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Research Article

Effects of Mobility and Cognition on Hospitalization and Inpatient Days in Women in Late Life

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Abstract

Background: This study examines effects of mobility and cognition on hospitalization and inpatient days among women late in life.
Methods: Prospective study of 663 women (mean age 87.7 years) participating in the Study of Osteoporotic Fractures Year 20 examination (2006–2008) linked with their inpatient claims data. At Year 20, mobility ascertained by Short Physical Performance Battery categorized as poor, intermediate, or good. Cognitive status adjudicated based on neuropsychological tests and classified as normal, mild cognitive impairment, or dementia. Hospitalizations ($n = 182$) during 12 months following Year 20.
Results: Reduced mobility and poorer cognition were each associated in a graded manner with higher inpatient health care utilization, even after accounting for each other and traditional prognostic indicators. For example, adjusted mean inpatient days per year were 0.94 (95% confidence interval [CI] 0.52–1.45) among women with good mobility increasing to 2.80 (95% CI 1.64–3.89) among women with poor mobility and 1.59 (95% CI 1.08–2.03) among women with normal cognition increasing to 2.53 (95% CI 1.55–3.40) among women with dementia. Women with poor mobility/dementia had a nearly sixfold increase in mean inpatient days per year (4.83, 95% CI 2.73–8.54) compared with women with good mobility/normal cognition (0.84, 95% CI 0.49–1.44).
Conclusions: Among women late in life, mobility limitations and cognitive deficits were each independent predictors of higher inpatient health care utilization even after considering each other and conventional predictors. Additive effects of reduced mobility and poorer cognition may be important to consider in medical decision making and health care policy planning for the growing population of adults aged ≥85 years.

Keywords: Physical performance—Cognitive status—Hospitalization—Elderly women

Coexisting deficits in mobility and cognition are common in aged populations. Growing evidence suggests a dynamic relationship between these two fundamental attributes of function (1). Some longitudinal studies have reported that mobility limitation is associated with the subsequent development of cognitive impairment (2–5) and dementia (6–8), whereas others have suggested that impaired cognition predicts risk of mobility decline (9–11).

A recent study (12) reported that cognitive impairment and reduced mobility were each associated with increased 5-year mortality risk in women in the 9th and 10th decades of life even after accounting for each other and conventional predictive indicators. However, it is unclear whether mobility and cognition predict risk of hospitalization independent of each other and the impact of combined deficits in these functional attributes on inpatient health care

utilization is unknown. Prospective studies in community-dwelling older adults have reported that reduced mobility is associated with an increased risk for hospitalization (13,14), but the impact of cognition on this association has not been evaluated. Similarly, cognitive decline (15,16) and dementia (17) are associated with higher risk of hospitalization (17), but only one study (16) has evaluated the impact of mobility on this relationship.

To examine effects of mobility and cognition on risk of hospitalization and rates of inpatient days in women late in life, we used a unique longitudinal data set composed of 663 women (mean age 87.7 years) participating in the Year 20 examination (2006–2008) of the Study of Osteoporotic Fractures (SOF) who were linked to their inpatient claims data.

Methods

Study Population and Linkage to Inpatient Claims

We studied participants enrolled in SOF, a prospective cohort study of community-dwelling women. From 1986 to 1988, 9,704 women ≥65 years old able to walk unassisted were recruited for participation from four geographic areas of the United States (18). Black women were originally excluded because of their low incidence of hip fracture. Subsequently, at the Year 10 visit (1997–1998), 662 African American women were enrolled in the study, increasing total enrollment to 10,366 women.

Using methods previously described (19,20), successful matches to Medicare claims were achieved for 9,228 SOF women (92.4% of surviving participants) as of January 1, 1991. Participants at the SOF Portland site were originally recruited into the study through membership in the Kaiser Permanente Northwest (KPNW) health plan, and there was a high rate of Medicare Advantage enrollment (Part C plan) at this site. Thus, SOF Portland participants were also linked to KPNW encounter records as of January 1, 1991. In combining Medicare claims and KPNW encounter records, 9,381 SOF participants (93.9% of surviving SOF participants as of January 1, 1991) were linked to claims data.

All active surviving women at three clinical centers were invited to participate in a Year 20 visit conducted between 2006 and 2008

Figure 1. Participant flow. *Note:* *KPNW = Kaiser Permanente Northwest.

(Figure 1). A total of 1,495 women completed an examination performed in the clinic (*n* = 1,016) or home (*n* = 479) that included a comprehensive battery of lower extremity physical performance and neuropsychological tests. Of these, 663 women who were enrolled in the Medicare Fee-For-Service (FFS) program (Parts A and B [and not Part C]) or KPNW during the month of the Year 20 examination and for the following 12 months (or up until death prior to this time point) comprised the analytical cohort for this study.

Measures of Mobility

Mobility at the Year 20 examination was ascertained by administering the Short Physical Performance Battery (SPPB) (13,21), comprised measures of standing balance, usual gait speed, and ability to rise from a chair five times without using the arms. Scores of 1–4 for each task were assigned based on quartiles of performance in the SPPB derivation cohort (21); participants were assigned a score of 0 for each task they were unable to complete. A summary score ranging from 0 to 12 was created for each participant by adding scores for each task and categorized as poor (score 0–3), intermediate (score 4–9), or good (score 10–12).

Assessment of Cognition

To assess cognition at the Year 20 examination, a battery of neuropsychological tests was administered including Trails B (22); the Modified Mini-Mental State Examination (3MS), a 100-point extended version of the Mini-Mental State Examination (MMSE) (23); the California Verbal Learning Test (CVLT) Short Form (24); Digit Span (25); and category and verbal fluency tests (26).

Cognitive impairment at the Year 20 exam was determined in a two-step process and detailed methods of the screening and adjudication process are described elsewhere (27). First, women were screened for impairment using the expanded neurological test battery. Women who screened negative were considered to have normal cognition. Women who screened positive had their clinical cognitive status adjudicated by a panel of experts. A diagnosis of dementia was made based on Diagnostic and Statistical Manual of Mental Disorders IV criteria (28). Mild cognitive impairment (MCI) was diagnosed using a modified Petersen criteria (29,30). Participants were classified as having normal cognition, MCI, or dementia.

Outcome Measures

Data on hospitalizations and cumulative inpatient days for the 12-month period following the month of the Year 20 visit were obtained from the Medicare Provider Analysis and Review (MedPAR) File for participants enrolled in a FFS plan and from KPNW inpatient encounter files for participants enrolled in a KPNW plan.

Other Measurements

Each participant completed a questionnaire and was asked at the Year 20 examination about self-reported health, whether she lived alone, smoking, walking for exercise, and ability to perform basic activities of daily living. Women were queried about a physician diagnosis of nine selected medical conditions (see footnote Table 1) and a comorbidity score for each participant was calculated as the sum of these comorbid conditions (range 0–9). Depressive symptoms were evaluated using the Geriatric Depression Scale (31). Body weight and height were measured and body mass index was calculated. Participants were queried about race/ethnicity and education at the time of initial SOF enrollment. Data on hospitalizations in the
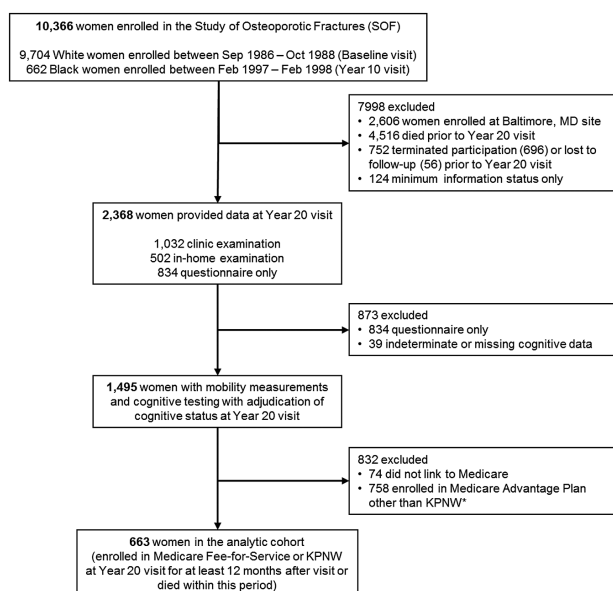
Table 1. Characteristics of 663 Women Enrolled in Medicare FFS or KPNW at Year 20 Overall and by Mobility Phenotype

Characteristic	Overall (n = 663)	Good Mobility (n = 174)	Intermediate Mobility (n = 346)	Poor Mobility (n = 143)	p Value
Age, y, mean (SD)	87.7 (3.5)	86.3 (3.2)	87.9 (3.3)	89.1 (3.7)	<.001
Age group, y, n (%)					<.001
75–79	13 (2.0)	6 (3.5)	7 (2.0)	0 (0.0)	
80–84	53 (8.0)	21 (12.1)	24 (6.9)	8 (5.6)	
85–89	416 (62.7)	125 (71.8)	218 (63.0)	73 (51.0)	
90–94	159 (24.0)	22 (12.6)	89 (25.7)	48 (33.6)	
95–100	22 (3.3)	0 (0.0)	8 (2.3)	14 (9.8)	
African American, n (%)	73 (11.0)	28 (16.1)	35 (10.1)	10 (7.0)	.007
Education, mean (SD)	13.0 (2.6)	13.2 (2.7)	13.2 (2.5)	12.2 (2.2)	<.001
Live alone, n (%)	422 (63.8)	117 (67.6)	218 (63.2)	87 (60.8)	.19
Health status, fair/poor/very poor, n (%)	149 (22.5)	22 (12.7)	75 (21.7)	52 (36.4)	<.001
Hospitalization in year prior, n (%)	147 (22.2)	25 (14.4)	68 (19.7)	54 (37.8)	<.001
Past/current smoker, n (%)	223 (33.7)	54 (31.2)	120 (34.8)	49 (34.3)	.47
GDS score (0–15), mean (SD)	2.5 (2.4)	1.5 (1.6)	2.5 (2.4)	3.8 (2.7)	<.001
BMI, kg/m², mean (SD)	26.3 (4.8)	25.9 (4.1)	26.3 (4.7)	26.9 (5.6)	.24
Comorbidity score* (0–9), mean (SD)	1.4 (1.2)	1.0 (1.0)	1.4 (1.2)	1.8 (1.2)	<.001
≥1 ADL† difficulty, n (%)	156 (23.9)	9 (5.2)	62 (18.1)	85 (60.7)	<.001
Walks for exercise, n (%)	272 (42.0)	97 (56.4)	153 (45.5)	22 (15.8)	<.001
Mild cognitive impairment, n (%)	146 (22.0)	33 (19.0)	79 (22.8)	34 (23.8)	<.001
Dementia, n (%)	136 (20.5)	13 (7.5)	72 (20.8)	51 (35.7)	

Notes: ADL = activities of daily living; BMI = body mass index; FFS = Fee-For-Service; GDS = Geriatric Depression Scale; KPNW = Kaiser Permanente Northwest; SD = standard deviation.

*A comorbidity score for each participant was calculated as the sum of the selected medical conditions including myocardial infarction, stroke, congestive heart failure, hip fracture, diabetes, arthritis, parkinsonism, chronic obstructive pulmonary disease, and cancer excluding non-melanoma skin cancer.

†ADLs assessed were bathing, dressing, and transferring.

12-month period preceding the Year 20 examination were obtained using MedPAR and KPNW inpatient encounter files.

Statistical Analysis

Characteristics of the 663 women at the Year 20 examination who were enrolled in Medicare FFS or KPNW plans (analytical cohort) were compared across the three categories of mobility and the three categories of cognition using chi-square tests (categorical variables) and analysis of variance (continuous variables).

Generalized linear models with a log link function were used for the outcome of number of inpatient days in order to obtain parameter coefficients in terms of rate ratios of mean inpatient days per year. Because the number of days did not follow a Poisson distribution, robust standard errors were used. The effects of reduced mobility and poorer cognition on the outcome of inpatient days were displayed by estimating mean days per year according to each of nine distinct combined phenotypes of mobility and cognition. Analyses were performed to determine if there was evidence of an interaction on the ratio scale between mobility (categorical variable, three levels) and cognition (categorical variable, three levels) among all women.

As the mean annualized number of inpatient days has two components (whether the participant has any hospitalizations and then the number of inpatient days if the participant has one or more hospitalizations), a two-part Hurdle Logit-Poisson model (32) was utilized to determine the independent effects of mobility on both components of hospitalization outcomes with and without adjustment for cognition (and vice versa). Bootstrapped 95% confidence intervals (CIs) were used in these models to avoid the assumption of a truncated Poisson distribution for the number of days once hospitalized. The two-part Hurdle model generated mean inpatient days per year by separately estimating the odds of being hospitalized (yes/no) using a logit function, and then among those who were hospitalized, estimating counts of inpatient days using generalized linear model regression with log link and Poisson variance functions.

Initial models were adjusted for age and site. Multivariable models were further adjusted for traditional prognostic indicators including race, health status, comorbidity score, and prior hospitalization in the past year. Sensitivity analyses were also performed to determine the impact of adjustment for additional covariates on associations of mobility and cognition with hospitalization outcomes.

Results

Among the 663 women studied, mean (SD) age was 87.7 (3.5) years (range 75–100 years) at the Year 20 examination (Tables 1 and 2). A total of 73 women (11.0%) reported African American race, 147 (22.2%) had been hospitalized at least once in the past year, and nearly all were living in the community (five women resided in nursing homes). Mean (SD) SPPB score was 6.7 (3.5); mobility was classified as poor (SPPB score 0–3) in 143 women (21.6%), intermediate (SPPB score 4–9) in 346 women (52.2%), and good (SPPB score 10–12) in 174 women (26.2%). A total of 136 women (20.5%) were classified as having dementia, 146 women (22.0%) as having MCI, and 381 women (57.5%) as having normal cognition. Coexisting deficits in mobility and cognition appeared to cluster together in the cohort. The prevalence of dementia ranged from 7.5% among women with good mobility to 20.8% among women with intermediate mobility to 35.7% among women with poor mobility. Similarly, the prevalence of poor mobility was 15.2% among women with normal cognition, 23.3% among women with MCI, and 37.5% among women with dementia. At the same time, substantial heterogeneity in combinations of mobility and cognition phenotypes was observed (Supplementary Figure 1). For example,

Table 2. Characteristics of 663 Women Enrolled in Medicare FFS or KPNW at Year 20 Overall and by Cognition Phenotype

Characteristic	Overall (n = 663)	Normal Cognition (n = 381)	Mild Cognitive Impairment (n = 146)	Dementia (n = 136)	p Value
Age, y, mean (SD)	87.7 (3.5)	87.1 (3.2)	87.9 (3.5)	89.2 (3.9)	<.001
Age group, y, n (%)					<.001
75–79	13 (2.0)	10 (2.6)	2 (1.4)	1 (0.7)	
80–84	53 (8.0)	30 (7.9)	14 (9.6)	9 (6.6)	
85–89	416 (62.7)	265 (69.5)	89 (61.0)	62 (45.6)	
90–94	159 (24.0)	73 (19.2)	35 (24.0)	51 (37.5)	
95–100	22 (3.3)	3 (0.8)	6 (4.1)	13 (9.6)	
African American, n (%)	73 (11.0)	37 (9.7)	20 (13.7)	16 (11.8)	.36
Education, mean (SD)	13.0 (2.6)	13.4 (2.5)	12.3 (2.7)	12.6 (2.5)	<.001
Live alone, n (%)	422 (63.8)	255 (66.9)	91 (62.8)	76 (56.3)	.027
Health status, fair/poor/very poor, n (%)	149 (22.5)	79 (20.7)	34 (23.5)	36 (26.7)	.15
Hospitalization in year prior, n (%)	147 (22.2)	66 (17.3)	36 (24.7)	45 (33.1)	<.001
Past/current smoker, n (%)	223 (33.7)	118 (31.0)	57 (39.3)	48 (35.6)	.18
GDS score (0–15), mean (SD)	2.5 (2.4)	2.0 (2.1)	3.0 (2.7)	3.4 (2.8)	<.001
BMI, kg/m², mean (SD)	26.3 (4.8)	26.4 (4.6)	26.4 (4.6)	25.9 (5.3)	.63
Comorbidity score* (0–9), mean (SD)	1.4 (1.2)	1.4 (1.2)	1.3 (1.1)	1.4 (1.2)	.48
≥1 ADL† difficulty, n (%)	156 (23.9)	68 (18.0)	42 (29.2)	46 (34.6)	<.001
Walks for exercise, n (%)	272 (42.0)	169 (45.6)	58 (40.6)	45 (33.8)	.018
Intermediate mobility (SPPB 4–9), n (%)	346 (52.2)	195 (51.2)	79 (54.1)	72 (52.9)	<.001
Poor mobility (SPPB 0–3), n (%)	143 (21.6)	58 (15.2)	34 (23.3)	51 (37.5)	

Notes: ADL = activities of daily living; BMI = body mass index; FFS = Fee-For-Service; GDS = Geriatric Depression Scale; KPNW = Kaiser Permanente Northwest; SD = standard deviation; SPPB = Short Physical Performance Battery.

*A comorbidity score for each participant was calculated as the sum of the selected medical conditions including myocardial infarction, stroke, congestive heart failure, hip fracture, diabetes, arthritis, parkinsonism, chronic obstructive pulmonary disease, and cancer excluding non-melanoma skin cancer.

†ADLs assessed were bathing, dressing, and transferring.

while a total of 51 women (7.7%) had both poor mobility and dementia, 46 women (6.9%) had good mobility but were cognitively impaired (33 with MCI and 13 with dementia) and 58 women (8.7%) had poor mobility but had normal cognition. Characteristics of the 663 participants enrolled in FFS or KPNW plans included in the analytical cohort did not differ from those of the 832 SOF participants attending Year 20 examination not enrolled in these two plans, with the exception that mean years of education was slightly higher among women in the analytical cohort (13.0 vs 12.6 years, p = .02; Supplementary Table 1).

During the 12-month period after the Year 20 examination, 182 women (27.5%) had at least one hospitalization. After adjustment for age and site, estimation of the combined effect of reduced mobility and poorer cognition on the outcome of mean inpatient days per year indicated that women with poor mobility and dementia had a nearly sevenfold increase in inpatient days per year (5.64, 95% CI 2.84–11.22) compared with women with good mobility and normal cognition (0.81, 95% CI 0.49–1.34; Figure 2). Although it appeared that association of dementia with greater inpatient days was most pronounced among women with poor mobility, there was no evidence that combined effects of mobility and cognition on cumulative inpatient days were multiplicative in nature (p for interaction term .52). After further accounting for race, health status, comorbidity score, and prior hospitalization, the increase in inpatient days per year was 5.8-fold higher among women with poor mobility and dementia (4.83, 95% CI 2.73–8.54) compared with women with good mobility and normal cognition (0.81, 95% CI 0.49–1.44).

In a model adjusted for age, site, race, health status, comorbidity score, and prior hospitalization, women with poor mobility compared with those with good mobility had a 1.7-fold higher odds of hospitalization (odds ratio 1.72, 95% CI 0.98–3.01) and among those hospitalized, had a 2.2-fold greater rate of inpatient days (rate ratio
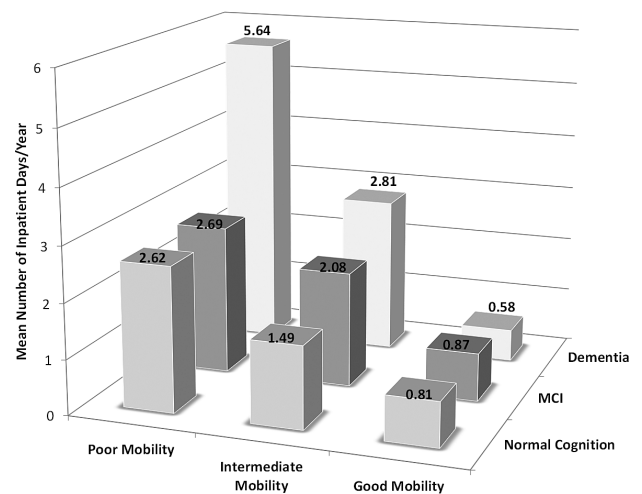
Figure 2. Mean inpatient days per year according to combined phenotype of mobility and cognition*. *Note:* *Adjusted for age and site.

2.23, 95% CI 1.31–3.59; Table 3). Among all women, mean adjusted inpatient days per year was 0.90 (95% CI 0.50–1.33) among women with good mobility, 1.94 (95% CI 1.34–2.42) among women with intermediate mobility, and 2.99 (95% CI 1.77–4.02) among women with poor mobility. After further adjustment for cognition, the association of poor mobility with the risk of hospitalization was somewhat attenuated and CIs around the point estimate of association were wider. However, consideration of cognition did not change the associations of reduced mobility with increased rate ratios of inpatient days among women hospitalized and did not attenuate the graded pattern of reduced mobility with higher mean inpatient days per year

Table 3. Effect of Mobility Phenotype on Inpatient Health Care Utilization, Adjusted for Cognition and Other Prognostic Indicators

Phenotype*	Odds Ratio (95% CI) of Hospitalization	Rate Ratio (95% CI) of Inpatient Days Among Those Hospitalized	Mean Rate of Inpatient Days (95% CI; d/y)
Base model†			
Good mobility (SPPB 10–12)	1.00 (referent)	1.00 (referent)	0.83 (0.49–1.23)
Intermediate mobility (SPPB 4–9)	1.55 (0.98–2.45)	1.72 (1.18–2.57)	2.00 (1.47–2.49)
Poor mobility (SPPB 0–3)	2.34 (1.38–3.95)	2.27 (1.44–3.73)	3.49 (2.25–5.04)
Base model† + cognition			
Good mobility (SPPB 10–12)	1.00 (referent)	1.00 (referent)	0.88 (0.51–1.29)
Intermediate mobility (SPPB 4–9)	1.43 (0.90–2.27)	1.70 (1.17–2.56)	1.96 (1.44–2.48)
Poor mobility (SPPB 0–3)	2.02 (1.18–3.47)	2.14 (1.37–3.44)	3.16 (2.03–4.39)
Multivariable model‡			
Good mobility (SPPB 10–12)	1.00 (referent)	1.00 (referent)	0.90 (0.50–1.33)
Intermediate mobility (SPPB 4–9)	1.37 (0.86–2.19)	1.70 (1.10–2.55)	1.94 (1.34–2.42)
Poor mobility (SPPB 0–3)	1.72 (0.98–3.01)	2.23 (1.31–3.59)	2.99 (1.77–4.02)
Multivariable model‡ + cognition			
Good mobility (SPPB 10–12)	1.00 (referent)	1.00 (referent)	0.94 (0.52–1.45)
Intermediate mobility (SPPB 4–9)	1.27 (0.79–2.04)	1.71 (1.09–2.66)	1.92 (1.31–2.45)
Poor mobility (SPPB 0–3)	1.51 (0.85–2.69)	2.19 (1.37–3.66)	2.80 (1.64–3.89)

Notes: CI = confidence interval; SPPB = Short Physical Performance Battery.

*Among the cohort, there were 174 women with good mobility, 346 women with intermediate mobility, and 143 women with poor mobility.

†Adjusted for age and site.

‡Adjusted for age, site, race, health status, comorbidity burden, and hospitalization in the last year.

(0.94 [95% CI 0.52–1.45] among women with good mobility, 1.92 [95% CI 1.31–2.45] among women with intermediate mobility, and 2.80 [95% CI 1.64–3.89] among women with poor mobility).

After consideration of traditional prognostic indicators and mobility, women with dementia compared with those with normal cognition had a 1.6-fold higher odds of hospitalization (odds ratio 1.62, 95% CI 1.01–2.59), but among those hospitalized, had a similar rate of inpatient days (rate ratio 1.12, 95% CI 0.71–1.65; Table 4). Among all women, adjusted mean inpatient days per year was 1.59 (95% CI 1.08–2.03) among women with normal cognition, 1.85 (95% CI 1.11–2.67) among women with MCI, and 2.53 (95% CI 1.55–3.40) among women with dementia.

Additional accounting for education, living arrangement, smoking status, walking for exercise, activities of daily living impairment, and depressive symptoms did not substantially alter the impact of mobility and cognition on hospitalization outcomes.

Discussion

In this cohort of women late in life, mobility limitations and cognitive deficits were each independent predictors of higher inpatient health care utilization in the subsequent year even after considering each other and conventional predictors for hospitalization.

Findings from several studies (2–11) have suggested a linkage between declines in mobility and cognition with aging. In support of this premise, we found that the prevalence of cognitive impairment increased with poorer mobility in our cohort of women in late life and vice versa. However, at the same time, we also observed considerable diversity in combined phenotypes of mobility and cognition indicating a complex relationship between mobility performance and cognitive function in aged populations.

In this study, mobility and cognition were independent predictors of inpatient health care utilization in the subsequent year and effects appeared additive in nature. Mean adjusted annualized inpatient days were nearly sixfold higher among women with poor mobility and dementia compared with women with good mobility and normal cognition. The association of reduced mobility with higher inpatient health care utilization was most strongly driven by increases in the number of inpatient days once hospitalized, whereas the relationship with poorer cognition and higher inpatient health care utilization was almost completely due to a greater odds of hospitalization. Two longitudinal studies in older community-dwelling adults have reported that mobility limitation is associated with a three- to fivefold higher risk of hospitalization during an average follow-up of 4–5 years (13,14), but neither study considered the effect of cognitive function on the association. Similarly, one longitudinal study (17) in older adults reported that hospitalization rate during an average follow-up of 8 years was 40% higher in individuals receiving a dementia diagnosis compared with those who remained free of dementia and another (15) found that cognitive decline over a 3-year period (but not baseline cognition) in high-functioning older adults was associated with an increased risk of hospitalization during the same period, but neither of these studies assessed the effect of mobility on the associations. Our findings are supported by those of a recent study (16) that reported that adjustment for comorbidities and lower extremity performance only modestly attenuated associations of baseline cognitive impairment and rate of cognitive decline with higher risks of subsequent hospitalization.

Deficits in mobility and cognition in this study were each strong predictors of inpatient health care utilization despite accounting for more commonly assessed patient characteristics in the practice setting including comorbidity burden and history of recent hospitalization. These findings suggest that both attributes of function may be critical to consider in medical decision making and in health care policy planning. Given the increasing societal burden of age-related decrements in mobility and cognition, our results also have implications for the design of future clinical trials of interventions including physical activity and drug treatments. These trials should evaluate the effect of any intervention in slowing rate of loss in both functional attributes and in reducing inpatient health care utilization.

Table 4. Effect of Cognition Phenotype on Inpatient Health Care Utilization, Adjusted for Mobility and Other Prognostic Indicators

Phenotype*	Odds Ratio (95% CI) of Hospitalization	Rate Ratio (95% CI) of Inpatient Days Among Those Hospitalized	Mean Rate of Inpatient Days (95% CI; d/y)
Base model†			
Normal cognition	1.00 (referent)	1.00 (referent)	1.49 (1.06–1.93)
Mild cognitive impairment	1.57 (1.02–2.42)	0.96 (0.67–1.41)	2.01 (1.27–2.77)
Dementia	1.97 (1.27–3.07)	1.43 (0.85–2.21)	3.44 (2.02–5.13)
Base model† + mobility			
Normal cognition	1.00 (referent)	1.00 (referent)	1.59 (1.14–2.01)
Mild cognitive impairment	1.49 (0.96–2.30)	0.88 (0.62–1.27)	1.88 (1.22–2.64)
Dementia	1.74 (1.10–2.73)	1.23 (0.76–1.81)	2.89 (1.69–4.12)
Multivariable model‡			
Normal cognition	1.00 (referent)	1.00 (referent)	1.51 (1.04–1.92)
Mild cognitive impairment	1.56 (1.00–2.43)	0.94 (0.64–1.38)	1.96 (1.18–2.81)
Dementia	1.73 (1.09–2.74)	1.28 (0.81–1.84)	2.86 (1.71–3.78)
Multivariable model‡ + mobility			
Normal cognition	1.00 (referent)	1.00 (referent)	1.59 (1.08–2.03)
Mild cognitive impairment	1.51 (0.96–2.35)	0.86 (0.57–1.33)	1.85 (1.11–2.67)
Dementia	1.62 (1.01–2.59)	1.12 (0.71–1.65)	2.53 (1.55–3.40)

Notes: CI = confidence interval.

*Among the cohort, there were 381 women with normal cognition, 146 women with mild cognitive impairment, and 136 women with dementia.

†Adjusted for age and site.

‡Adjusted for age, site, race, health status, comorbidity burden, and hospitalization in the last year.

This study has several strengths including the well-characterized cohort of women late in life linked to their inpatient claims data, comprehensive assessment of mobility and cognition, and consideration of major confounding and mediating factors. However, this study has limitations. The cohort was composed of predominantly community-dwelling women and results may not be generalizable to men or institutionalized populations. Data on number of hospitalizations and inpatient days were limited to SOF study participants enrolled in FFS or KPNW plans, but characteristics of SOF participants enrolled in these plans were on average similar to those among SOF participants enrolled in other health care plans who were excluded from this study. Power was limited to detect an interaction between mobility and cognition. The Year 20 examination was the last clinical examination attended by SOF participants and we were unable to examine associations of changes in mobility and cognition in late life with patterns of hospitalization. Residual confounding remains a potential explanation for our findings. For example, mobility and cognition may be markers of other life domains including environmental factors and availability of resources such as ease of transportation and availability of social support. Finally, future studies are warranted to examine additional outcomes such as total health care costs.

In conclusion, mobility limitations and cognitive deficits were each strong independent predictors of higher inpatient health care utilization among this cohort of women late in life even after considering each other and conventional indicators including comorbidity burden and prior hospitalization. Results from this study suggest that combined effects of reduced mobility and poorer cognition may be important to consider in clinical decision making and health care policy planning for the growing population of adults in the 9th and 10th decades of life.

Supplementary Material

Please visit the article online at http://biomedgerontology.oxfordjournals.org/ to view supplementary material.

Conflict of Interest

The authors report no conflicts of interest.

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