Trajectories and Predictors of Functional Capacity Decline in Older Adults From a Brazilian Northeastern Hospital

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ABSTRACT

Background and Purpose: Older adults face increased risk of loss of functional capacity both before and during hospitalization, so identifying older adults at risk for loss in functional capacity during hospitalization would help researchers and clinicians make informed decisions. This study aims to evaluate functional changes from preadmission (baseline) until discharge of hospitalized older adults and identify predictors of loss in functional capacity.

Methods: This is a prospective cohort study conducted at a tertiary care hospital in Natal, Brazil, and enrolled all consecutive patients aged 60 years and older between January 1, 2014, and April 30, 2015. Independent variables included personal characteristics, instrumental activities of daily living (IADL) (evaluated by the Lawton and Brody scale), cognition (evaluated by the Leganés cognitive test), depression (assessed by the Geriatric Depression Scale—15), and in-hospital mobility (evaluated by the Short Physical Performance Battery). The dependent variable functional capacity was assessed by the Katz scale. These instruments were applied at 2 different times: upon admission (within first 24 hours) and at discharge (12-24 hours before). Functional trajectories were defined as the course of functioning from preadmission until discharge using functional capacity data. A multivariate analysis with generalized estimating equation estimated the longitudinal changes in functional capacity.

Results and Discussion: The final sample consisted of 1191 older adults and 53.9% were less than 70 years of age. Regarding changes in functional capacity, 52.5% of the older adults presented worse functional capacity at discharge than at baseline. Being dependent for IADL instrumental daily living activities, the presence of depressive symptoms, low levels of cognition, and in-hospital mobility were risk factors for greater loss in functional capacity during a hospitalization event.

Conclusion: Hospitalization events may be catastrophic for functional capacity in older adults in Brazil. Functional, cognitive, and emotional status and in-hospital mobility must be carefully assessed at hospital admission and monitored during hospitalization. Effective strategies for preventing loss in functional capacity in older people must improve in the Brazilian hospital system.

Key Words: aged, functioning, hospitalization, mobility limitation

CLINICAL HIGHLIGHTS

• Functional capacity decline (FCD) in older adults can occur prior to and during hospitalization.
• Hospitalization increases the odds of FCD, especially in those 85 years of age or older, who were dependent in IADLs and/or had depression before or at the time of admission. Having better cognition and higher in-hospital mobility protected against FCD.
• To prevent FCD in hospitalized older adults, screening for high risk of decline and referral of at-risk older adults for rehabilitation therapies and depression management should be considered.

INTRODUCTION

Functional trajectory in hospitalized older adults is a complex dynamic process, which may include loss before admission and recovery or loss in the hospital setting. However, most prior studies on functional changes in hospitalized older adults have entirely focused on rates of functional loss between admission and discharge, or between admission and postdischarge. To our knowledge, only 1 study has investigated functional changes since preadmission (2 weeks before) until discharge. Older adults can increase
the risk of loss of functional capacity both before and during hospitalization. Predictors of functional loss in prior studies include older age, sociodemographic characteristics, preexisting loss in instrumental activities of daily living (IADL) depression, cognitive status, comorbidity, length of stay, and admission service. In-hospital mobility is directly related to posthospitalization functional outcomes and is one of the strongest predictors of loss in functional capacity. Older adults with functional limitations are rendered more vulnerable to the effects of hospitalization.

Brazil has been experiencing an accelerated process of population aging in the last decades. However, the Brazilian public primary health care system is still not prepared to face this change in the demographic profile, which leads to a large number of hospitalized older adults. Because of sociocultural diversity, especially in less-favored economic regions, the health and functional capacity of the older population in these locations deserve special attention to implement effective strategies for preventing loss in functional capacity. Few studies about the hospitalization effects on older adults have been conducted, and those carried out in Brazil were done on populations from the Southeast region, which is the wealthiest region.

Identifying older adults at risk for loss in functional capacity during hospitalization would help researchers and clinicians make informed decisions about appropriate interventions to avoid this issue. The scarcity of studies evaluating the full trajectory of functional changes from preadmission until discharge has led us to develop this study, which sought to evaluate functional changes in hospitalized older adults from preadmission until discharge and to identify predictors of loss in functional capacity. The purpose of this study was also to explore whether the predictors of functional loss identified in other countries (age, gender, instrumental activities of daily living, cognition, depression, in-hospital mobility, and surgery) were similar in the Brazilian context.

METHODS

Study Design and Eligibility Criteria
A prospective cohort study was conducted at the Unofre Lopes University Hospital, a tertiary care 300-bed hospital in Natal, Rio Grande do Norte, Brazil. Data were collected between January 2014 and April 2015. The study enrolled all consecutive patients aged 60 years and older who were acutely admitted and met the following inclusion criteria: (1) ability to provide informed consent; (2) admitted directly from the community; and (3) screening for study eligibility performed in the first 24 hours of admission. Patients were excluded if they were admitted directly to the intensive care unit, or if they were discharged to another hospital or rehabilitation center instead of to home.

Independent Variables
Personal and health data were collected by a questionnaire, including age, gender (male/female), marital status (single/married/divorced), length of hospital stay (days), performed surgery (yes/no), and death. Age was categorized into 6 groups (60-64, 65-69, 70-74, 75-79, 80-84, and 85 and more) to detect possible differing findings in young and oldest old.

Instrumental activities of daily living were evaluated by the 8-item Lawton and Brody scale. Each activity is scored 0 (dependent) or 1 (independent) with an overall score of 0 to 8, with higher scores meaning greater independence. The stability of the Brazilian version of these measures can be classified as almost perfect agreement, both for the reliability (ICC = 0.89) as for the objectivity (ICC = 0.80).

Cognitive capacity was measured by the Leganés cognitive test with an overall score of 0 to 32 and cutoff point of ≤22 (indicative of dementia). Leganés cognitive test has acceptable levels of reliability for use in low-educated Brazilian older adults. Depressive symptoms was obtained by the Geriatric Depression Scale (GDS-15) with a cutoff point of 6 or more indicating depression. The test-retest reliability of short versions of the GDS for Brazilian older adults was evaluated and total GDS-15 scores were reasonably stable, as assessed by paired Wilcoxon (z = 1.60, P = .109), Spearman correlation coefficient (ρ = 0.86, P < .001), and weighted κ (κ = 0.64).

In-hospital mobility was assessed by the Short Physical Performance Battery (SPPB). Participants score in the “unable to perform” category if they try but are unable or if the interviewer or the participant feels that it is unsafe. A summary performance score is obtained for each participant by adding the 3 individual categorical scores together (range: 0-12). The SPPB measures lower limb strength, balance, and gait speed and there and evidence supports the validity and reliability of SPPB in diverse populations. Also, this test has been found to be predictive of nursing home admissions, rehospitalization, loss of functional mobility/disability, and all-cause mortality.

Dependent Variable
Functional capacity was assessed by the Katz scale. For the 6 activities of daily living (ADLs) (bathing, dressing, transferring, going to the bathroom, continence, and eating), patients were quoted by interview as independent (score = 1) if able to perform each activity without assistance, or dependent (score = 0) if not able to perform or if they needed assistance. Scores range from 0 to 6 points, with higher scores meaning greater independence. An overall score is created for each time point (baseline, admission, and discharge) and defined as the number of ADL activities in which the older adult was independent. Functional capacity decline was defined as a loss of at least 1 point (activity) on the Katz scale between baseline and admission and/or between admission and discharge evaluation.

Data Collection
Trained physiotherapists collected data using a standardized interview. Data were obtained at 2 different times: at admission and at discharge. Upon admission, older adults answered questions regarding their functional capacity.
2 weeks before hospitalization (ie, baseline). Studies of hospitalized older people regularly use this time point because it reflects the patient’s functional capacity before the onset of the acute illness episode that necessitated hospitalization.\(^1\) The respondent was asked to report information about social and health characteristics, domestic life activities, functional capacity, cognition, and depression. Data were obtained from a caregiver if the patient was not able to answer. At discharge (12-24 hours before), the patient's current ability to perform the Katz activities, the Cognitive Legané's test, the GDS-15, and SPPB was assessed again. Information regarding length of stay, surgery, inhospital physiotherapy, or death was obtained from the medical chart.

Analysis

Six functional trajectories were observed for the description of functioning trajectories from baseline (2 weeks prior to admission) until discharge: trajectory 1: no decline between baseline and admission, or between admission and discharge; trajectory 2: no decline between baseline and admission, and decline between admission and discharge; trajectory 3: decline between baseline and admission, and improvement between admission and discharge; trajectory 4: decline between baseline and admission, and no decline between admission and discharge; trajectory 5: decline between baseline and admission, and decline between admission and discharge; and trajectory 6: death during hospitalization.

Mann-Whitney test was used to compare the means of functional capacity score at the 3 different times of evaluation (baseline, admission, and discharge) and the functional capacity at discharge (dependent or independent). To provide the smallest change of functional capacity score that can be interpreted as real change above variability in performance or measurement error, we calculated the minimal detectable change as follow: \(1.96 \times \sqrt{2} \times SEM\).\(^{21}\) The minimal detectable change found was 0.86. The factors associated with longitudinal functional capacity changes were analyzed in a multivariate analysis by the generalized estimating equation,\(^{22}\) fitting logistic regression; thus, the results are presented as odds ratio (OR) with corresponding 95% confidence intervals (95% CIs). A variable time was entered in the model representing the 3 assessment time points (2 weeks before admission, on admission, and discharge). Trajectory 6 was excluded from the sample descriptive analysis and generalized estimating equation analysis. Data were analyzed using the SPSS version 18.0.

Ethical Considerations

This study was approved by the ethics committee of the Onofre Lopes University Hospital (certificate 496.645/2013).

RESULTS

From all patients admitted in the hospital between January 2014 and April 2015, 1297 patients agreed to participate (77%); 41 patients (3.2%) were excluded during the study because of missing information at discharge.

### Table 1. General Characteristics of the Hospitalized Older Adults at Admission and Discharge (n = 1191)

| Variable                  | n (%)       | M (SD) |
|---------------------------|-------------|--------|
| Admission                 |             |        |
| Age, y                    |             |        |
| 60-64                     | 350 (27.9)  |        |
| 65-69                     | 327 (26)    |        |
| 70-74                     | 256 (20.4)  |        |
| 75-79                     | 178 (14.2)  |        |
| 80-84                     | 93 (7.4)    |        |
| ≥85                       | 52 (4.1)    |        |
| Gender                    |             |        |
| Male                      | 507 (42.6)  |        |
| Female                    | 684 (57.4)  |        |
| Marital status            |             |        |
| Single                    | 283 (23.8)  |        |
| Married                   | 790 (66.3)  |        |
| Not married               | 118 (9.9)   |        |
| Domestic activities (Lawton scale—IADL) | | |
| Independent               | 189 (15.9)  |        |
| Dependent                 | 1002 (84.1) |        |
| Cognitive impairment (Legané cognitive test, cutoff point ≥22) | | |
| No                        | 997 (83.7)  |        |
| Yes                       | 194 (16.3)  |        |
| Depression (GDS-15, cutoff point ≥6) | | |
| No                        | 1050 (83.6) |        |
| Yes                       | 206 (16.4)  |        |
| Discharge                 |             |        |
| Surgery                   |             |        |
| Yes                       | 880 (71.0)  |        |
| No                        | 359 (29.0)  |        |
| Physiotherapy             |             |        |
| Yes                       | 245 (20.6)  |        |
| No                        | 946 (79.4)  |        |
| Mobility (SPPB—total score, 0-12) | 5.20 (±3.77) | |
| Length of stay, d         | 7.65 (±9.94) |        |
| Total                     | 1191 (100)  |        |

Abbreviations: GDS, Geriatric Depression Scale; IADL, instrumental activity of daily living; SPPB, Short Physical Performance Battery.

Descriptive data of the participants are presented in Table 1. The mean length of hospital stay was 7.6 days (±9.9). Our sample had a high prevalence of surgery (70.1%) and the most common were prostatectomy (n = 212, 17.8%) and cholecystectomy (n = 143, 12.0%).

The 6 functional trajectories are represented in the Figure. At baseline (2 weeks before admission), 72.0% (n = 904) of older adults were independent for all ADL...
activities. Regarding functional capacity, we observed that 47.8% (n = 570) did not present functional decline between baseline and discharge (Figure). This includes 40.6% of older adults from trajectory 1 (stable functional capacity throughout their hospitalization), and 7.2% from trajectory 3 (had decline in function before hospitalization but recovered to their baseline functional capacity at discharge). A total of 52.2% of older adults had decline in functional capacity between baseline and discharge. This includes those 26% older adults from trajectory 2 (decline between admission and discharge), and 25.6% and 0.6% from trajectories 4 (decline before hospitalization and unable to recover to baseline functional capacity at discharge) and 5 (decline in functional capacity at baseline and had additional decline during hospitalization). Trajectory 6 included those 5.1% (n = 65) older adults who died in the hospital. From those, 58.4% (n = 38) did not present decline in functional capacity between baseline and admission, meaning that they were independent at the moment of admission.

The means of functional capacity in the 3 distinct moments of evaluation were different according to the functional capacity at discharge as shown in Table 2. Those considered dependent at discharge presented lower functional capacity 3.00 (1.58) than those at baseline 4.99 (1.58) exceeding the minimal detectable change estimated for this sample.

Generalized estimating equation was used to characterize and to estimate the predictors of longitudinal changes on functional capacity at baseline, admission, and discharge. As shown in Table 3, time (P < .001), age (P = .002), ADLS (P < .001), cognition (P < .001), depression (P < .001), and in-hospital mobility (P < .001) were predictors of the longitudinal changes in functional capacity. This model indicates that functional capacity varies according to time. This also means that just the fact of being hospitalized increases the odds (OR = 1.8; 95% CI, 1.69-1.96) for presenting loss in functional capacity. When stratified according to age-decade-specific, we observed that the older patients are at a higher risk for presenting decline in longitudinal functional capacity than the younger patients (OR = 1.76; 95% CI, 1.23-2.52). Dependence to perform IADLs instrumental activities of daily living (OR = 2.02; 95% CI, 1.52-2.68) and depression (OR = 1.77; 95% CI, 1.43-2.20) increases the odds to present decline in functional capacity. Cognition and in-hospital mobility are protective factors against longitudinal decline in functional capacity, where older adults with a higher level of cognition were less likely to present decline in functional capacity (OR = 0.94; 95% CI, 0.92-0.97). In a similar way, those with a higher level of in-hospital mobility were less likely than their counterparts to have decline in functional capacity at hospital discharge (OR = 0.86; 95%CI, 0.84-0.89).

**DISCUSSION**

Given the importance of decline in functional capacity for quality of life and maintaining independence in older...
adults, understanding its trajectories is relevant for preventing limitations and has important implications for therapeutic decisions on clinical practice and public health policies. This fact became more relevant for older adults who were hospitalized, since this event may be catastrophic for their functional capacity. We observed that 52.5% of older adults presented with decline in functional capacity at discharge. Of those patients discharged with worse functional capacity than at baseline, half of them presented decline in function between baseline and discharge. Moreover, a large number of older adults who were stable at admission presented decline in functional capacity during hospitalization. Only 7.2% of our sample was able to recover their baseline functional capacity at discharge. This result is opposite to the findings by Covinsky et al.,\(^1\) who observed that half of the patients who lose functional capacity before hospitalization recovered to their baseline level of function before discharge, thus demonstrating that functional recovery is also common after hospital admission. Results suggest that the process of hospitalization may play a different role in functioning of Brazilian older adults, demonstrating the high functional decline vulnerability of this population. Our previous studies on biological, social, and life course adversity aspects have demonstrated high levels of frailty, functional, and mobility incapacity on community-dwelling older people living in this region.\(^23,24\)

Regarding functional capacity predictors, our results corroborate studies where older adults were more likely to present functional decline than younger adults.\(^1,4\) Also, similar results such as being dependent for daily living activities, presence of depression symptoms, low levels of cognition, and in-hospital mobility were risk factors for greater decline in functional capacity after a hospitalization event. Dependent patients for daily living activities at admission had 2 times more chance to develop decline in functional capacity in our study. This represents pronounced vulnerability for future health conditions after hospital discharge. Previous studies have also shown an association between depression symptoms, cognitive impairment, and functionality in hospitalized older adults, and Brazilian patients presented similar percentages to international populations.\(^5,25,26\)

Although length of stay in hospital and surgery are considered predictors of functional decline,\(^27\) they did not present an association in the final longitudinal analysis model in our study. The study sample had characteristics that can influence these results; the majority of admissions in the study hospital were cases for selective and eligible surgical procedures, so these aspects determine short periods of hospitalization and specific clinical procedures that may not impact on patients’ functional parameters.

Preventing decline in functional capacity associated with hospitalization is possible only if modifiable risk factors are identified. Although we identified a set of risk factors for decline in functional capacity, only in-hospital mobility could be modified by intervention during hospitalization. Our results demonstrated that each point on the SPPB scale decreases the odds of decline in functional capacity during hospitalization by 0.86 times. Current literature emphasizes the importance of in-hospital mobility for preventing adverse effects of hospitalization.\(^28,29\) Lack of inpatient mobility can be especially devastating to older adults. Daily assessments could monitor mobility, track changes, and help in setting therapeutic goals to prevent or minimize decline of functional abilities.\(^26\) By accurately evaluating mobility, at-risk patients can be identified by acute care physiotherapists and future interventions be planned to prevent or slow decline in functional capacity or promote functional recovery. Nevertheless, in this study, only those patients with formal prescription by a physician received physical therapy and generally, this happens to those who present more severe disease; thus, only a few patients did exercises during hospitalization mainly targeting respiratory function recovery.

Some limitations need to be addressed. First, once older adults had been included in the study, we reevaluated only

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Table 2. Total Score for Functional Capacity (Katz Scale) at the 3 Evaluation Moments by Functional Capacity at Discharge

| Variables         | Functional Capacity at Discharge, M (SD) | P\(^a\) |
|-------------------|-----------------------------------------|--------|
|                   | Dependent | Independent |        |
| Baseline          | 5.0 (1.6)  | 5.9 (0.6)    | <.001  |
| Admission         | 4.7 (1.8)  | 5.7 (0.9)    | <.001  |
| Discharge         | 3.0 (1.7)  | 6.0 (0.3)    | <.001  |

\(^{a} P\text{ value from Mean-Whitney test.}\)

Table 3. Predictors of Loss in Functional Capacity From Generalized Estimating Equation Regression Models\(^b\)

| Variables                        | Odds Ratio | 95% CI  | P     |
|----------------------------------|------------|---------|-------|
| Time                             | 1.8        | 1.68-1.93 | <.01 |
| Age, y                           |            |         |       |
| 60-64                            | 1.0        |         |       |
| 65-69                            | 1.0        | 0.78-1.33 | .86  |
| 70-74                            | 0.9        | 0.68-1.20 | .50  |
| 75-79                            | 0.9        | 0.65-1.19 | .41  |
| 80-84                            | 1.3        | 0.82-1.93 | .27  |
| ≥85                              | 1.7        | 1.02-2.67 | .03\(^a\) |
| Gender (men)                     | 0.9        | 0.71-1.00 | .18  |
| Instrumental activities of daily living | 2.1    | 1.57-2.80 | <.01 |
| Cognition                        | 1.7        | 1.35-2.22 | <.01 |
| Depression                       | 1.8        | 1.47-2.23 | <.01 |
| Mobility                         | 0.9        | 0.84-0.89 | <.01 |
| Surgery                          | 1.1        | 0.84-1.29 | .65  |

\(^{b}\) The model also included length of stay, as a confounder, which was not significant.

\(^{a} P < .05.\)

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their functional capacity at discharge. We know that a significant amount of variability in functional capacity occurs during hospitalization and it is likely that some older adults had recovery and subsequent decline in functional capacity between admission and discharge.38 We believe that repetitive evaluations of functional capacity during the hospital stay could more accurately identify the functional changes. Second, our research was carried out at a high complexity hospital that restricts the generalizability of our findings and limits it to this subset of acute care patients. Finally, we had very few people aged 80 years or older, an age group in which the decline in functional capacity is more pronounced. This reflects the current Brazilian’s life expectancy, which is around 74.6 years of age. Third, the ADL function was measured on the basis of self-report and it is possible that results might have been different for performance-based measures, though there is evidence of the validity of patient reports of ADL function.31

On the contrary, our study presented relevant strengths contributing to knowledge on functional capacity of hospitalized older adults. Our sample was representative from the whole population admitted to the hospital. We also highlighted the importance to identify at which moment decline in functional capacity occurred (baseline, admission, and discharge), so that future interventions could be addressed according to each moment.

CONCLUSION
Hospitalization events may be catastrophic for the functional capacity of older adults in Brazil. Functional, cognitive, and emotional status, and in-hospital mobility must be carefully assessed at hospital admission and monitored during hospital stay. Effective strategies for preventing decline in functional capacity in older adults must improve in the local hospital system. Time, age, ADLs, cognition, depression, and in-hospital mobility were recognized as predictors for functional decline in this population. Identifying patients at risk for decline in functional capacity from baseline would help clinicians and researchers better define early interventions to maintain or recover functional capacity during hospitalization. So, this study reinforces the need for nonpharmacological interventions such as a proper physical therapy monitoring for all older patients as a strategy to improve clinical practice in a Brazilian tertiary hospital.

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