Correlates of Improvement in Walking Ability in Older Persons in the United States

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Objectives. We analyzed factors associated with improvement in walking ability among respondents to the nationally representative Health and Retirement Study.

Methods. We analyzed data from 6574 respondents aged 53 years or older who reported difficulty walking several blocks, 1 block, or across the room in 2000 or 2002. We examined associations between improvement (versus no change, deterioration, or death) and baseline health status, chronic conditions, baseline walking difficulty, demographic characteristics, socioeconomic status, and behavioral risk factors.

Results. Among the 25% of the study population with baseline walking limitations, 29% experienced improved walking ability, 40% experienced no change in walking ability, and 31% experienced deteriorated walking ability or died. In a multivariate analysis, we found positive associations between walking improvement and more recent onset and more severe walking difficulty, being overweight, and engaging in vigorous physical activity. A history of diabetes, having any difficulty with activities of daily living, and being a current smoker were all negatively associated with improvement in walking ability. After we controlled for baseline health, improvement in walking ability was equally likely among racial and ethnic minorities and those with lower socioeconomic status.

Conclusions. Interventions to reduce smoking and to increase physical activity may help improve walking ability in older Americans. (*Am J Public Health.* 2009; 99:533–539. doi:10.2105/AJPH.2008.142927)

In the past 2 decades, older Americans have experienced accelerating gains in disability-free life expectancy.[1–4] This phenomenon is in part related to primary prevention of chronic illness, the so-called compression of morbidity.[5–7] However, chronic conditions are increasingly prevalent among older Americans, and key factors in the reduction of disability are earlier detection and better management, including innovative therapeutics and rehabilitation strategies.[3,8] Among many examples of how older Americans limit the disabling effects of chronic illness are improved pain medication; better control of hyperlipidemia, heart disease, diabetes, and hypertension; and increased use of cataract surgery and of canes and walkers.[1] The rapid increase in numbers of total joint replacement surgeries may in itself account for half a percentage point of the recent 2% to 3% annual decreases in disability rates.[9] Modification of behavioral risk factors, particularly smoking cessation and increased physical activity, also affect both primary prevention and maintenance of function among Americans with chronic conditions.[6,9,10]

Although there is disease-specific literature on recovery after acute episodes of illness, population-based disability research has focused almost exclusively on correlates of declining functional status. However, several recent panel studies of functional and health status transitions (i.e., changes from 1 level of function to another), which used different methods, found that improvement in function was common.[11–15] One study of several hundred adults aged 70 years and older with new-onset disabilities involving activities of daily living (ADL) found that more than 80% recovered at some point over the next year.[14] Analyses of improvement rates found that many of the demographic, socioeconomic, and behavioral risk factors that predicted functional decline and mortality did not necessarily predict functional improvement.[12,15–17]

We analyzed functional improvement in walking difficulty among a nationally representative sample of Americans 53 years or older in 2000 who reported difficulty in walking in 1 of 2 biennial waves (1998–2004) of the Health and Retirement Study (HRS). We examined the likelihood of walking improvement among respondents who reported specific chronic conditions and behavioral risk factors, important targets for public health interventions. We also examined the range of improvement in walking ability reported across age groups and among those with more recent onset of walking limitations. Finally, to evaluate the role of demographic characteristics, baseline health status, socioeconomic status, and behavioral risk factors as predictors of improvement in walking ability, we assessed correlations of improvement with these variables.

We hypothesized that walking improvement would differ significantly across baseline levels of limitation, with the greatest likelihood of improvement occurring among those whose only baseline difficulty was walking several blocks and those with the most recent onset of a walking limitation.[13]

METHODS

Study Population and Inclusion Criteria

We analyzed data from the 2000 and 2002 biennial waves of the HRS. The HRS is a nationally representative longitudinal sample of US households with a multistage area probability design. The survey population comprised noninstitutionalized adults living in the contiguous United States who were 51 years or older in 1998, when the HRS and the Assets and Health Dynamics Among the Oldest Old cohorts were merged. Mortality across survey waves was confirmed through the National Death Index and other means.

We used 3 hierarchical walking difficulty items to assess improvement in walking ability. Respondents were asked about "difficulty, because of a health problem," with walking across a room, walking 1 block, or walking several blocks. Our sample included all respondents in 2000 and 2002 who reported that they had difficulty walking at least several blocks or

could not or did not walk that distance. However, because we observed no important mobility transition differences between the 3% to 6% of respondents who answered "could not/don't do" and those who just reported difficulty, all walking items were dichotomized as having or not having difficulty.

We used 1998 survey responses solely to determine whether limitations reported in the 2000 survey were already present in 1998 or were of more recent onset. Similarly, we used 2000 data to estimate onset among 2002 respondents. All respondents who reported no difficulty walking several blocks in either 2000 or 2002 were excluded from analysis. Thus, we analyzed walking improvement over 2 years for 4722 respondents in 2000 and 4850 in 2002 who reported walking difficulty. Because our study sample included 2998 respondents who reported walking difficulty in both years, we followed a total sample of 6574 HRS participants from either 2000 to 2002 or 2002 to 2004. For each individual, we examined any transition in walking difficulty for 2000 to 2002, 2000 to 2004, or both periods.

Outcomes and Explanatory Variables

Walking improvement from the 2000 survey wave to the subsequent survey wave was defined as transition to a less severe level of walking difficulty or to no difficulty. No change in walking difficulty level over a 2-year period was classified as maintaining the same level of difficulty. Because our endpoint was walking improvement, we chose to categorize functional decline and death as both representing deteriorating health outcomes. Although transitions to more severe walking difficulty or death are not equivalent and require separate modeling when health decline is the study focus, we compared respondents who improved to all respondents who experienced no change, declined in walking ability, or died.

Demographic factors included respondents' age, gender, race/ethnicity (White or other, Black, English-speaking Hispanic, or Spanish-speaking Hispanic), and marital status at baseline. Baseline health was assessed by self-rated overall health (poor to excellent) and respondents' reports of physician-diagnosed arthritis, diabetes, hypertension, vision problems, cancer, stroke, heart disease, or lung disease. In addition, we classified respondents' baseline disability status by 4 levels of disability: whether they reported no limitation in either instrumental activities of daily living (IADL) or ADL, IADL limitations only, 1 or 2 limitations in ADL, or 3 or more ADL limitations.[18] We further characterized respondents as having poor cognitive status if they achieved a zero score on the immediate verbal recall test or if their data were derived from a proxy interview. Previous transitions in walking difficulty (improvement, no change, or decline in walking ability from the past 2 years) reflected change since the previous survey interview.

Socioeconomic status was measured as years of school completed, self-reported income (from all sources in the previous year), and wealth (net value of all assets, including primary housing, minus debts), categorized as population-weighted quartiles. Imputed estimates of family wealth and household income, which were developed at the University of Michigan for the HRS, were used when only partial information was provided.[19]

Behavioral risk factors included current smoking, whether respondents engaged in vigorous physical activity ("such as sports, heavy housework, heavy physical labor 3 times a week or more during the previous year"), and self-reported body mass index (BMI: weight in kilograms divided by height in meters squared), categorized as underweight (<18.5 kg/m^2 often a proxy for poor health); normal weight (18.5 kg/m^2–24.9 kg/m^2); overweight (25.0 kg/m^2–29.9 kg/m^2); or obese (≥ 30 kg/m^2). All baseline explanatory variables were updated in 2000 and 2002.

Statistical Analysis

For all analyses, we used SUDAAN version 9.0 (Research Triangle Park, NC) to account for the complex HRS sampling design, which provided valid inferences to the US population.[20] We restricted our analyses to HRS respondents in 2000 who participated in the 2002 or 2004 follow-up interviews. Approximately 6% of the overall HRS study population were missing data, including 868 nonrespondents, 837 persons with missing walking difficulty status in either 2000 or 2002, and 190 respondents with partial information for 2000 covariates or missing 1998 walking difficulty status. Because of our study design, we excluded an additional 9670 persons who did not report walking difficulty at both the 2000 and 2002 interviews, making them ineligible to report walking improvement.

We adjusted models for potential bias attributable to missing interview information or nonresponse by handling respondents with complete data as an additional sampling stage to obtain adjusted sampling weights, per standard sampling methods.[21] The adjusted sampling weight equaled the 2000 HRS sampling weight multiplied by the inverted probability of being a 2002 respondent given the following 2000 characteristics: gender, race/ethnicity, marital status, Spanish language interview, proxy or phone interview, educational status, withholding of permission to access additional records, self-reported overall health, chronic disease status, limitations in ADL or IADL, health insurance status, dental care visit in past 2 years, employment status, nonresponse to sensitive questions, cooperation rating, interview time, and sampling error stratum.

The univariate improvement rates we present are from sample averages pooled across both baseline years. We used logistic regression modeling with generalized estimating equations to evaluate the relative effect of risk factors on improvement in walking ability compared to no improvement (no change, decline in ability, or death).[22] We used time-dependent covariates that were updated in each baseline year, an approach that validly accounted for potentially correlated observations attributable to repeated measures for some individuals. Results were reported as odds ratios (ORs) and associated 95% confidence intervals (CIs); 95% CIs that excluded 1.00 indicated a significant relationship of a risk factor with improved walking ability.

RESULTS

From 2000 to 2002, 12.9% of sample respondents died; another 13.5% died between 2002 and 2004. Two-year mortality was less than 5% for respondents aged 53 to 70 years (younger respondents), 16% for those aged 71 to 80 years, and 26% for those aged 81 years or older. One quarter of participants who had difficulty walking across a room had died within 2 years; only 14% and 8% of those with difficulty walking 1 block or several blocks, respectively, died in the same period. Overall, 18.5% of the respondents reported engaging

in regular vigorous physical activity during the year before their baseline interview, including 25% of those with difficulty walking several blocks, 15% of those with difficulty walking 1 block, and 8% of those with difficulty walking across a room. Respondent characteristics at the 2000 and 2002 interviews were very similar.

Transitions in Walking Difficulty

Descriptive statistics (as weighted averages from the 2000 and 2002 interviews) and pooled transition rates for the study sample are shown in Table 1. The sample we analyzed comprised approximately 25% of all HRS respondents in each survey year. Approximately half of the respondents in our sample were 70 years or younger; 82% were classified as White or other, more than two thirds were female, and half were unmarried. The transitions in walking difficulty in Table 1 represent the experience of between 16 and 17 million Americans with walking limitations.

Overall, 29% of all sample respondents reported improved walking ability 40% reported no change, and 31% reported a decline in ability or had died. We observed a steep gradient of improvement rates by age, from almost 40% of younger respondents to only 17% of those aged 81 years or older (Table 1). We found few differences by gender or marital status. Hispanics (especially Spanish-speaking Hispanics) had the highest improvement rates; we observed few differences between Blacks and Whites and others.

Approximately half of all sample respondents reported difficulty in walking several blocks, approximately 30% also reported difficulty walking 1 block, and almost 20% reported difficulty in walking across a room. Approximately the same proportion (28%–30%) of respondents at each level of baseline walking difficulty reported improvement by the next interview. Participants who had reported a decline in walking ability in the previous interview wave had the greatest improvement. Those who had reported the same limitation for 2 consecutive waves (39.9%) reported far less improvement.

More than 55% of respondents reported being in fair or poor health; approximately 14% reported excellent or very good health. We found a 27–percentage-point range in improvement rates across self-reported health

TABLE 1—Population-Weighted Data for 2-Year Mobility Transitions Among Older Americans With Baseline Walking Limitation: Health and Retirement Study, 2000 and 2002

		2-Year Mobility Transition[a]		
	% of Sample[b]	Improved, %	No Change, %	Declined or Died, %
Total sample (n = 6574)	100.0	28.9	39.8	31.3
Age in 2000				
53–60 y	20.6	38.7	43.3	18.0
61–70 y	25.9	34.6	42.0	23.4
71–80 y	30.3	26.4	34.3	34.3
≥81 y	23.2	17.0	35.1	47.9
Race/Ethnicity				
White/Other	82.1	28.4	40.1	31.5
Black	11.3	28.9	39.5	31.6
Hispanic, Spanish speaking	3.8	33.8	38.7	27.5
Hispanic, English speaking	2.8	37.3	33.4	29.3
Gender				
Men	36.0	29.8	36.8	33.5
Women	64.0	28.4	41.6	30.0
Marital status				
Married	50.4	32.7	40.0	27.3
Unmarried	49.6	25.0	39.7	33.3
Walking difficulty level				
Several blocks	50.4	27.8	39.4	32.8
1 block	30.6	30.2	37.1	33.7
Across a room	19.0	29.5	45.5	25.0
Previous 2-year period walking ability transition				
Improved (but still with walking difficulty)	10.2	10.9	37.7	51.4
No change	37.8	24.2	46.0	39.8
Declined (lower level of walking ability)	52.0	39.9	34.0	26.1
Self-rated overall health				
Excellent	2.2	37.8	39.7	22.5
Very good	12.1	39.0	37.0	24.0
Good	29.2	32.3	40.6	27.1
Fair	34.2	27.2	40.3	32.5
Poor	22.3	20.6	39,8	39.6
Disability status				
No IADL difficulties	63.2	32.8	39.6	27.6
IADL difficulty only	10.4	22.3	37.3	40.4
1–2 ADL difficulties	17.8	27.1	40.2	32.7
>2 ADL difficulties	8.6	12.0	44.2	43.8
Poor cognitive status	14.8	30.1	40.8	29.1
No. of chronic conditions[c]				
None	4.0	47.0	29.5	23.5
1	17.4	35.1	39.0	25.9
2	29.1	31.2	41.4	27.4
3	24.8	27.1	40.0	31.4
≥4	24.7	20.3	38.2	40.5
Chronic condition[d]				
Arthritis	76.8	28.1	41.3	30.6

Continued

TABLE 1—*Continued*

Cancer	15.8	25.3	35.6	39.2
Diabetes	24.5	23.0	42.6	34.4
Heart disease	37.1	24.0	39.0	37.0
Hypertension	62.4	27.4	40.5	32.1
Pulmonary disease	17.9	24.1	38.5	37.4
Stroke	13.7	20.5	37.6	41.8
Poor vision	12.3	19.5	40.4	40.1
Income quartile				
Lowest	42.3	25.0	39.5	35.5
Medium (2 or 3)	46.4	29.6	40.4	30.0
Highest	11.3	40.4	38.6	21.0
Wealth quartile				
Lowest	36.7	26.5	41.1	32.4
Medium (2 or 3)	47.4	29.8	39.0	31.2
Highest	15.9	31.6	39.6	28.8
Education level				
0–11 y	37.3	26.1	39.0	34.9
High school diploma or GED, 12 y	33.9	29.2	41.3	29.6
Any college, ≥13 y	28.9	32.1	39.3	28.6
Body mass index, kg/m^2				
Underweight (<18.5 kg/m^2)	3.4	16.8	29.0	54.2
Normal weight (18.5–24.9 kg/m^2)	29.2	24.8	35.4	39.8
Overweight (25–29.9 kg/m^2)	34.1	31.7	40.0	28.3
Obese (≥30 kg/m^2)	33.3	30.8	44.8	24.4
Smoking status				
Current smoker	16.2	28.6	40.8	30.6
Current nonsmoker	83.8	28.9	39.6	30.5
Regular physical activity				
Vigorous[e]	18.5	38.9	36.8	24.3
Low level	81.5	26.6	40.5	32.9

Note. IADL = instrumental activities of daily living; ADL = activities of daily living; GED = general equivalency diploma.
[a]Percentages total across the row for each category.
[b]Percentages total down the column for each category.
[c]Out of 8 possible conditions.
[d]Based on physician's diagnosis.
[e]Sports, heavy housework, or heavy physical labor 3 times a week or more during the previous year.

status levels, the same range seen as that across the number of chronic conditions from none to 4 or more. We observed the lowest improvement rates among participants reporting poor vision (19.5%), stroke (20.5%), or diabetes (23.0%). Those reporting no disability had the highest improvement rate (32.8%). However, participants who reported 1 or 2 ADL difficulties had greater improvement in walking ability (27.1%) than did those who reported difficulty only with IADL (22.3%). Only 12% of respondents with more than 2 ADL difficulties had improved walking ability after 2 years. Respondents with poor cognition had only slightly worse outcomes than did the sample as a whole.

Despite the generally low socioeconomic status of our participants, unadjusted rates of improvement reflected a strong socioeconomic gradient, most pronounced across income quartiles. Underweight respondents had the lowest rate of improvement (16.8%) of any subgroup. Those who were overweight or obese had higher improvement rates than did normal-weight respondents. There was virtually no difference in unadjusted improvement rates by smoking status. Respondents who reported engaging in regular vigorous physical activity had improvement rates more than 12 percentage points above those reporting a lower level of physical activity.

Multivariate Predictors of Improved Walking Ability

Table 2 shows logistic regression results for the independent contribution of demographic characteristics, level of walking difficulty, health status, and socioeconomic status to improved walking ability. In this fully adjusted model, there were declining odds of improved walking by age, although respondents aged 61 to 70 years did not have significantly different odds from those of the youngest age group in the table. There were no significant gender disparities, but unmarried respondents were marginally less likely to experience improved walking ability. Black respondents had greater odds of improved walking than did members of other groups. Spanish-speaking Hispanics had 1.6 times the odds of reporting improvement in walking compared to Whites and others, which may be reflective of a language difference or the Hispanic paradox.[23]

After we controlled for all other factors, including baseline health and disability, respondents with successively more severe walking difficulties at baseline had better odds of improved walking ability than did respondents who reported difficulty only with walking several blocks (across the room, OR=3.05; 95% CI=2.44, 3.82; 1 block, OR=1.44; 95% CI=1.25, 1.65). As expected, those with recent declines in walking ability (reported within the past 2 years) had a greater likelihood of improvement in walking (OR=2.61; 95% CI=2.31, 2.94) than did participants whose difficulty level had been stable over the previous 2 years. Those who had experienced improved walking at a previous wave were significantly less likely to experience further improvement by the next interview (OR=0.59; 95% CI=0.49, 0.71) than were those who reported no change in walking ability. Respondents who reported poor health were less likely to improve walking ability than were individuals with all other levels of self-reported health.

The only chronic condition independently associated with lower likelihood of improvement in walking was diabetes (OR=0.71; 95% CI=0.62, 0.82). We found a strong gradient

TABLE 2—Odds Ratios (ORs) From Multiple Logistic Regression of the Likelihood of 2-Year Improvement in Walking Ability Among Older Americans With Baseline Walking Limitation: Health and Retirement Study, 2000 and 2002

	OR (95% CI)
Age, y	
53–60 in 2000 or 55–60 in 2002 (Ref)	1.00
61–70	0.93 (0.76, 1.13)
71–80	0.61* (0.50, 0.76)
≥81	0.36* (0.28, 0.46)
Race/ethnicity	
White/Other (Ref)	1.00
Black	1.22* (1.03, 1.44)
Hispanic, Spanish speaking	1.61* (1.30, 2.00)
Hispanic, English speaking	1.34 (0.88, 2.02)
Gender	
Men (Ref)	1.00
Women	1.06 (0.94, 1.21)
Marital status	
Married (Ref)	1.00
Unmarried	0.85* (0.73, 0.99)
Walking difficulty level	
Several blocks (Ref)	1.00
1 block	1.44* (1.25, 1.65)
Across a room	3.05* (2.44, 3.82)
Previous 2-year period walking ability transition	
Improved (but still with walking difficulty)	0.59* (0.49, 0.71)
No change (Ref)	1.00
Declined (lower level of walking ability)	2.61* (2.31, 2.94)
Self-rated overall health	
Excellent	1.86* (1.24, 2.78)
Very good	1.93* (1.56, 2.38)
Good	1.55* (1.32, 1.83)
Fair	1.32* (1.11, 1.56)
Poor (Ref)	1.00
Disability status	
No IADL difficulties (Ref)	1.00
IADL difficulties only	0.71* (0.58, 0.87)
1–2 ADL difficulties	0.62* (0.50, 0.76)
>2 ADL difficulties	0.20* (0.13, 0.31)
Poor cognitive status	0.92 (0.76, 1.12)
Chronic conditions[a]	
None (Ref)	1.00
Arthritis	0.95 (0.82, 1.11)
Cancer	0.90 (0.76, 1.07)
Diabetes	0.71* (0.62, 0.82)
Heart disease	0.96 (0.84, 1.08)
Hypertension	0.95 (0.85, 1.07)
Pulmonary disease	0.89 (0.76, 1.05)
Stroke	0.85 (0.71, 1.03)

Continued

of reduced odds of improved walking ability associated with greater disability at baseline; those who reported difficulty with more than 2 ADLs at baseline had only 20% the likelihood of improving walking as respondents without any IADL or ADL difficulties. Poor cognition, higher education, and income and wealth levels were not significantly associated with improvement in walking.

Compared with being of normal weight, being overweight but not obese was predictive of walking improvement (OR=1.18; 95% CI=1.03, 1.36). Smoking was significantly associated with a lower likelihood of walking improvement (OR=0.77; 95% CI=0.64, 0.93). Participants who reported engaging in regular, vigorous physical activity were more than 1.4 times as likely to report mobility improvement. Thus, after we controlled for age and baseline health, physical activity was the strongest predictor of improved walking ability.

DISCUSSION

We found that among persons 53 years and older who reported some degree of difficulty in walking, improvement over a 2-year interval was common and was reported by more than one third of respondents who were younger than 70 years and a quarter of those aged 71 to 80 years. As hypothesized, those reporting a recent walking limitation were much more likely to experience improved walking, as were those reporting better overall health at baseline. However, after we controlled for age and self-reported health, several surprising results emerged from the multivariate analysis.

First, although improvement was equally common for respondents with all levels of walking limitation at baseline, after control for baseline health, disability status, age, and other factors, those with more severe baseline walking difficulties were much more likely to experience improved walking ability than were those who only had difficulty walking several blocks. This greater improvement among those most disabled may be related to regression to the mean effects (i.e., that those furthest from the mean often are more likely to have greater change over time than those closer to the mean) or it may reflect a lower improvement threshold for those with more severely limited walking ability. Regaining the ability to walk

TABLE 2—*Continued*

Poor vision	0.94 (0.80, 1.11)
Income quartile	
Lowest (Ref)	1.00
Medium (2 or 3)	0.98 (0.85, 1.12)
Highest	1.21 (0.95, 1.54)
Wealth quartile	
Lowest (Ref)	1.00
Medium (2 or 3)	1.01 (0.87, 1.18)
Highest	0.90 (0.75, 1.09)
Education level	
0–11 y	1.02 (0.88, 1.19)
High School diploma or GED, 12 y (Ref)	1.00
Any college, ≥13 y	1.08 (0.96, 1.21)
Body mass index, kg/m^2	
Underweight (<18.5 kg/m^2)	0.77 (0.56, 1.05)
Normal weight (18.5–24.9 kg/m^2; Ref)	1.00
Overweight (25–29.9 kg/m^2)	1.18* (1.03, 1.36)
Obese (≥30 kg/m^2)	1.03 (0.88, 1.21)
Smoking status	
Current smoker	0.77* (0.64, 0.93)
Current nonsmoker (Ref)	1.00
Regular physical activity	
Vigorous[b]	1.41* (1.24, 1.58)
Low level (Ref)	1.00

Note. CI = confidence interval; IADL = instrumental activities of daily living; ADL = activities of daily living; GED = general equivalency diploma.
[a]Based on physician's diagnosis.
[b]Sports, heavy housework, or heavy physical labor 3 times a week or more during the previous year.
*$P \leq .05$.

across a room or 1 block may require a smaller health improvement than that required to enable an older person with limited mobility to walk several blocks without difficulty. This would be particularly true for the oldest and most frail respondents, who were most likely to have difficulty walking across a room at baseline.

Among participants who only reported difficulty walking several blocks, 28% improved to the point of no longer reporting a walking limitation; far fewer of those with more severe difficulties reported a similar improvement (11% of those reporting difficulty walking 1 block and less than 4% of those with difficulty walking across a room).

After we controlled for self-reported health status and disability, we found that only diabetes independently reduced the likelihood of walking improvement. This finding is particularly ominous because diabetes was the chronic condition that affected the youngest population in the sample (mean age 70.1 years vs 75.4 years for those reporting vision problems). Diabetes is a marker for multiple chronic complications and comorbidities; only 15.5% of respondents without diabetes had 4 or more chronic conditions; 55.1% of those with diabetes had at least 3 additional conditions. The negative effect of diabetes on mobility raises major public health concerns because the prevalence of diabetes continues to increase in the middle-aged and older population.

After we controlled for age and baseline health, we observed few socioeconomic disparities in improvement among respondents reporting walking limitations. This may be because those who were less well off were more likely to report more severe functional limitations and poorer health at baseline.[24] Forty-two percent of respondents in the lowest income quartile and 63% of those in the highest income quartile reported difficulty walking several blocks, the least severe level of walking ability we analyzed. The socioeconomic gradient of improvement thus disappeared in multivariate analysis because of the greater likelihood that those with more severe baseline walking limitations, who showed a greater likelihood of mobility improvement after we controlled for age and health status, had a lower socioeconomic status.

Finally, excess weight, smoking, and physical activity all had significant effects on the likelihood of walking improvement. The greater likelihood of overweight respondents to report walking improvement is consistent with evidence that both mortality and disability are lower among older individuals with a body mass index between 25 and 30 kg/m^2.[2,25,26] Multivariate results, controlled for the younger age of smokers (smokers, mean age=66.3 years; nonsmokers, mean age=72.6 years), showed significantly lower rates of walking improvement among smokers. The strong positive association of mobility improvement with more vigorous physical activity in both adjusted and unadjusted analyses is consistent with previous studies of the value of habitual physical activity.[15] Indeed, a study of HRS respondents aged 51 to 61 years who had arthritis, which asked detailed questions about leisure-time exercise, found that baseline physical activity was the only significant variable predicting general functional improvement.[17]

Walking Difficulty as a Functional Status Endpoint

We focused on improvement in self-reported walking difficulties because of its intuitive appeal as a basic measure of physical functioning. Similar to disability endpoints based on ADL, transitions in walking difficulty capture change in both an individual's underlying health states and an individual's social and physical environment. However, walking difficulty is less likely than disability to be influenced by an individual's social support network, economic circumstances, and assistance from paid caregivers, and it may be easier to interpret than unit changes in disability or functional status scales.[17,27]

Although self-rated health might in theory be a better reflection of an individual's true state of health, it is well known that this measure is heavily influenced by comparative expectation, which often produces a paradox of

better average health status ratings among older than among middle-aged populations.[4] Change in walking limitation can thus provide a simple and uniquely valuable measure of functional status trends in the older population. It is also important that the cascade of ADL disability most often begins with difficulty walking across a room[28]; understanding mobility improvement may therefore provide important insight into strategies to prevent ADL disability.

Limitations

It was not possible to assess the actual mechanisms of walking improvement in our study. The HRS has poor clinical, disease severity, and health care utilization data, so we were unable to assess how transitions in walking difficulty were related to specific aspects of medical care, such as recent hospitalization, the onset of new health conditions, use of new medications, or adoption of supportive care or assistive devices.

Measurement error is inevitable in self-reported functional difficulty items; one source is the decision of some respondents not to ascribe their difficulty to a health problem. Reports of improvement in mobility on questions repeated in successive survey waves may have been sensitive to changes in interviewer characteristics, such as tone, gender, and age.[29] Weather may have contributed to variations in reports of mobility limitations as well.[1] Finally, respondents whose walking ability declined or did not change, or who had died, were a diverse group, and these transitions in mobility require multiple separate analyses beyond the scope of our study.

Conclusions

Our results provide encouraging evidence of a relatively high rate of walking improvement among the most vulnerable 25% of the older population. Longitudinal, population-based research on health improvement can be used to evaluate public health interventions as well as to assess the complex interaction of innovations in medical care with social determinants of health. Future research on causal pathways of walking improvement should focus on how personal behavior, social support, access to health services, and the community environment interact to overcome chronic illness and disability. ■

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Contributors

J. Feinglass originated and supervised the study. J. Song, L.M. Manheim, and D.D. Dunlop helped develop and conduct the analyses. P. Semanik and R.W. Chang helped develop study aims, review the results, and edit the article.

Human Participant Protection

The study was approved by the Northwestern University institutional review board.

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