next two columns present results stratified by cohort. Although there were no gender differences in the full sample, women in the older cohort were about 11% less likely to survive to age 90 while women in the younger cohort were about 17% more likely to survive. Blacks had a similar survival disadvantage regardless of cohort, though the hazard ratio was only statistically significant in the younger cohort. The higher survival of widows was also similar across cohorts, as were the lower survival of current and former smokers and the higher survival of those who drink. The lower survival associated with increasing numbers of diseases was similar across cohorts. Only among individuals in the younger cohort was increasing ADL limitations associated with lower survival.

DISCUSSION

This is the first study to examine predictors of longevity among U.S. men and women using a long follow-up period. Many of the factors found to be associated with longevity have been identified as important to survival in other studies of older adults, including smoking and drinking behaviors and chronic diseases. This study also showed that, at least for younger cohorts, disability is also an important predictor of survival. Unlike prior studies that found no race differences in survival (e.g., Kaplan et al. 1987), we found that survival was lower among older blacks than older whites, a difference that was not explained after accounting for health behaviors, disease, and disability. Most studies of older adult survival lacked sufficient data on race/ethnic groups for making such comparisons. We also found that widows were more likely to survive to age 90 and that this survival advantage was not attributable to age or gender differences in the composition of survivors and nonsurvivors. This finding is surprising in light of a considerable body of literature showing health and longevity benefits of marriage.

This study has a number of strengths, including the prospective design, large sample size, information on a number of important risk factors, and long follow-up. In addition, the use of nationally representative data allowed us to examine social group differences in predictors of longevity among older U.S. adults. The elderly is becoming more racially and ethnically diverse and research on aging and longevity should consider social variation within this increasingly diverse population.

This study also has some limitations. First, all measures were from self-report and may be subject to reporting bias. Second, the baseline sample consists only of community-dwelling adults and does not include older adults living in nursing facilities. Thus the sample represents initially healthier older adults.

In summary, this study suggested that lifestyle factors and physical health conditions among adults in their 70's and 80's are associated with exceptional longevity of 90 years of more. In addition, black-white differences in health and mortality that have been observed in younger adults are persistent into very advanced old age, with blacks continuing to be disadvantaged relative to whites.

Next Steps

We plan to utilize the longitudinal data available in the HRS to examine several other potential important differences between survivors and nonsurvivors. For instance, in the analyses presented here we used a summary of all reported diseases but some diseases may be more important for old-age survival than others. Therefore, we plan to examine differences in disease prevalence at baseline and disease incidence over follow-up by survivorship.

We also plan to examine differences in survival to 90 according to combinations of risk factors. In the analyses presented, and in much of the existing research, survival is examined with respect to singular effects of behavioral and health characteristics. However, it is more likely that individuals have multiple risk factors that lower their likelihood of surviving to exceptional old age. For instance, although we did not find obese older adults to have lower survival, adults who are both obese and smokers may have lower survival than those who are either obese or smokers.

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TABLES

Table 1. Baseline Characteristics by Survivorship

Characteristic	Survivors (n = 2,155)	Nonsurvivors (n = 3,759)	*p* Value
Age, years	80.4 (4.7)	76.9 (4.1)	*<.001*
Cohort, %			
1904-1912	47.6	20.4	*<.001*
1913-1921	52.4	79.6	
Female, %	67.8	56.6	*.009*
Race/ethnicity, %			
White	88.6	86.9	
Black	6.9	8.4	*.03*
Hispanic	3.6	3.4	
Other	0.9	1.4	
Education, %			
Less than 12 years	42.7	42.2	
12 years	27.8	31.9	*.002*
More than 12 years	29.6	25.9	
Marital Status, %			
Married/partnered	45.3	53.2	
Divorced/separated	3.8	5.1	*<.001*
Widowed	47.9	38.4	
Never married	3.0	3.3	
Smoking Status, %			
Never smoked	56.9	42.6	
Current smoker	5.2	11.9	*<.001*
Former smoker	37.9	45.4	
Drinking Status, %			
Doesn't drink	52.2	56.6	
1 drink/day	37.4	32.6	*.002*
3+ drinks/day	10.4	10.8	
Obese, %	12.0	12.9	*.64*
Diseases (0-6)	0.90	1.37	*<.001*
ADLs (0-6)	0.80	0.47	*.31*

Notes: Numbers are means (standard deviations) and percentages. P values are obtained from Wald chi-square tests.

Table 2. Hazard Ratios for Survival to Age 90 in the Full Sample and by Cohort

	Full Sample		Cohort			
			1904-1912		1913-1921	
Cohort 1913-1921	0.34	***				
	(0.03)					
Female	1.04		0.89	**	1.17	**
	(0.04)		(0.04)		(0.06)	
Race/Ethnicity (ref=white)						
Black	0.89	*	0.94		0.83	*
	(0.05)		(0.05)		(0.08)	
Hispanic	0.98		0.96		0.97	
	(0.06)		(0.06)		(0.09)	
Other	0.80		1.01		0.55	+
	(0.15)		(0.14)		(0.31)	
Education (ref=13+ years)						
Less than 12 years	1.05		1.02		1.05	
	(0.04)		(0.04)		(0.06)	
12 years	0.95		0.93	+	0.96	
	(0.04)		(0.05)		(0.06)	
Marital Status (ref=married)						
Divorced/separated	1.00		1.04		0.99	
	(0.08)		(0.09)		(0.12)	
Widowed	1.13	***	1.16	***	1.13	*
	(0.03)		(0.04)		(0.05)	
Never married	0.98		1.13		0.87	
	(0.09)		(0.10)		(0.17)	
Smoking Status (ref=nonsmoker)						
Current smoker	0.67	***	0.89		0.56	***
	(0.08)		(0.10)		(0.11)	
Former smoker	0.91	**	0.95		0.90	*
	(0.03)		(0.04)		(0.05)	
Drinking Status (ref=nondrinker)						
1 drink/day	1.11	**	1.00		1.20	***
	(0.03)		(0.04)		(0.06)	
3+ drinks/day	1.09		1.01		1.18	*
	(0.05)		(0.06)		(0.10)	
Obese	1.02		1.05		1.00	
	(0.05)		(0.06)		(0.06)	
Diseases	0.87	***	0.93	***	0.83	***
	(0.02)		(0.02)		(0.02)	
ADLs	0.98		1.01		0.90	*
	(0.02)		(0.02)		(0.04)	

Intercept	0.26	***		0.09	***		0.03	***
	(0.06)			(0.05)			(0.07)	
N	5,945			1,846			4,068	

*** p<.001, ** p<.01, * p<.05, + p<.10