Predictors of Mild Mobility Limitation Recovery among Late Midlife Adults

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Abstract

Mobility limitation, defined as difficulty walking, is prevalent among older adults and an important predictor of institutionalization, disability, and mortality. This research explores predictors of mild mobility limitation recovery and is particularly interested in the role of sociodemographic characteristics and modifiable risk factors (MRF). Utilizing Waves 3-9 (1996-2008) of the Health and Retirement Study (HRS), discrete-time event history models with multiple competing events were estimated using multinomial logistic regression. There was evidence to suggest that racial/ethnic minorities experienced recovery from mild mobility limitation more often than Whites. Additionally, respondents in the highest income quartile were more likely to recover than those in the lowest. Among MRFs, physical activity was associated with greater odds of recovery, while current smoking status and obesity were associated with lower odds of recovery. This research highlights the potential of MRFs for intervention and increasing rates of recovery from mild mobility limitation among older adults.

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Mobility limitation is often measured as difficulty walking, climbing, and/or standing (Iezzoni, 2003). Previous estimates of mobility limitation state that approximately one third of U.S. adults 50 years or older live with mobility limitation (Freedman & Martin, 1998). Rates of mobility limitation increase with age (Iezzoni, McCarthy, Davis, & Siebens, 2001). Two studies of Medicare beneficiaries found that almost half of US adults 65 years or older reported difficulty walking (Hardy, McGurl, Studenski, & Degenholtz, 2010; Shumway-Cook et al., 2005). Mobility limitation is widespread among older adults, and it is an important predictor of other serious health outcomes such as hospitalizations, institutionalization, disability, and mortality as well as increased health care costs (Guralnik et al., 1995; Hardy, Kang, Studenski, & Degenholtz, 2011; Melzer, Lan, & Guralnik, 2003; Newman et al., 2006). While there is a growing body of literature exploring mobility limitation including determinants and subsequent outcomes, research examining recovery from mobility limitation is much more limited; however, recovery occurs more often than typically characterized. Clark, Stump, & Wolinsky (1998) investigated mobility limitation transitions and revealed that 56% of United States (US) adults aged 51-61 years experienced recovery in a two-year period.

Recovery or improvement in mobility limitation may reduce an individual's likelihood of experiencing serious health outcomes associated with mobility limitation. For example, Hardy, Perera, Roumani, Chandler, & Studenski (2007) demonstrated a decreased risk of mortality following improvement of usually gait speed. The research addressing recovery from mobility limitation is limited and often relies on clinical data. The purpose of this research is to identify predictors of mild mobility limitation recovery, specifically recovery from difficulty walking

several blocks without other walking difficulties, among a nationally-representative sample of older US adults with an emphasis on sociodemographic characteristics and modifiable risk factors (MRF). By identifying predictors of mobility limitation, this research may inform functional health intervention which may prevent subsequent health declines associated with mobility limitation. Furthermore, because this research examines recovery from difficulty walking several blocks without other walking difficulties (i.e., walking one block or across the room), this research focuses on the mild end of the mobility limitation spectrum, which may also provide a unique opportunity to consider prevention of progressive mobility deterioration from chronic conditions.

Methods

Data

To complete this research, Waves 3 through 9 (1996-2008) of the Health and Retirement Study (HRS) were used (HRS, 2011). The HRS is an ongoing nationally-representative longitudinal survey, and it is primarily focused on the health, finances, and employment history of a late midlife cohort (born 1931-1941). In 1992, baseline face-to-face structured interviews were completed with follow-up telephone surveys occurring every two years. The initial sample size was over 12,000 individuals (including age-eligible respondents and their spouses) from approximately 7,600 households. The HRS employed a multi-stage, clustered probability frame and oversampled important subgroups (i.e., Blacks/African Americans (1.86:1), Hispanics/Latinos (1.72:1), and Florida residents (2.00:1). Response rates have varied from approximately 81% to 89% per wave. Additionally, to assist in the data management and

analysis of this project, the RAND HRS Data file (version k) was used (RAND, 2011). The analysis was restricted to HRS respondents 55 to 65 years of age at Waves 3 (1996) (N=8,233).

Measures

The HRS includes several measures of mobility limitation such as difficulty walking and climbing stairs; however, this research concentrates on difficulty walking. There are three measures of difficulty walking available in the HRS which reflect varying distances and levels of strain: 1) difficulty walking several blocks; 2) difficulty walking one block; 3) difficulty walking across the room. These measures can be conceptualized as hierarchal indicators of mobility limitation including mild mobility limitation (difficulty walking several blocks), moderate mobility limitation (difficulty walking one block), and severe mobility limitation (mobility disability) (difficulty walking across the room). It is anticipated that an individual reporting difficulty walking across the room would also report difficulty walking one and several blocks. It is important to note that while the vast majority of respondents responded in an anticipated manner (representing a hierarchy of mobility limitation), there were some respondents who reported difficulty walking across the room without difficulty walking one or several blocks—these cases were treated as missing data (the number of cases ranged from 8 to 21 depending on the wave). Difficulty walking across the room was asked in a separated section of the HRS, which may contribute to the validity concerns about respondents reporting difficulty walking across the room but no difficulty walking one or several blocks. A trichotomous measure of mobility limitation was created, where no mobility limitation=0, mild mobility limitation=1, and moderate to severe mobility limitation=2.

Sociodemographic characteristics included age, gender, race/ethnicity, education, household income, and married/partnered status. Age, sex, race/ethnicity, and education were treated as time-fixed. Age was measured continuously in years in 1996, which represented relative age within the sample. A dichotomous measure of sex was created, where female=1. A four category variable of race/ethnicity was created with White (reference), Black/African American, Hispanic/Latino, and other race as the categories. Education was measured using credential attainment and a trichotomous measure was generated with less than high school, high school or equivalent (e.g., GED) (reference), and more than high school as the categories. Household income and married/partnered status were treated as time-varying measures and assess at the beginning of each interval. Household income quartiles were constructed for each wave and the bottom quartile was used as the reference category. A dichotomous measure of married/partnered status was created, where married/partnered=1.

Modifiable risk factors (MRF) included physical activity, smoking status, and body mass index (BMI) and all MRFs were treated as time-varying and assessed at the beginning of each interval. Physical activity was measured as participating in vigorous exercise or sports multiple times per week. Waves 3-6 respondents were asked whether they participated in vigorous activity 3 or more times per week, while stating in Wave 7, the respondents were asked whether they participated in vigorous activity more than once a week. The physical activity measure was as a dichotomous variable, where physically active=1. Smoking status was measured as a trichotomous variable with never smoked (reference), former smoker, and current smoker as the categories. Categorical measures of BMI were generated from self-reports of weight and height (height in meters/weight in kilograms squared). The categories thresholds were based on the Center for Disease Control and Prevention adult BMI guidelines (CDC, 2011) and included

underweight (BMI below 18.5), healthy weight (BMI = 18.5-24.9) (reference), overweight (BMI=25-29.9), and obese (BMI above 30).

Morbidity status measures were also included in the analysis as controls. Self-rated health, health conditions, and mental health were used to assess morbidity status. Self-rated health was measured continuously on a five-point Likert scale with 1=poor health and 5=excellent health. Health conditions relied on self-reports of physician diagnosis and included arthritis, cancer, diabetes, heart problems, high blood pressure, lung disease, and stroke. A dichotomous variable was created for each condition, where ever having the condition=1. Two measures of mental health status were utilized: 1) psychological problems (i.e., emotional, nervous, or psychiatric problems) and 2) depressive symptoms. Psychological problems were also based on self-reports of physician diagnosis, where ever having been diagnosed=1. The Center for Epidemiology Depression Scale (CESD) score was used to measure depressive symptoms, which ranged from 0 to 8 with the high-end reflecting more depressive symptoms. All morbidity measures were treated as time-varying and assessed at the beginning of each interval.

Analytic Strategy

Discrete-time event history (i.e., Cox-proportional hazard) modeling with multiple competing events was estimated using multinomial logistic regression. The risk group at the beginning of each interval was respondents reporting difficulty walking several blocks (without any other walking difficulty) (mild mobility limitation) and possible outcomes included: mild mobility limitation (stable), no limitation (recovery), moderate to severe limitation (mobility limitation deterioration), and attrited from lost to follow-up or death (right-hand censoring) (see

Figure 1). Although attrition is explicitly modeled, the results for attrited are not presented, but are available upon request from the author. Hazard rate odds ratios (and 95% confidence intervals (CI)) were then ascertained for each variable. The analyses were weighted and robust standard errors were employed to adjust for clustering at the individual level from repeated observations. A series of models were created to evaluate sociodemographic characteristics and MRFs as predictors of mild mobility limitation recovery. Model 1 included sociodemographic characteristics, while Model 2 included MRFs. Model 3 included both sociodemographic characteristics, and Model 4 introduced morbidity status.

[Figure 1 about here]

Results

Approximately 79% of HRS respondents in Wave 3 (1996) reported no difficulty walking any distance. By Wave 9 (2008), about 68% of respondents reported no difficulty walking. Figure 2 displays the percentage of HRS respondents reporting difficulty walking for each distance by wave. For all three measures of difficulty walking, there was a general trend of increasing mobility limitation. In Wave 3 (1996), approximately 11% of respondents reported difficulty walking several blocks (mild mobility limitation), while, in Wave 9 (2008), almost 16% of respondents reported having mild mobility limitation. More respondents reported difficulty walking several blocks compared to walking one block or across the room.

[Figure 2 about here]

Table 1 presents the descriptive statistics for the initial risk group (i.e., respondents with mild mobility limitation at Wave 3 (1996)). The results shown for the descriptive statistics are weighted. The average age of the respondent in the initial risk group was 60 years. The majority

(64.5%) of the initial risk group was female. Additionally, the majority (77.4%) of the initial risk group was White. Over half (55.1%) of respondents in the initial risk group had a high school education. Only 14.8% of the initial risk group belonged to the upper household income quartile in 1996. Over two-thirds (67.5%) of the initial risk group was married or partnered in 1996. About 30% of the initial risk group reported being physically active. Only 33.2% of respondents reported never smoking, while only 20.6% reported being a healthy weight. The average self-rated health of a respondent in the initial risk group was 2.6--representing a rating between fair and good. Arthritis (72.6%) and high blood pressure (50.5%) were prevalent among the initial risk group in 1996, and on average, respondents reported 2 depressive symptoms.

[Table 1 about here]

Table 2 displays the hazard ratios (and 95% confidence intervals) of mild mobility limitation recovery by sociodemographic characteristics, MRFs, morbidity status, and time. Black and Hispanic respondents, compared to White respondents, were more likely to recover. In Model 1, three sociodemographic characteristics were associated with mild mobility limitation recovery. Both Hispanic (hazard ratio=1.35) and other race (hazard ratio=2.87) respondents were more likely to recover from mild mobility limitation compared to White respondents. Being in the upper household income quartile, compared to the bottom quartile, was also linked to increased likelihood of recovery. Model 2 included MRFs without sociodemographic characteristics. Being physically active (hazard ratio=1.51) was positively associated with greater recovery from mild mobility limitation. Being a current smoker or obese was associated with a lower likelihood of recovery with hazard ratios of 0.67 and 0.73, respectively.

[Table 2 about here]

Model 3 included both sociodemographic characteristics and MRFs. With the inclusion of MRFs, Hispanic respondents were no longer more likely to recover from mild mobility limitation. Other race (hazard ratio=2.63) respondents and respondents in the upper income quartile (hazard ratio=1.58) continued to be more likely to experience recovery. From Model 2 to 3, the MRFs remained relatively stable with physical activity (hazard ratio=1.48) continuing to be associated with increased odds of recovery, and current smoking (hazard ratio=0.71) and obesity (hazard ratio=0.71) being linked to reduced odds of recovery from mild mobility limitation. Model 4 introduced morbidity status. After adjusting for morbidity status, Black (hazard ratio=1.28) and Hispanic (hazard ratio=1.40) respondents were more likely to experience recovery from mild mobility limitation suggesting a suppressor effect. Similarly, compared to White respondents, other race respondents had nearly three times the odds of recovery, net of other variables. Respondents in the upper income quartile (hazard ratio=1.45) were also more likely to recover compared to respondents in the bottom quartile. Physical activity (hazard ratio=1.39) continued to be associated with greater odds of recovery in Model 4, while current smoking status (hazard ratio=0.72) and obesity (hazard ratio=0.76) continued to be associated with lower odds of recovery. Higher ratings of self-rated health (hazard ratio=1.16) was linked to increased recovery from mild mobility limitation. Heart problems (hazard ratio=0.77), high blood pressure (hazard ratio=0.79), and lung disease (hazard ratio=0.71) were all associated with a lower likelihood of recovery. Additionally, more depressive symptoms (hazard ratio=0.95) were associated with decreased recovery from mild mobility limitation.

Although the results are not presented in Table 2, there were only four variables associated with moving from mild mobility limitation to moderate to severe mobility limitation

(mobility limitation deterioration): 1) self-rated health; 2) stroke; 3) psychological problems; and 4) depressive symptoms. Higher ratings of self-rated health (hazard ratio=0.81) had a protective effect on mobility limitation deterioration. Respondents reporting ever having a stroke (hazard ratio=1.83) were more likely to experience mobility limitation deterioration. Both mental health measures were linked to mobility limitation deterioration with ever having psychological problems (hazard ratio=1.44) and more depressive symptoms (hazard ratio=1.05) being associated with greater likelihood of mobility limitation deterioration.

Discussion

Gaining a better understanding of predictors of mild mobility limitation recovery enables researchers and clinicians to consider interventions aimed at improving the rates of recovery and preventing other serious health outcomes. In general, only a few sociodemographic characteristics were associated with recovery including race/ethnicity and household income. In the full model (Model 4), compared to White respondents, racial and ethnic minorities were more likely to recover with other race respondents being particularly more likely with nearly a three-fold likelihood of recovery. Respondents with the highest household income compared to the lowest household income were also more likely to recover from mild mobility limitation. Physical activity, smoking status, and BMI were all linked to recovery, where physically active respondents were more likely to experience recovery, while current smokers and obese respondents were less likely. These findings underscore the importance of a healthy lifestyle, and potential for intervention via MRFs. Future research should endeavor to identify salient predictors of mobility limitation recovery maintenance. Also, future research should examine environmental factors and how they influence mobility limitation recovery.

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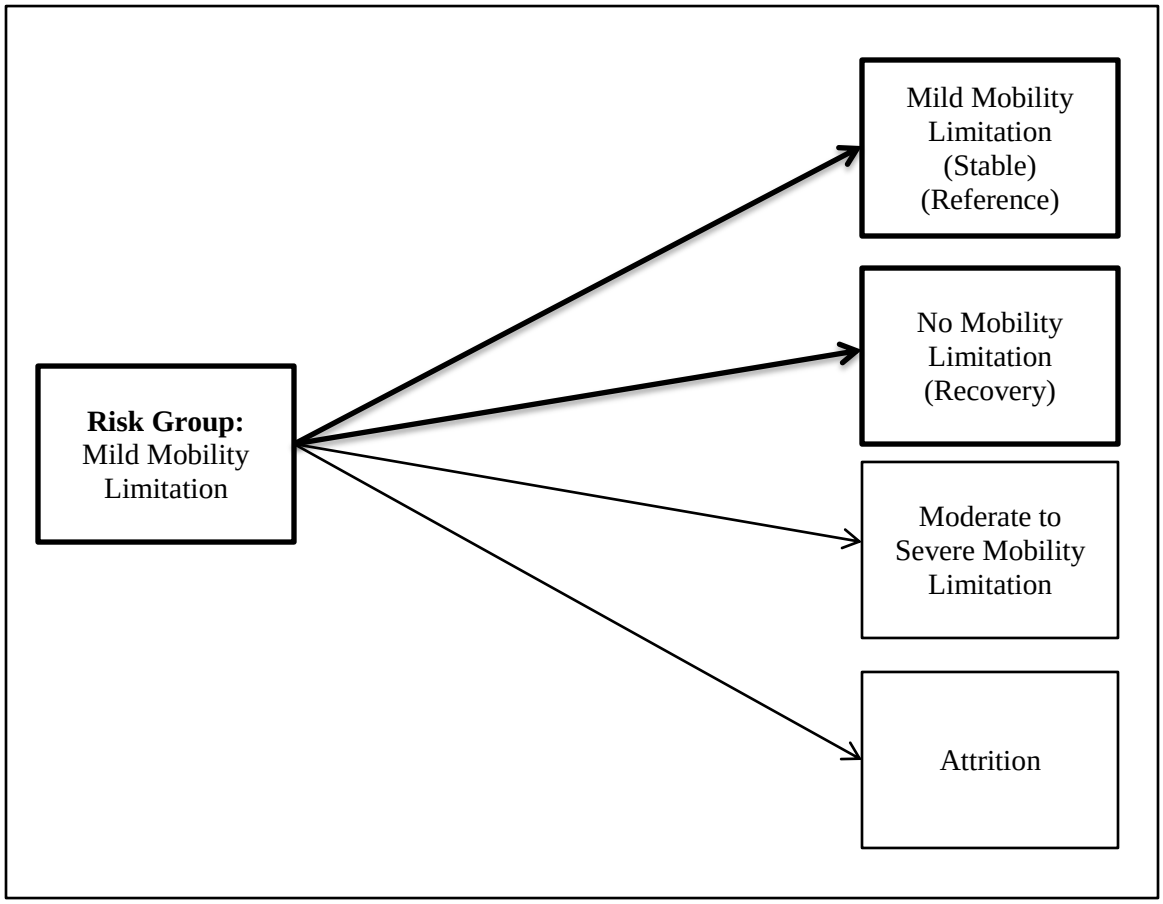

Figure 1. Illustration of risk group and potential outcomes for mild mobility limitation

Note: Bolded items represent transitions of interest.

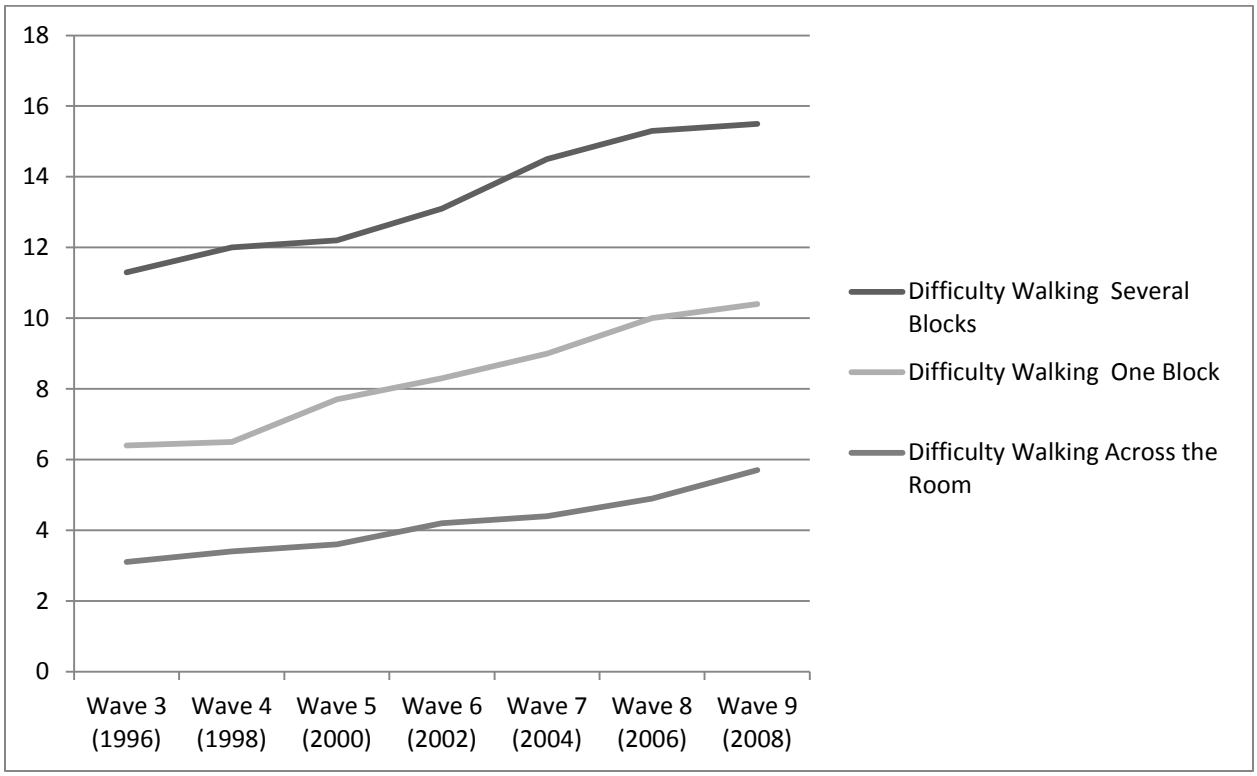

Figure 2. Percentage of HRS respondents reporting difficulty walking by wave

Table 1. Descriptive Statistics of Initial Risk Group (N=865)

	Distribution Information[a,b]
Sociodemographic Characteristics:	
Age	60.0 (2.6)
Sex (female=1)	64.5%
Race/Ethnicity:	
White	77.4%
Black	13.4%
Hispanic	7.5%
Other Race	1.7%
Education:	
Less than High School	33.4%
High School/GED	55.1%
More than High School	11.5%
Income Quartiles:	
Bottom Quartile	38.6%
Bottom-Middle Quartile	25.6%
Upper-Middle Quartile	21.1%
Upper Quartile	14.8%
Married/Partnered (yes=1)	67.5%
Modifiable Risk Factors:	
Physically Active (yes=1)	29.9%
Smoking Status:	
Never Smoked	33.2%
Former Smoker	38.4%
Current Smoker	28.4%
Body Mass Index:	
Underweight	4.3%
Healthy Weight	20.6%
Overweight	34.0%
Obese	41.2%
Morbidity Status:	
Self-Rated Health (Excellent=5)	2.6 (0.9)
Health Conditions:	
Arthritis	72.6%
Cancer	8.7%
Diabetes	20.3%
Heart Problems	24.1%
High Blood Pressure	50.5%
Lung Disease	15.2%
Stroke	5.3%
Mental Health:	
Psychological Problems	19.1%
Depressive Symptoms (CESD)	2.2 (2.0)

Source: *Health and Retirement Study* (HRS) Data (1998)

Notes: [a] Percentage distributions are shown for categorical variables; means and (standard deviations) are shown for continuous variables; [b] Descriptive statistics shown are weighted.

*Table 2***.** Hazard Ratios (and 95% Confidence Intervals) of Mild Mobility Limitation Recovery, by Sociodemographic Characteristics, Modifiable Risk Factors, and Morbidity Status, and Time[a]

	Model 1	Model 2	Model 3	Model 4
Sociodemographic Characteristics:				
Age	1.00 (0.97, 1.02)		0.99 (0.96, 1.02)	0.99 (0.96, 1.02)
Sex (female=1)	1.03 (0.86, 1.23)		1.02 (0.84, 1.24)	0.99 (0.82, 1.21)
Race/Ethnicity:				
White (ref.)				
Black	1.17 (0.94, 1.46)		1.19 (0.95, 1.50)	1.28 (1.02, 1.62)*
Hispanic	1.35 (1.01, 1.82)*		1.35 (1.00, 1.83)	1.40 (1.02, 1.91)*
Other Race	2.87 (1.53, 5.36)***		2.63 (1.40, 4.94)***	2.92 (1.58. 5.38)***
Education:				
Less than High School	0.89 (0.72, 1.10)		0.89 (0.72, 1.10)	1.01 (0.81, 1.26)
High School/GED (ref.)				
More than High School	1.15 (0.89, 1.49)		1.14 (0.88, 1.48)	1.05 (0.80, 1.37)
Income Quartiles:				
Bottom Quartile (ref.)				
Bottom-Middle Quartile	1.16 (0.92, 1.45)		1.14 (0.91, 1.43)	1.12 (0.89, 1.40)
Upper-Middle Quartile	1.19 (0.91, 1.54)		1.16 (0.89, 1.51)	1.11 (0.84, 1.45)
Upper Quartile	1.64 (1.21, 2.23)**		1.58 (1.16, 2.15)**	1.45 (1.06, 1.99)*
Married/Partnered (yes=1)	1.12 (0.91, 1.39)		1.09 (0.88, 1.35)	1.00 (0.80, 1.25)
Modifiable Risk Factors:				
Physically Active (yes=1)		1.51 (1.25. 1.83)***	1.48 (1.23, 1.80)***	1.39 (1.14, 1.68)***
Smoking Status:				
Never Smoked (ref.)				
Former Smoker		0.85 (0.70, 1.03)	0.87 (0.71, 1.06)	0.91 (0.74, 1.12)
Current Smoker		0.67 (0.53, 0.84)***	0.71 (0.56, 0.90)**	0.72 (0.56, 0.93)**
Body Mass Index:				
Underweight		0.87 (0.54, 1.41)	0.86 (0.53, 1.40)	0.85 (0.51, 1.40)
Healthy Weight (ref.)				
Overweight		1.06 (0.85, 1.33)	1.04 (0.83, 1.30)	1.05 (0.83, 1.32)
Obese		0.73 (0.58, 0.92)**	0.71 (0.57, 0.89)**	0.76 (0.60, 0.96)*
Morbidity Status:				
Self-Rated Health (Excellent=5)				1.16 (1.05, 1.28)**
Health Conditions:				
Arthritis				0.83 (0.67, 1.02)
Cancer				0.97 (0.73, 1.27)
Diabetes				0.77 (0.62, 0.96)*
Heart Problems				0.85 (0.70, 1.04)
High Blood Pressure				0.79 (0.66, 0.95)*
Lung Disease				0.71 (0.55, 0.90)**
Stroke				1.07 (0.76, 1.49)
Mental Health:				
Psychological Problems				1.03 (0.81, 1.30)
Depressive Symptoms				0.95 (0.91, 0.99)*
Time:				
Interval 1 (ref.)				
Interval 2	1.03 (0.81, 1.31)	1.05 (0.94, 1.57)	1.03 (0.81, 1.31)	1.07 (0.84, 1.38)
Interval 3	1.04 (0.81, 1.33)	1.05 (0.82, 1.34)	1.04 (0.81, 1.33)	1.07 (0.83, 1.39)
Interval 4	0.82 (0.65, 1.05)	0.83 (0.65, 1.07)	0.82 (0.64, 1.05)	0.87 (0.68, 1.13)
Interval 5	0.84 (0.66, 1.08)	0.92 (0.71, 1.18)	0.90 (0.69, 1.16)	0.98 (0.75, 1.28)
Interval 6	0.93 (0.73, 1.19)	1.00 (0.78, 1.29)	0.97 (0.75, 1.26)	1.05 (0.80, 1.38)
Intercept	-0.26	-0.06	0.43	0.65
Likelihood Ratio	176.87***	161.65***	301.60***	605.05***
Degrees of Freedom	16	11	22	32

Source: *Health and Retirement Study* (1996-2008)

Notes: *0.01 < p ≤ 0.05; ** 0.01 ≤ p < 0.001; *** p ≤ 0.001
[a] Risk group=respondents with mobility limitation; N= 3,685.75 (weighted) person-intervals