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Identifying Factors Associated with Mobility Decline among Hospitalized Older Adults

Jo-Ana D. Chase, PhD, APRN-BC,
Post-doctoral Fellow, University of Pennsylvania, 338G School of Nursing, 418 Curie Blvd., Philadelphia, PA 19104, Assistant Professor, University of Missouri – Columbia

Alicia Lozano, MS,
Master's Level Data Analyst, 418 Curie Blvd, Suite 479L, Claire M. Fagin Hall, School of Nursing, University of Pennsylvania

Alexandra Hanlon, PhD, and
Research Professor of Biostatistics, 418 Curie Blvd, Suite 479L, Claire M. Fagin Hall, School of Nursing, University of Pennsylvania

Kathryn H. Bowles, PhD, FAAN, FACMI
van Ameringen Professor in Nursing Excellence, University of Pennsylvania School of Nursing, 418 Curie Boulevard Room 340, Philadelphia, PA 19104; Director of the Center for Home Care Policy and Research, Visiting Nurse Service of New York

Abstract

Hospitalization can negatively impact mobility among older adults. Early detection of older patients most at-risk for mobility decline can lead to early intervention and prevention of mobility loss. This study's purpose was to identify factors from the International Classification of Functioning, Disability, and Health associated with mobility decline among hospitalized elders. We conducted a secondary analysis of data from 959 hospitalized adults age 65 and older. We estimated the effects of health conditions, environmental, and personal factors on mobility decline using logistic regression. Almost half of the sample declined in mobility function during hospitalization. Younger age, longer length of hospital stay, having a hearing impairment, and non-emergency admit type were associated with mobility decline, after adjusting for covariates. Findings may be used to develop an evidence-based, risk-determination tool for hospitalized elders. Future research should focus on individual, environmental, and policy-based interventions promoting physical activity in the hospital.

Keywords

older adult; aging; physical function; hospitalization

Correspondence to: Jo-Ana D. Chase.

Introduction

Mobility, an important component of physical functioning (PF), is essential to maintaining independence among chronically ill older adults. Mobility impairment has been associated with several important patient-centered outcomes including higher risk of 30-day hospital readmission (Fisher et al., 2013) and long-term disability (Fried, Bandeen-Roche, Chaves, & Johnson, 2000). Mobility impairment is also a predictor of future institutionalization (Hajek et al., 2015). Among women age 65 and older, poor mobility was not only associated with greater risk for hospitalization, but also greater number of inpatient days compared to women with good mobility (Ensrud et al., 2008). Mobility impairment is associated with a greater risk of falls which may contribute to significant injury and subsequent hospitalization among older adults (Enderlin et al., 2015; Ganz, Bao, Shekelle, & Rubenstein, 2007). Thus, mobility impairment can lead to adverse patient outcomes, as well as increase health care utilization and health care cost.

Hospitalization can negatively impact mobility due to disease processes and aspects of clinical care, such as surgical procedures and activity restriction (Brown, Friedkin, & Inouye, 2004; Brown, Redden, Flood, & Allman, 2009; Gill, Allore, Holford, & Guo, 2004; Lafont et al., 2011). Expedient recovery of baseline functioning after hospitalization can improve morbidity and mortality outcomes among older adults (Boyd et al., 2008; Boyd, Xue, Guralnik, & Fried, 2005; Han et al., 2013); however, only about one-third of patients are able to recover within a year of hospital discharge (Boyd et al., 2008, 2005; Han et al., 2013). Therefore, identifying factors associated with a decline in mobility among hospitalized older adults could lead to early identification of subgroups most at-risk, and guide the development of interventions to prevent progression of mobility impairment to disability.

The World Health Organization’s International Classification of Functioning, Disability, and Health (ICF) framework (Figure 1) is a widely-accepted framework used in interdisciplinary research describing factors associated with disability and rehabilitation (Jette, 2006; Stucki, 2016; Stucki, Cieza, & Melvin, 2007; World Health Organization, 2002). Thus, this framework was selected to be consistent with current research on PF among older adults. The ICF suggests that an individual’s PF exists on a continuum where impairment in body function and structures (e.g., knee osteoarthritis, heart failure, respiratory illness) leads to limitations in discreet activities (e.g., ability to walk up and down stairs, ability to rise from a chair, ability to walk a distance) and potential subsequent disability (e.g., inability to do laundry, ambulate in one’s household, perform self-care activities independently). The continuum of PF, from impairment to disability, is affected by health conditions and contextual factors, such as environmental and personal factors (World Health Organization, 2002). Health conditions constitute issues such as chronic or acute illnesses and factors, sensory deficits, comorbidities, and number of medications. Environmental factors may include home environments and exposure to hospital environments. Personal factors include sociodemographic factors, such as age, gender, and race/ethnicity.

Mobility limitations occur later in the ICF model, after impairments in body functions and structures occur, and relates to levels of activity and participation. Impaired mobility at the activity level may be described as impaired gait speed or balance disturbance, which can be measured by assessing performance in an isolated, clinical setting. Impaired mobility at the participation level may be described in the social context, as when an individual's ambulation is so impaired that they are unable to walk around their house independently. Measures of mobility at this level could include basic activities of daily living (ADLs) and could be operationally defined as using the ambulation component of basic ADLs.

Past research has largely focused on factors that impact composite ADLs as measures of PF outcomes versus specifically examining mobility among hospitalized older patients. For example, among personal factors, older age (Covinsky et al., 2003; Lafont et al., 2011; Mudge, O'Rourke, & Denaro, 2010) and female gender (Buurman et al., 2012; Lafont et al., 2011) appear to be at greater risk for a loss of baseline ADL. Regarding health conditions, multiple studies have demonstrated that cognitive status, especially with the presence of dementia, also could increase risk of mobility loss (Buurman et al., 2012; Lafont et al., 2011; McCusker, Kakuma, & Abrahamowicz, 2002; Mudge et al., 2010; Volpato et al., 2007; Wakefield & Holman, 2007). Additional health conditions, such as hearing and vision impairment (Buurman et al., 2012; Lafont et al., 2011), comorbities (Lafont et al., 2011), nutritional status (Mudge et al., 2010), and fall risk (Buurman et al., 2012; Lafont et al., 2011; Volpato et al., 2007) have also been linked to a decline in PF as measured by ADLs during hospitalization. Past research also suggest that environmental factors, such as living situations (Lafont et al., 2011) and socioeconomic status (Nilsson et al., 2014), could moderate risk. Although the factors listed here have been studied in relation to composite ADLs, it is plausible they also may impact the ambulation component of basic ADLs.

Studies that have specifically examined mobility outcomes among hospitalized older adults have primarily focused on developing mobility measures (Callen, Mahoney, Wells, Enloe, & Hughes, 2004; MacKnight & Rockwood, 1995), exploring mobility as a predictor for other patient outcomes (Fisher et al., 2013; Hubbard et al., 2011; Kozakai, von Bonsdorff, Sipilä, & Rantanen, 2013; Ostir et al., 2013), or testing interventions to increase mobility among hospitalized older adults (Killey & Watt, 2006; Padula, Hughes, & Baumhover, 2009; Şimşek, Yümin, Sertel, Öztürk, & Yümin, 2012; Tucker, Molsberger, & Clark, 2004). Little research has been done to identify environmental and personal factors associated with a decline in mobility or ambulation function (Zisberg et al., 2011). Therefore, the purpose of this study is to investigate a broad range of factors associated with a decline in mobility, defined by the ambulation component of basic ADLs, among hospitalized older adults. Using the ICF (World Health Organization, 2002) as a conceptual framework, we hypothesized that environmental factors, such as living alone and length of hospital stay, and personal factors, such as older age and female gender, would be associated with a decline in mobility among hospitalized older adults. We further hypothesized that health conditions, such as poorer cognitive and nutritional status, illness severity related to comorbidities, and hearing and vision deficits, would also be associated with a decline in mobility among hospitalized older adults.

Materials and Methods

This study was a secondary analysis of data obtained from a parent study designed to develop and test a new clinical decision support tool for post-acute care referrals. For the parent study, researchers obtained assessment data from the electronic health records of a stratified random sample of 1,496 patients from six hospitals located in Pennsylvania, Connecticut, and Illinois (Bowles et al, 2016). Patients were eligible for inclusion for the parent study if they were age 55 and older, were admitted and discharged from one of the four hospitals between October 2011 and July 2012, and whose stay was coded as inpatient versus observational stays. Patient selection for the parent study was stratified by primary diagnosis categories to match percentages of patients in each 16 of the most common primary diagnoses of hospitalized patient nationwide. Patients were then randomly selected within each primary diagnosis category. Data were collected by hospital staff nurses as part of a structured nursing admission assessment conducted on all new patients and from the nursing documentation as the patient was cared for during the hospital stay. The data set included 71 patient characteristics such as sociodemographic and health data as well as clinical assessments (e.g., Braden Pressure Ulcer Risk Assessment and Fall Risk), including an assessment of ADLs collected by registered nurses either upon admission assessment of the patient or in daily documentation during the hospital stay. Patients in the parent study were not followed longitudinally; therefore, no data regarding rehospitalizations were collected.

Patients were included in this secondary analysis if they were age 65 and older and were community-dwelling prior to hospital admission. Figure 2 depicts sample selection from the patients included in the parent study. We limited the sample to age 65 and older to be consistent with national and global definitions of “older adult” (Centers for Medicare and Medicaid Services, 2014; World Health Organization, 2016). The ICF framework and relevant past literature were used to guide selection of 25 variables for the present study. Some variables in the original data set were collapsed into categories as described below. Approval for the present study was obtained from the University of Pennsylvania and University of Missouri Institutional Review Boards.

Independent variables

Independent variables selected for analysis were categorized under the ICF constructs of health conditions and environmental and personal factors (Figure 1).

Health conditions—Comorbidities, number of prescribed medications, and surgeries or procedures for each patient were collected from the patients’ electronic health records. Comorbidities were identified using ICD-9 diagnosis codes on patient admission. Comorbidities were then used to calculate the age-adjusted Charlson Comorbidity Index (CCI) (Charlson, Pompei, Ales, & MacKenzie, 1987; Deyo, Cherkin, & Ciol, 1992). The CCI was developed and validated as a tool to predict mortality and assigns weights to 17 different diagnoses according to 1-year mortality risk. Higher CCI indicates greater illness severity and mortality risk. The age-adjusted CCI incorporates patient age such that an extra point is assigned to patients’ scores for each decade of age above 50 (Charlson, Szatrowski, Peterson, & Gold, 1994). Primary diagnoses were only used to describe the sample due to the large number of different diagnoses entered in patient charts. Admit type was also obtained from patient charts and categorized as emergency or not emergency (e.g., elective or transfer) admit. Self-rated health was defined using three categories: poor-fair, average, good-excellent. Self-report prior hospitalization and prior emergency room visits were dichotomized as yes/no to stays or visits within the prior six months. Patient orientation was assessed by nurses and operationally defined as oriented or not to person, place, time, and situation. To assess orientation to person, patients were asked their name. To assess orientation to place, patients were asked if they knew where they were (e.g., in the hospital). To assess orientation to time, patients were asked to provide the current day of the week, date, and year. To assess situation, patients were asked why they were in the hospital. Patients were categorized as oriented x4, indicating orientation to all four domains, or not oriented x4 (e.g., only oriented to three or less domains). Similarly nursing assessment of consciousness level was operationalized as alert or not alert. Patient-reported depression symptoms, nutrition risk based on weight loss, nutrition risk based on poor eating, and nurse-assessed vision and hearing impairments were all dichotomized (e.g., presence/absence). Fall risk was assessed by nurses using the Morse Fall Scale (Morse, Black, Oberle, & Donahue, 1989; Morse, Morse, & Tylko, 1989; Morse, 1997). The Morse Fall Scale has moderate predictive validity with a sensitivity of 0.76 (95% CI 0.70 – 0.81) and specificity of 0.68 (95% CI 0.66 – 0.70) among hospitalized patients (Aranda-Gallardo et al., 2013). Data were collapsed into risk or no risk categories. Patients who were scored at no risk on the scale were categorized as “no risk” for falls; whereas patients who scored at low, moderate, or high risk on the scale were categorized as “at risk” for falls.” Braden Pressure Ulcer Risk Assessment risk categories were similarly collapsed into risk or no risk options. A recent meta-analysis reported moderate predictive validity for this measure among hospitalized older adults, with a sensitivity of 0.71 (95% CI 0.67 – 0.74) and specificity of 0.68 (95% CI 0.67 – 0.70) (Park, Lee, & Kwon, 2016). Patients who were scored as not at risk category were categorized as “no risk” for pressure ulcers; whereas patients who scored as mild, moderate, high, or severe risk were categorized as “at risk” for pressure ulcers.

Environmental factors—Environmental factors are defined as the external, physical, and social environment in which people live and interact (World Health Organization, 2002). Living arrangement was collapsed into two categories: whether or not the patient lived in a single family home or apartment environment. Data on whether or not the patient lived alone or with someone were also collected. These data were collected by nursing staff. Different hospital environments may contribute to different patient outcomes; thus, we created a variable for each of the four hospitals from which patients were recruited. Hospital length of stay was included in the environmental category, as this variable describes duration of exposure to a specific environment. This information was collected from the hospital administrative data.

Personal factors—Personal factors include demographic variables, such as age, gender, and race/ethnicity. Age was categorized by decades (e.g., 65–74 years, 75–84 years, greater than 85 years old). Although the original data had multiple race categories, there were too few patients in some categories (e.g., Asian, Native American) to include in the analysis.

Thus, race was categorized to three levels: White, African-American, or unknown. Ethnicity was similarly categorized into non-Hispanic/Latino, Hispanic Latino, and unknown. Marital status was dichotomized into married/partnered or single. Those who were divorced or separated were determined to be single. Education was defined as up to high school only or college and beyond. These data were collected by nursing staff.

Dependent variable

Mobility was conceptually defined as ambulation function and operationalized using a single-item, ADL assessment of ambulation function performed by nurses on admission to and near discharge from the hospital. Responses were based on level of required assistance categorized as independent, assistive equipment, assistive person, assistive person and equipment, or completely dependent. To describe change in mobility for each patient, admission and discharge responses were compared and responses were dichotomized into decline or no decline in ambulation function. For example, a patient who was independent on admission, but required assistive equipment on discharge was described as having a decline in ambulation function or mobility. The "no decline" category encompassed both improvement and no change in mobility outcomes. The data set for this study only contained information on the dichotomized ambulation function variable.

Statistical Analysis

To summarize all control variables, categorical variables were described using frequencies and percentages while continuous variables were described with means and standard deviations or medians and interquartile ranges. For categorical variables, a Chi-square test of independence was used to examine differences in characteristics of patients who declined versus those that did not decline in mobility as well as to detect differences in complete and incomplete outcome data. Two sample t-tests were conducted for all continuous variables. Univariate logistic regression analyses were used to assess the individual impact of each covariate on the odds of decline in mobility.

Backwards selection was employed to fit a multivariable logistic regression model to examine the effects of environmental, personal, and health condition factors on decline in mobility. All variables significant at the 0.20 level in univariate analyses were considered in the full model. The final multivariable model using odds ratios (OR) was built using backwards selection with a stopping criteria of 0.05. The moderating effect of age×gender was examined. A significance level of 0.10 was selected for the interaction term because it requires more power and we did not wish to dismiss an important finding. The final model was adjusted for gender, age-adjusted CCI, and surgery/procedures, which were forced into the model on the basis of existing literature. Model fit was examined using the Hosmer Lemeshow goodness of fit test and the c-statistic. All statistical analyses were performed using SAS Version 9.4 (SAS Institute, Inc., 2013).

Results

Table 1 shows descriptive statistics of the sample. Of the 959 patients included in this secondary analysis, 49% experienced a decline in mobility. Age range for patients was 65 to

103. Mean age of the sample was 78.14 years (SD 8.29). Patients were predominantly White (88%), and female (56%). Only 1% of participants identified themselves as Hispanic/Latino. Fifty-three percent of patients were married and 67% did not live alone. Only about 32% of patients were educated beyond the high school level. Patients spent from one to 33 days in the hospital, with a median of 5 days (Interquartile Range=4–8). The sample was clinically complex overall, as patients took an average of 8.51 medications (SD 5.43, range 0–29) and had a mean age-adjusted CCI score of 5.58 (SD 2.36, range 2–16). Furthermore, based on Morse Fall Scale scores, 81% of patients were at risk for falls. The five most common primary diagnoses, in order of most frequent, were pneumonia, atrial fibrillation, urinary tract infection, obstructive chronic bronchitis and osteoarthrosis. Over half of the sample (57%) had a surgery or procedure during hospitalization. Most had not had a hospital stay (60%) or emergency room (58%) visit six months prior to this hospitalization. Overall 48% patients rated their health as good to excellent, about 90% were alert, and 91% were oriented to person, place, time, and situation. Most patients were not experiencing recent weight loss (96%), poor eating (93%), or depressive symptoms (93%). Although 51% of patients reported some vision impairment, 78% did not have a hearing impairment.

Table 1 provides descriptive statistics for ICF variables by decline status, along with statistical comparisons. Table 2 lists the results for the univariate analyses. The variables admit type, having a surgery/procedure, orientation, having a hospital stay in the past 6 months, presence of a hearing impairment, length of hospital stay, and age were included in a multivariable logistic regression and backward selection was used to construct the final adjusted model. For the final adjusted model (Table 3), age×gender (p=.280), was not statistically significant; therefore, it was not included in the final model. Good model fit was determined based on the Hosmer-Lemeshow Test (p = .267) and c-statistic (0.624).

Health conditions

In the univariate analyses, health condition factors of having surgery/procedure (p=.010), non-emergency admit type (p<.001), orientation times four (p =.020), and having a hearing impairment (p =.018) were statistically significantly associated with a decline in mobility. Table 3 displays the results of the final, adjusted, multivariable logistic regression model. Non-emergency admit type and having a hearing impairment remained significant health condition factors. The odds of decline for patients who had a hearing impairment were 1.58 times as large in those who did not decline in mobility (95% CI: 1.12–2.23). Patients that were non-emergency admits were 1.62 times as likely to decline in mobility versus not decline compared to patients that were emergency admits (95% CI: 1.06–2.49).

Environmental factors

Having one hospital stay in the past 6 months (p=.010) and length of hospital stay (p=.006) were significantly associated with mobility decline in the univariate analysis. In the final adjusted model, however, only longer length of hospital stay (OR 1.04; 95% CI: 1.00–1.08) remained statistically significant (Table 3).

Personal factors

Personal factors significantly associated with a decline in mobility were unknown ethnicity ($p = .008$) and age ($p < .001$) in the univariate analysis. In the final adjusted model, patients who were age 65–74 (OR: 1.68; 95% CI 1.15–2.47) or age 75–84 (OR: 2.19; 95% CI: 1.50–3.20) were more likely to decline in mobility versus not decline compared to those patients 85 years or older.

Discussion

Mobility is essential to maintaining independence and quality of life among older adults. Our study addresses an important research gap concerning the identification of factors associated with a decline in mobility among hospitalized older adults. Identifying risk factors for mobility decline in this population could lead to early identification of at-risk subgroups and guide the development of targeted interventions to prevent impairment and subsequent disability in mobility.

We hypothesized that health conditions, environmental factors, and personal factors would be associated with a decline in mobility among hospitalized patients. Although our hypotheses were supported, only a few variables from each ICF construct reached statistical significance. Two health condition-related factors were statistically significant. In our study, older patients who were admitted non-emergently were more likely to decline in mobility versus not decline. It is possible that, in our sample, patients admitted non-emergently had greater room for decline versus patients who were admitted emergently. Patients admitted non-emergently included elective admissions who may have been more ambulatory prior to admission and were being admitted for surgeries or procedures. Additional research may be needed to examine and compare admission sources as a predictor of mobility outcome in a larger, more diverse sample.

Previous research has linked sensory deficits with poor PF (Lafont et al., 2011). In our study, hearing impairment, but not vision impairment, was associated with a decline in mobility. This association could have multiple explanations. Some older patients may not have hearing aids or amplifiers given their cost, or may have chosen not to bring their hearing devices fearing they may get lost in the hospital. As a result, communication challenges with clinical staff may impact hearing impaired older patients' ability or willingness to engage in physical activity to prevent a decline in mobility (Gispen, Chen, Genther, & Lin, 2014). Research evidence has also suggested a link between hearing and balance function given the close proximity of physiologic structures attributed to both functions (Chen et al., 2015; Mikkola et al., 2015). Balance disturbances could limit activity, especially in an unfamiliar setting such as the hospital, and further impact mobility (Chen et al., 2015; Gispen et al., 2014; Mikkola et al., 2015). Limited environmental awareness and perception has also been posited as a potential factor linking hearing impairment to poor PF (Chen et al., 2015; Mikkola et al., 2015). Clinicians caring for hospitalized older patients should assess them for hearing impairments given the potential connections between sensory deficit and mobility. Efforts should be made to ensure hearing impaired older patients have access to their hearing aids or amplifiers. Furthermore, research is needed to explore the impact of interventions at the individual level, such as hearing rehabilitative interventions and the policy level, such as financial support for hearing aids, on mobility outcomes.

We also found that hospital length of stay, an environmental factor, was associated with increased odds of decline in mobility. Older adults who spend more time in the hospital may have greater illness severity, affecting their mobility. Additionally, more time in the hospital could expose older adults to more procedures, such as surgeries or invasive testing, that require limited mobility afterwards. It is well known that limited mobility and immobility during hospitalization greatly increase the risk of functional decline in this population (Brown et al., 2004, 2009; Zisberg et al., 2011). Clinicians should be cognizant of older patients' mobility in the hospital setting and evaluate rationales for orders to limit mobility. Reviewing the appropriateness of bed rest and limited mobility orders could reveal circumstances in which activity limitations could be modified to encourage greater activity among older adult patients to prevent mobility decline (Brown et al., 2004; Gill et al., 2004; Kleinpell, 2007; Yoon et al., 2015). Interventions targeting hospital environments are also needed to ensure ample opportunities to mobilize older patients. Researchers have tested physical activity interventions to increase mobility among hospitalized older adults (Drolet et al., 2013; Killey & Watt, 2006; Padula et al., 2009), as well as ways to accurately and consistently quantify mobility in this population (Brown, Roth, & Allman, 2008; Fisher et al., 2011). However, additional research is needed to test feasibility of different technologies, such as sensors or accelerometers, to evaluate continuous, real-time mobility among older adults for the duration of their hospital stay. These types of measures could be useful in early detection and prevention of mobility impairment and disability related to hospitalization.

Age was the only personal factor associated with a decline in mobility in our study. Physical and cognitive changes associated with older age may increase sedentary behavior, which could impact mobility and overall PF (Manns, Ezeugwu, Armijo-Olivo, Vallance, & Healy, 2015). Although younger age was associated with a decline in mobility in our sample, past research has demonstrated a relationship between older age and worsening PF (Buurman et al., 2012; Covinsky et al., 2003; Lafont et al., 2011; Mudge et al., 2010). Prior to hospitalization, young-older patients may be more ambulatory and have better mobility function prior to hospitalization; whereas old-older patients may already have some mobility limitations. It is possible that, in our sample, the young-older patients had more room to decline in mobility compared to the old-old. In contrast, pre-hospitalization mobility limitations among old-older patients may prompt providers to order rehabilitative therapies possibly resulting in an improvement in mobility function. When appropriate, promoting independence in activities and limiting sedentary time among all hospitalized older patients could optimize mobility function and prevent mobility decline (Boltz, Chippendale, Resnick, & Galvin, 2015; Boltz, Resnick, Capezuti, Shabbat, & Secic, 2011; Boltz, Resnick, Capezuti, Shuluk, & Secic, 2012; Resnick & Galik, 2013). For example, Boltz and colleagues (2015) demonstrated better walking performance and less cognitive symptoms among older adults with dementia who received nursing care designed to engage older patients in ADLs and physical activity. Additional research is needed to scale this type of nursing intervention to larger, more diverse older adult samples.

Study Limitations

This study has some limitations which may impact interpretation and generalizability of findings. This study is a secondary analysis of data used to develop a clinical decision support tool (Bowles et al, 2016). Thus, limitations regarding the operationalization of mobility are present. The data set used for this study included the final categorization of decline/no decline for ambulation function. Therefore, patients who may have been completely dependent in mobility function at baseline were included in this sample, creating a floor effect (e.g., patients who are completely dependent have no further room to decline based on the specific ADL ambulation categories). We excluded older adults who were admitted to the hospital from institutional settings, such as nursing homes or assisted living facilities, to mitigate the potential inclusion of patients who may be completely dependent in mobility. Regardless, such ceiling and floor effects may limit using ADLs as research measures (Hartigan, 2007). Performance-based measures of mobility, such as gait speed or 6-minute walk test, may be more accurate assessments to determine objective changes in mobility. Replication of this study or future primary research examining mobility among hospitalized older adults should involve performance-based measures of mobility.

Although the sample for the parent study was taken from multiple hospital locations across the country, racially and ethnically diverse older adults were not well represented in this study; therefore, generalizing this study's findings to more diverse populations is limited. Past research has demonstrated socioecomonic status as an important factor in mobility status (Nilsson et al., 2014). Unfortunately, we had little information on socioeconomic status of the sample, limiting our ability to fully evaluate this variable. Future research examining PF among older adults should explore important social determinants of health by including more diverse samples and examining socioeconomic variables, to ensure generalizability to a larger population, and to identify possible disparities in patient outcomes.

The analytic sample size was limited due to our age inclusion criteria. Thus it is possible that some associations that have been recognized in prior research as factors linked to PF decline, such as cognition, depression, or social factors, might also be statistically significant with a larger, more diverse sample. We used common nursing assessments to evaluate patient orientation; however, we do not have information regarding reliability and validity of these nursing assessments. Researchers may consider using more validated, objective measures of orientation in future studies.

Conclusion

Hospitalized older adults are at risk for a decline in mobility, which could ultimately impact their quality of life. Determining which older adults are at most risk for mobility decline during hospitalization is an initial step to developing interventions to prevention mobility loss. Findings from this study demonstrated non-emergent admission, the presence of a hearing impairment, longer length of hospital stay, younger age, and fewer comorbidities were significantly associated with a decline in mobility. Further research is needed to implement early risk determination among older adults admitted to the hospital, to develop feasible, real-time mobility measures, and to examine individual, environmental, and policy-based interventions to prevent mobility decline among hospitalized older adults. Moreover, additional research is needed to identify factors associated with mobility decline among more racially and ethnically diverse older patients.

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Biography

Dr. Chase is a Ruth L. Kirschtein Postdoctoral Fellow, Ms. Lozano is a Master's Level Data Analyst, Dr. Hanlon is a Research Professor of Biostatistics, Dr. Bowles is a van Ameringen Professor in Nursing Excellence at the University of Pennsylvania School of Nursing, Philadelphia, Pennsylvania. Dr. Chase is also Assistant Professor at the University of Missouri Sinclair School of Nursing, Columbia, Missouri. Dr. Bowles is also Director of the Center for Home Care Policy and Research at the Visiting Nurse Service of New York, New York, New York.

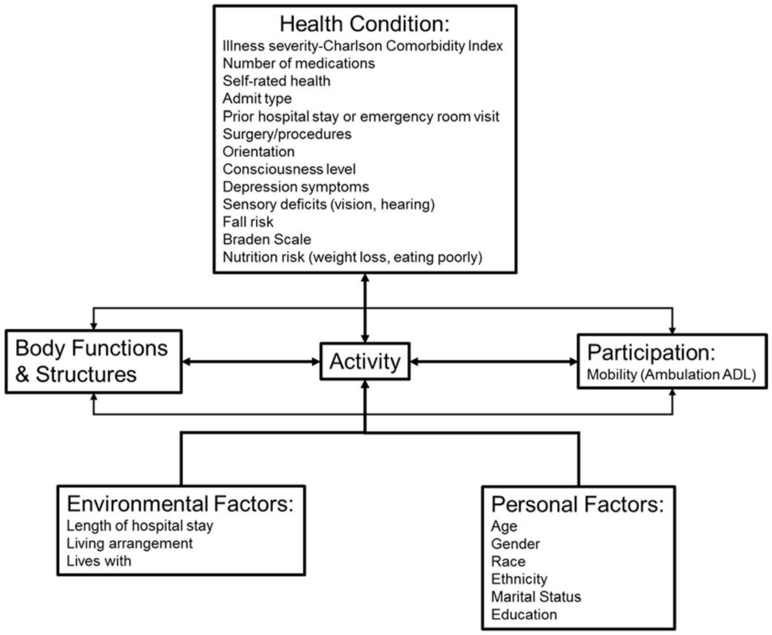

Figure 1.
Conceptual Model

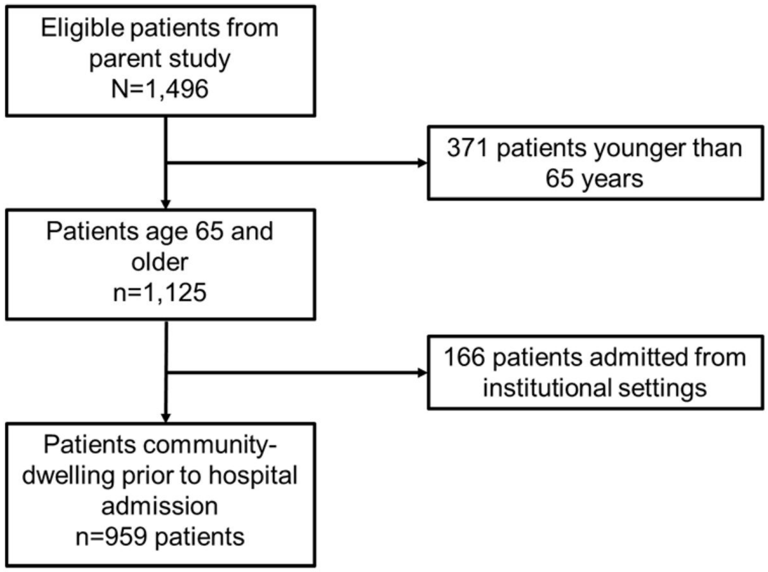

Figure 2.
Sample selection from parent study patients

Table 1

Participant Characteristics of Decline vs. No Decline in Ambulation Function

Variable	Overall N (%) Mean±SD	Decline N (%) Mean±SD	No Decline N (%) Mean±SD	P–value*
Sex				.545
Female	486 (55.61)	243 (56.64)	243 (54.61)	
Male	388 (44.39)	186 (43.36)	202 (45.39)	
Race				.255
White	737 (88.16)	365 (89.46)	372 (86.92)	
Black/African-American	99 (11.84)	43 (10.54)	56 (13.08)	
Ethnicity				.008
Non-Hispanic/Latino	523 (59.84)	236 (55.01)	287 (64.49)	
Hispanic/Latino	13 (1.49)	5 (1.17)	8 (1.80)	
Unknown	338 (38.67)	188 (43.82)	150 (33.71)	
Education				.274
Up to high school only	550 (68.24)	263 (66.41)	287 (70.00)	
College and Beyond	256 (31.76)	133 (33.59)	123 (30.00)	
Age				<.001
65–74 years old	375 (39.10)	183 (42.66)	172 (38.65)	
75–84 years old	340 (35.45)	160 (37.30)	127 (28.54)	
85 years and older	244 (25.44)	86 (20.05)	146 (32.81)	
Living Arrangement				.500
House/Mobile home	712 (84.56)	357 (85.41)	355 (83.73)	
Other community dwelling (e.g., apartment)	130 (15.44)	61 (14.59)	69 (16.27)	
Lives With				.323
Alone	273 (32.54)	128 (30.92)	145 (34.12)	
Not alone	566 (67.46)	286 (69.08)	280 (65.88)	
Marital Status				.294
Married or life partner	408 (46.90)	235 (54.91)	227 (51.36)	
Not married	462 (53.10)	193 (45.09)	215 (48.64)	
Hospital Stay Past 6 Months				.287
None	484 (59.98)	226 (57.22)	258 (62.62)	

Variable	Overall N (%) Mean±SD	Decline N (%) Mean±SD	No Decline N (%) Mean±SD	P–value*
Once	199 (24.66)	105 (26.58)	94 (11.65)	
Two or More	124 (15.37)	64 (16.20)	60 (14.56)	
Emergency Room Visit Past 6 Months				.215
None	465 (57.98)	219 (27.31)	246 (59.85)	
Once	204 (25.44)	98 (25.06)	106 (25.79)	
Two or More	124 (15.37)	74 (18.93)	59 (14.36)	
Surgery or Procedure				.010
No	373 (42.73)	164 (38.32)	209 (46.97)	
Yes	500 (57.27)	264 (61.68)	236 (53.03)	
Hospital				.731
1	238 (24.82)	104 (24.24)	108 (24.27)	
2	243 (25.34)	110 (25.64)	117 (26.29)	
3	231 (24.09)	98 (22.84)	112 (25.17)	
4	247 (25.76)	117 (27.27)	108 (24.27)	
Length of Hospital Stay Median (IQR=Q1-Q3)	5 (4)	6 (4)	5 (3)	.005
Age-adjusted Charlson Comorbidity Index	5.58 ± 2.36	5.53 ± 2.37	5.61 ± 2.35	.607
Number of Medications	8.51 ± 5.43	8.63 ± 5.51	8.51 ± 5.42	.738
Admit Type				<.001
Emergency	730 (83.52)	337 (78.55)	393 (88.31)	
Not emergency	144 (16.48)	92 (21.45)	52 (11.69)	
Self-Rated Health				.974
Poor to fair	171 (20.28)	82 (20.00)	89 (20.55)	
Average	269 (31.91)	137 (31.64)	132 (32.20)	
Good to excellence	403 (47.81)	207 (47.81)	196 (47.80)	
Orientation				.020
Oriented x4**	765 (91.40)	386 (93.69)	379 (89.18)	
Not oriented x4	72 (8.60)	26 (6.31)	46 (10.82)	
Consciousness Level				.323
Alert	761 (89.85)	379 (90.89)	382 (88.84)	
Confused or not alert	86 (10.15)	38 (9.11)	48 (11.16)	

Variable	**Overall N (%) Mean±SD**	**Decline N (%) Mean±SD**	**No Decline N (%) Mean±SD**	**P–value***
Fall Risk Score				.715
Not at fall risk	165 (18.94)	83 (19.44)	82 (18.47)	
At fall risk	706 (81.06)	344 (80.56)	362 (81.53)	
Braden Scale Score				.473
Not at risk	595 (68.08)	297 (69.23)	298 (66.97)	
At risk	279 (31.92)	108 (25.17)	127 (28.54)	
Weight Loss				.657
No	822 (96.14)	406 (96.44)	416 (95.85)	
Yes	33 (3.86)	15 (3.56)	18 (4.15)	
Eating Poorly				.879
No	797 (93.22)	393 (93.35)	404 (93.09)	
Yes	58 (6.78)	28 (6.65)	30 (6.91)	
Depression Symptoms				.473
No	713 (91.29)	345 (90.55)	368 (92.00)	
Yes	68 (8.71)	36 (9.45)	32 (8.00)	
Vision Impairment				.669
No	387 (48.93)	179 (48.12)	208 (49.64)	
Yes	404 (51.07)	193 (51.88)	211 (50.36)	
Hearing Impairment				.018
No	636 (78.23)	288 (74.61)	348 (81.50)	
Yes	177 (21.11)	98 (25.39)	79 (18.50)	

Note.

* *p*-values from chi-square test for categorical variables or two-sample t-test for continuous variables.

** *Orientedx4* indicates orientation to person, place, time, and situation.

Table 2

Odds of Decline in Ambulation Function Based on Univariate Analysis

Variable	OR	95% CI	P-value
Sex			
Female	1.09	0.83 – 1.42	.545
Male	REF	REF	
Race			
White	REF	REF	
Black/African-American	0.78	0.51 – 1.19	.256
Education			
Up to high school only	0.85	0.63 – 1.14	.275
College and Beyond	REF	REF	
Age			
65–74 years old	1.81	1.29 – 2.53	.001
75–84 years old	2.14	1.50 – 3.05	<.001
85 years and older	REF	REF	
Living Arrangement			
House/Mobile home	REF	REF	
Other community dwelling (e.g., apartment)	0.88	0.61 – 1.28	.501
Lives With			
Alone	REF	REF	
Not alone	1.16	0.87 – 1.55	.323
Marital Status			
Married or life partner	REF	REF	
Not married	1.15	0.88 – 1.51	.295
Hospital Stay Past 6 Months			
No	REF	REF	
Once	1.28	0.92 – 1.78	.150
Two or More	1.22	0.82 – 1.81	.329
Emergency Room Visit Past 6 Months			
No	REF	REF	
Once	1.04	0.75 – 1.44	.822

Variable	OR	95% CI	P-value
Two or More	1.41	0.96 – 2.08	.083
Surgery or Procedure			
No	REF	REF	
Yes	1.43	1.09 – 1.87	.010
Hospital			
1	0.89	0.61 – 1.29	.539
2	0.87	0.60 – 1.26	.452
3	0.81	0.55 – 1.18	.267
4	REF	REF	REF
Length of Hospital Stay	1.05	1.02 – 1.09	.006
Age-adjusted Charlson Comorbidity Index	0.99	0.93 – 1.04	.607
Number of Medications	1.00	0.98 – 1.03	.737
Admit Type			
Emergency	REF	REF	
Not emergency	2.06	1.43 – 2.99	<.001
Self-Rated Health			
Poor to fair	0.96	0.65 – 1.40	.819
Average	REF	REF	
Good to excellence	0.98	0.72 – 1.34	.912
Orientation			
Oriented x4*	REF	REF	
Not oriented x4	0.56	0.34 – 0.92	.021
Consciousness Level			
Alert	REF	REF	
Confused or not alert	0.80	0.51 – 1.25	.324
Fall Risk Score			
Not at fall risk	REF	REF	
At fall risk	0.94	0.67 – 1.32	.715
Braden Scale Score			
Not at risk	REF	REF	

Variable	OR	95% CI	P-value
At risk	0.90	0.68 – 1.20	.473
Weight Loss			
No	REF	REF	
Yes	0.85	0.43 – 1.72	.659
Eating Poorly			
No	REF	REF	
Yes	0.96	0.56 – 1.64	.879
Depression Symptoms			
No	REF	REF	
Yes	1.20	0.73 – 1.98	.473
Vision Impairment			
No	REF	REF	
Yes	1.06	0.80 – 1.41	.669
Hearing Impairment			
No	REF	REF	
Yes	1.50	1.07 – 2.10	.018

Note. OR=odds ration; 95% CI=95% confidence interval; REF=reference category.

[*] *Orientedx4* indicates orientation to person, place, time, and situation.

Table 3

Odds ratios for Multivariable Logistic Regression Analysis of Decline in Ambulation Function on Various Characteristics

Variable	OR	95% CI	P-value
Age			
65–74 years old	1.68	1.15 – 2.47	.008
75–84 years old	2.19	1.50– 3.20	<.001
85 years and older	REF	REF	REF
Length of Hospital Stay	1.04	1.00 – 1.08	.035
Admit Type			
Emergency	REF	REF	
Not emergency	1.62	1.06 – 2.49	.026
Surgery or Procedure			
No	REF	REF	
Yes	1.26	0.93 – 1.70	.136
Hearing Impairment			
No	REF	REF	
Yes	1.58	1.12 – 2.23	.009
Age-adjusted Charlson Comorbidity Index	1.03	0.97 – 1.10	.376
Gender			
Male	REF	REF	
Female	1.15	0.86 – 1.54	.338

Note. OR=odds ration; 95% CI=95% confidence interval; REF=reference category