BASELINE FUNCTIONAL STATUS AND ONE-YEAR MORTALITY AFTER HOSPITAL ADMISSION IN ELDERLY PATIENTS: A PROSPECTIVE COHORT STUDY

FUNCIONALIDAD BASAL Y MORTALIDAD AL AÑO DEL EGRESO HOSPITALARIO EN ADULTOS MAYORES: UN ESTUDIO DE COHORTE PROSPECTIVA

FUNCIONALIDADE BASAL E MORTALIDADE UM ANO APÓS A ALTA HOSPITALAR EM IDOSOS: UM ESTUDO DE COORTE PROSPECTIVO

V.P. Sáenz[1], N. Zuljevic[2], C. M. Elizondo[3], I. M. Lesende[4], D. Caruso[5]

Este estudio es de gran relevancia, ya que permite identificar a los adultos mayores que presentan mayor riesgo perder su autonomía, con el fin último de fortalecer los esfuerzos necesarios para evitar este deterioro, tanto previo a la internación como durante la misma; y una vez brindado el alta hospitalario, favorecer la rehabilitación y recuperación de la funcionalidad de los pacientes.

Conceptos claves:

A) Qué se sabe sobre el tema: se conoce la asociación que existe entre la pérdida de funcionalidad al egreso hospitalario y resultados negativos en el corto y el largo plazo en adultos mayores, tales como re internación y mortalidad.

B) Qué aporta este trabajo: poco se conoce del impacto del estado previo a la hospitalización y su influencia en estos resultados, lo cual refleja la reserva funcional de los adultos mayores de nuestro medio.

1 Médica, especialista en Medicina Interna. Gerente del área de *Real World Evidence* en el laboratorio Roche. ORCID: 0000-0002-4392-5885. Email de contacto: victoriapsaenz@gmail.com

2 Médico especialista en Terapia Intensiva. Hospital General de agudos "Juan A. Fernández" Ciudad Autónoma de Buenos Aires/ Hospital Interzonal general de agudos "General San Martín", La Plata, Provincia de Buenos Aires. ORCID: 0000-0002-2216

3 Médica del área de investigación en Medicina Interna y Docente de Doctorado de Ciencias de la Salud y Secretaria académica de la Maestría de Investigación Clínica. ORCID: 0000-0002-3262-2176

4 Médico, especialista en Medicina Familiar, investigador en atención ambulatorio en adultos mayores. miembro de la línea de Prevención y Manejo de la fragilidad del Ministerio de Sanidad de España. Investigador principal del estudio de validación del cuestionario VIDA (Vida Diaria del Anciano). ORCID: 0000-0001-7258-5288

5 Médico, especialista en Medicina Interna. Médico del servicio de Medicina Interna de la Unidad Asistencial Dr. César Milstein, Coordinador y miembro del comité de ética en investigación clínica de esta institución. Docente del curso internacional de la American Thoracic Society, Methods in Epidemiological, Clinical and Operational Research program. Magíster en investigación clínica. ORCID: 0000-0003-2981-7981

Resumen:

Introducción: la hospitalización representa un factor que puede favorecer la pérdida de la funcionalidad. El objetivo principal de este estudio fue determinar el efecto de la funcionalidad previa a la admisión hospitalaria sobre la sobrevida al año del egreso, en pacientes adultos mayores.
Métodos: este estudio de cohorte prospectiva incluyó pacientes de 65 años o mayores que fueron hospitalizados en la sala general o la unidad de terapia intensiva en un hospital universitario de la ciudad de Buenos Aires, Argentina. La funcionalidad basal fue medida a través del cuestionario VIDA modificado, el cual evalúa las actividades instrumentales de la vida diaria. Utilizamos un modelo multivariable de Cox para estimar el efecto de la funcionalidad basal sobre la sobrevida al año posterior al egreso, el cual permitió ajustar por potenciales confundidores. Además, analizamos el efecto de la funcionalidad luego del egreso hospitalario sobre la mortalidad al año del mismo.
Resultados: se incluyeron 297 pacientes, de los cuales 12.8% fallecieron durante la hospitalización, y 86 pacientes (33.2%) fallecieron dentro del año del egreso hospitalario. Un aumento de un punto en la escala de la funcionalidad basal (es decir, mejor funcionalidad), se asoció a una disminución en el riesgo de muerte al año del egreso (Hazard Ratio [HR]: 0.96; Intervalo de confianza [IC] 95%: 0.94–0.98). Por último, la declinación funcional posterior al egreso hospitalario se asoció a un mayor riesgo de muerte durante el seguimiento (HR: 2.19, IC 95%: 1.09–4.37).
Conclusión: la funcionalidad previa a la hospitalización de los adultos mayores impacta en los resultados a largo plazo luego de una hospitalización.

Palabras clave: actividades cotidianas; fragilidad; personas con discapacidad; mortalidad; anciano.

Abstract:

Introduction: Hospitalization represents a major factor that may precipitate the loss of functional status and the cascade into dependence. The main objective of our study was to determine the effect of functional status measured before hospital admission on survival at one year after hospitalization in elderly patients.
Methods: Prospective cohort study of adult patients (over 65 years of age) admitted to either the general ward or intensive Care units (ICU) of a tertiary teaching hospital in Buenos Aires, Argentina. Main exposure was the pre-admission functional status determined by means of the modified "VIDA" questionnaire, which evaluates the instrumental activities of daily living. We used a multivariate Cox proportional hazards model to estimate the effect of prior functional status on time to all-cause death while controlling for measured confounding. Secondarily, we analyzed the effect of post-discharge functional decline on long-term outcomes.
Results: 297 patients were included in the present study. 12.8% died during hospitalization and 86 patients (33.2%) died within one year after hospital discharge. Functional status prior to hospital admission, measured by the VIDA questionnaire (e.g., one point increase), was associated with a lower hazard of all-cause mortality during follow-up (Hazard Ratio [HR]: 0.96; 95% Confidence Interval [CI]: 0.94–0.98). Finally, functional decline measured at 15 days after hospital discharge, was associated with higher risk of all-cause death during follow-up (HR: 2.19, 95% CI: 1.09–4.37).
Conclusion: Pre-morbid functional status impacts long term outcomes after unplanned hospitalizations in elderly adults. Future studies should confirm these findings and evaluate the potential impact on clinical decision-making.

Keywords: activities of daily living; frailty; disable persons; mortality; aged.

Resumo

Introdução: a hospitalização representa um fator que pode favorecer a perda de funcionalidade. O principal objetivo deste estudo foi determinar o efeito da funcionalidade anterior à admissão hospitalar na sobrevida um ano após a alta em pacientes idosos.
Métodos: Este estudo de coorte prospectivo incluiu pacientes com 65 anos ou mais de idade internados na enfermaria ou unidade de terapia intensiva de um hospital universitário da cidade de Buenos Aires, Argentina. A funcionalidade da linha de base foi medida através do questionário VIDA modificado, que avalia as atividades instrumentais da vida diária. Utilizamos um modelo multivariável de Cox para estimar o efeito da funcionalidade da linha de base na sobrevida um ano após a alta, o que permitiu o ajuste para possíveis fatores de erro. Além disso, tambem foi avaliado o efeito da funcionalidade após a alta hospitalar na mortalidade um ano após a alta.
Resultados: foram incluídos 297 pacientes, dos quais 12,8% obitaram durante a internação e 86 pacientes (33,2%) foram a óbito dentro de um ano após a alta hospitalar. Um aumento de um ponto na escala da funcionalidade da linha de base (ou seja, melhor funcionalidade) foi associado a uma diminuição do risco de morte um ano após a alta (Hazard Ratio [HR]: 0,96; Intervalo de Confiança [IC] 95) %: 0,94-0,98). Finalmente, o declínio funcional após a alta foi associado a um risco aumentado dos casos de óbito durante o acompanhamento (HR: 2,19, IC 95%: 1,09–4,37).
Conclusão: a funcionalidade anterior à hospitalização dos idosos afeta os resultados a longo prazo após a hospitalização.

Palavras-chave: atividades cotidianas; fragilidade; pessoas com deficiência; mortalidade; idoso.

Introduction

Aging is associated with progressive loss of adaptive capacity. In healthy older adults, multiple physiological functions are in equilibrium, but exposure to stressful situations can rapidly change such state and make the deficit in functional reserves evident.[1] Hence, the assessment of this functional reserve provides additional information regarding the patient's health and potential outcomes. The importance of this assessment lies within the ability to identify those patients with less functional reserve who - when faced with acute stress - might face the irreversible loss of their functional status or death.[2]

Hospitalization represents a major factor that may precipitate the loss of functional status and the cascade into dependence.[3,4,5] In recent years, several authors have shown that loss of functional status may arise both from individual risk factors (linked to lifestyle and comorbidities) and extra-individual factors such as hospitalization.[6,7] In this context, older adults represent a particularly vulnerable population. In this regard, patients with functional limitations in mobility and in the instrumental activities of daily living (IADL) at baseline show greater functional decline and mortality at 3 and 12 months after hospitalization.[8, 10] On the other hand, this impact may be heightened by the presence of depression, cognitive impairment, social isolation and low socioeconomic status.[9 10]

The factors that determine functional decline and mortality after an index hospitalization have been evaluated both in high-income and developing countries. Of note, different socio-cultural contexts are a key limitation to the extrapolation of these results. To our knowledge, no studies have evaluated this issue in Latin America in general and Argentina in particular. Therefore, the primary objective of this study was to determine the effect of functional status before an unplanned hospital admission on survival during one year follow-up after discharge in patients older than 65 years of age. Our secondary objective was to assess the effect of functional decline secondary to hospitalization on mortality during one-year follow-up in elderly patients. Our overall aim is to better inform decision making for elderly patients both during and after the occurrence of an acute illness.

Methods

Design, Setting, and Participants

We conducted a prospective cohort study which consecutively included patients over 65 years of age admitted for at least 72 hours to the general hospital ward or the intensive care unit (ICU) of a tertiary teaching hospital in Buenos Aires, Argentina (Unidad Asistencial Dr. Cesar Milstein, UACM). Admissions considered were due to an acute medical condition (e.g., unplanned, non-surgical).

UACM is a medium-complexity university hospital that has an in-hospital care capacity of 200 beds, including critical care units, and only provides care to those affiliated with the Argentinian Institute of Social Services for Retirees and Pensioners (*Instituto Nacional de Servicios Sociales para Jubilados y Pensionados*, [PAMI]). Patients were enrolled between April 2015 and January 2016. The protocol was approved by the research ethics committee of the Hospital Italiano de Buenos Aires (protocol number: 2408/March, 2015) and by the Teaching and Research Committee of the UACM. The patients or their relatives gave their written informed consent before enrollment. Investigators received training on Good Clinical Practices, adhered to the principles of the amended declaration of Helsinki and the data obtained was protected in accordance with the regulations of the Argentinian Personal Data Protection Act, Law 25,326/00.

Definition of Variables

We defined an acute medical condition as an unscheduled hospital admission that did not require surgical intervention within the first 48 hours. We excluded patients who had prior hospitalizations within the past 3 months, those with severe

dependence according to the Katz Activities of Daily Living scale,[11] patients that would meet terminal illness criteria,[12] and patients whose reason for hospitalization was an acute structural neurological disease.

Our main exposure, pre-morbid functional status, was defined and measured using the modified "VIDA" questionnaire, which evaluates ten IADL, with no gender bias, by means of a Likert-like scale. This scale ranges from 10 points, maximum dependence, to 39 points, no dependence.[13] The questionnaire was conducted at the time of inclusion in the study, and represents baseline functional status in the 2 weeks prior to hospital admission. We defined functional decline 15 days after discharge as a decline of at least two points in the modified VIDA questionnaire scale from the baseline scores. We selected this cut-off value because it represents additional dependence in at least one instrumental activity of daily living.

In addition, we collected demographic, clinical, functional and breadwinner data [14] as well as variables related to hospitalization. In order to the assess for prevalent comorbidities, we used the CIRS-G score.[15] This score assesses 13 organ systems with 5 severity levels, 0 = no problem affecting that system, 4 = extremely severe problems with organ failure or severe functional impairment. The minimum score is 0 and the maximum, 52. Patients were classified according to the presence of at least one level-4 comorbidity.

Furthermore, to determine the severity of the acute pathology at the time of hospital admission, we used the SAPS 3 score.[16] Finally, we assessed the occurrence of hospitalization-related complications as predictors of decline or death. We defined the variable "hospitalization-related complications" by the presence of at least two of the following: acute delirium, admission to an ICU, hospital-acquired infection (e.g., pneumonia or line-related sepsis), development of pressure ulcers, days of complete bed rest, dialysis, surgery or invasive ventilation during hospital stay and hospital discharge to a long-term facility (e.g., not home-discharge).

Research assistants conducted telephone follow-ups at two and three weeks after hospital discharge. They administered the previously validated modified VIDA questionnaire[13] and collected information on mortality and readmissions. Research assistants received two training sessions of one hour each related to study procedures and data entry before beginning the study. Our main outcome, all cause death, was measured by the previously mentioned scheduled follow-up but also captured by means of the PAMI public registry so as to minimize loss to follow-up and misclassification.

Statistical Analysis

We reported continuous variables as either means and standard deviations (SD) or medians and interquartile ranges (IQR), according to their distribution and reported categorical variables as frequencies and proportions.

In order to estimate the effect of pre-hospitalization functional status on time to all-cause mortality, we fitted a multivariable Cox proportional hazards model. This model included the exposure as a main effect, in addition to potential measured confounders selected by prior subject matter knowledge, in addition to a significant association on the bivariate analysis (at the p <0.2 level).

Furthermore, in order to estimate the effect of functional decline after hospital discharge, we carried out a similar analysis, but excluding those patients who died during hospital stay or within the first 15 days after hospital discharge. We assessed the potential interaction between functional decline and functional status prior to hospital admission. To that end, we categorized patients into two groups according to their baseline functional status: preserved functional status versus impaired functional status. We established the cut-off value of 30 points on the modified VIDA questionnaire on the basis of its alignment with the Lawton and Brody scale in accordance with findings from the study performed by Soler-König *et al.* [13]

As a secondary analysis, we first assessed the interaction between functional decline at 15 days and prior functional impairment, and second, we assessed the association between

functional decline at 15 days and readmission within 3 months, stratified according to the modified VIDA questionnaire on admission.

We tested the proportional hazards assumption using log-log plots and Schoenfeld residuals. We used p < 0.05 for statistical significance and all reported p values are two sided.

Finally, we assessed the survival curve at 1 year in patients with and without functional decline within 15 days after hospital discharge.

STATA (StataCorp. 2013. *Stata Statistical Software: Release 13*. College Station, TX: StataCorp LP) was used for all statistical analysis.

Sample size calculation

For our sample size calculation, we used the recommendations of Peduzzi and Vittinghoff, of 10 events for each variable included in the model. [17,18] We calculated that 291 patients should be included given a mortality rate at one year of 30% and the need of seven independent variables, while taking into account a loss to follow-up of 10%, and an in-hospital mortality of 15%.

Results

We evaluated a total of 882 patients who were admitted to the hospital during the study period. Of these 297 patients met the eligibility criteria and were included in the present report (see figure 1). Thirty-eight patients (12.8%) died during initial hospitalization. Of the 259 patients who survived hospitalization, 13 (5%) died within the first 15 days after discharge. Finally, during long term follow-up, we could not determine the functional status of 16 patients (6.5%).
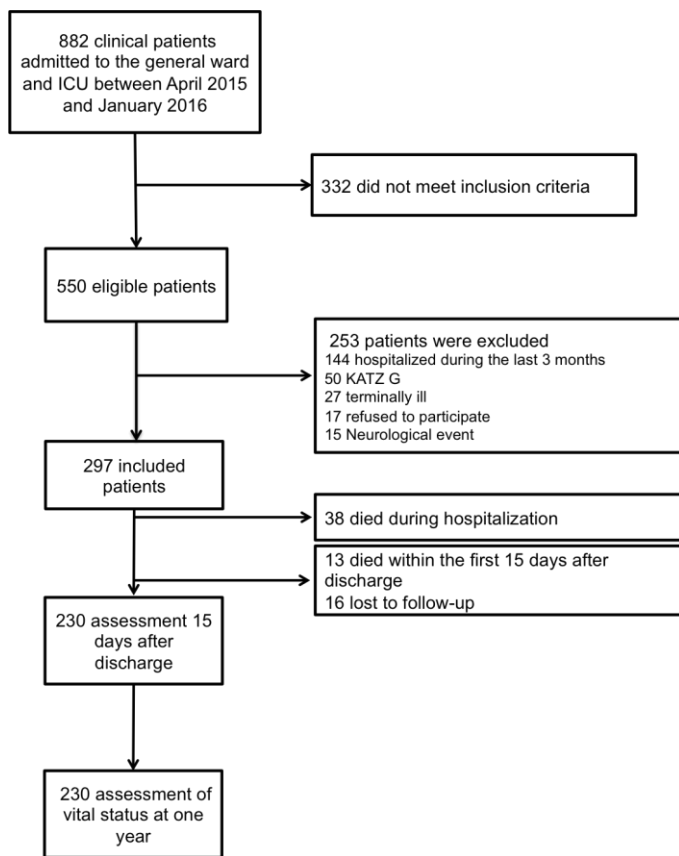

Figure 1. Flow chart of study patients

The median age of included patients was 77 years (IQR 71-83), and 169 patients (56.9%) were female. 43.8% lived with a spouse or partner and 163 (55.1%) had no education above elementary school. The mean CIRS-G comorbidity score was 11.9 ± 4.3 points and the index (total score/ organ systems affected) provided a mean score of 2 ± 0.4, which indicates that, on average, the patients presented a severity of 2 points in 6 organ systems (Table 1).

Table 1. Demographic characteristics and comorbidities of included patients

	n=297	
Age, median (IQR)	77 (71-83)	
Female Sex, n (%)	169 (56,9)	
Lives with a spouse or partner, n (%)		
No	152 (51,2)	
Yes and does not live with spouse or partner	15 (5,0)	
Yes and lives with spouse or partner	130 (43,8)	
Level of education, n (%)		
Incomplete and complete elementary school	163 (55,1)	
Incomplete and complete secondary school	85 (28,7)	
Incomplete or complete tertiary or university education	48 (16,2)	
Total years of formal education, mean (SD)	8,5	(4)
Prior hospitalization (between 3 months and 1 year)	42	14,2
Social risk, Gijon scale, mean (SD)	5,94	(1,84)
Low risk Gijon, n (%)	248	(83,5)
Intermediate and high risk Gijon, n (%)	49	(16,5)
Total CIRS-G comorbidities score, mean (SD)	11,9	(4,3)
CIRS G index*, mean (SD)	2.0 (0,4)	
At least one comorbidity with severity level 4, n (%)	113	(38)
Level of perceived health (n= 247), n (%)		
Good and very good	119	(48,2)
Fair	98	(39,7)
Poor or very poor	30	(14,2)

*CIRS-G index= total score/amount of categories with severity >0

Regarding the main causes of hospitalization, 117 (40%) were due to an infectious cause, 52 (18%) to a metabolic and/or hydro electrolytic disorder, and 26 (8.8%) to an oncological or onco-hematological disorder. 94% of the patients were initially admitted to the General Ward. During hospitalization, 135 patients (45%) had at least one complication and 82 patients (28%) had at least two. The median hospital stay was 8 days (IQR 5–13) (Table 2).

Table 2. Hospitalization conditions

	Mean (N)	SD (%)
Reason for admission		
Infectious cause (without sepsis)	117	39,7
Metabolic/ hydroelectrolytic disorder	52	17,6
Onco-hematological/ oncological disorder	26	8,8
Thromboembolic disease	24	8,1
Cardiovascular cause	21	7,1
Diseases of the digestive system	21	7,1
Other causes	34	11,5
Hospital admission to General Ward	279	93,9
SAPS 3 score	52	8,7
At least two complications during hospital stay	82	28
Total length of stay (days) median and IQR	8	5-13
ICU stay length (days) median and IQR (n = 41)	8	3-14

A total of 86 patients (33.2%) died during the first year following hospital discharge. Of those patients, 54 (62.8%) died within the first 3 months. In the same period, 67 (25.5%) patients required readmission. Of the 230 patients who were discharged and had a functional status assessed after, 157 (68.3%) showed functional decline within 15 days.

In the adjusted multivariable model, the score on the VIDA questionnaire prior to hospital admission was associated with mortality at one year (Hazard ratio [HR] 0.96; 95% Confidence Interval [CI] 0.94-0.98; p=.006 for a point increase in the questionnaire's score). Both the presence of at least one maximum severity comorbidity (HR 1.68; 95% CI 1.15-2.44; p=.006), and SAPS 3 score (HR 1.03; 95% CI 1.01-1.05; p=.002) were associated with a higher risk of all cause death during follow-up, based on a multivariable Cox proportional hazards model including age, male gender and prior hospitalization.

Functional decline measured at 15 days after hospital discharge, was associated with a higher mortality risk during one-year follow-up (HR 2.19; 95% CI 1.09–4.37, p=.02), based on a multivariable Cox proportional hazards model including the presence of at least two complications during the hospitalization, SAPS 3 score and hospital stay longer than 7 days.

Secondary analysis

We did not find a significant interaction when analyzing the effect of functional decline at 15 days across functional status subgroups prior to admission (dichotomized in: 1) higher than 30 points (preserved functional status) and 2) lower than 30 points (impaired functional status)). Specifically, in patients who had impaired functional status before admission, the decline 15 days after hospitalization, although not statistically significant, could be associated with one-year mortality regardless of events during hospitalization. Conversely, in patients with preserved functional status, events during hospitalization were associated with one-year mortality after hospital discharge whereas functional decline 15 days after hospital discharge was not (p=.10). (Tables 3 and 4).

Table 3. Factors associated with mortality at one year in patients with functional assessment 15 days after hospital discharge (N = 230).
Patients with preserved prior functional status (Modified VIDA questionnaire score greater than or equal to 30 points)

Variable	Adjusted HR	95% CI	p
Functional decline 15 days after hospital discharge	2,22	0,85–5,84	0,104
Presence of at least two complications during hospitalization	2	0,90–4,45	0,089
SAPS 3 score	1,06	1,02–1,10	0,002
Hospital stay longer than 7 days	0,95	0,44–2,01	0,894

Table 4. Factors associated with mortality at one year in patients with functional assessment 15 days after hospital discharge (N = 230).
Patients with impaired prior functional status (Modified VIDA questionnaire score lower than 30 points)

Variable	Adjusted HR	95% CI	P
Functional decline 15 days after hospital discharge	2,68	0,99–7,38	0,056
Presence of at least two complications during hospitalization	1,5	0,57–3,89	0,404
SAPS 3 score	1,02	0,98–1,06	0,267
Hospital stay longer than 7 days	0,82	0,32–2,05	0,673

Finally, the survival curves of those patients with functional decline and those who maintained their functional status after hospitalization were significantly different, with a decrease in one-year survival in those patients with decline (log-rank test p= .003) (Figure 2).
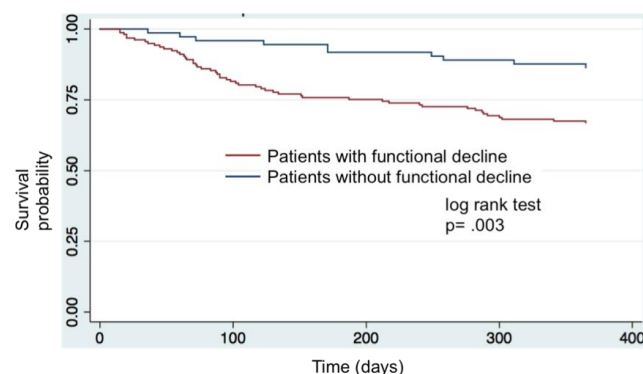
Figure 2. Survival curves in patients with and without functional decline after hospital discharge

Discussion

Our study shows that baseline functional status affects the survival of hospitalized elderly patients in a tertiary teaching centre in Argentina. Moreover, we also show that functional decline in IADL 15 days after hospital discharge is associated with a doubling of the risk of all cause death during the first year of follow-up after hospital discharge among older adults. To our knowledge, this is the first study evaluating this topic in our setting.

Our results are consistent with previously published data. For example, a study by Matzen et al. showed that functional level at the time of hospital admission, measured by the Barthel index, was an independent predictor of survival at 3 and 12 months.[2] Moreover, Portegijs et al. have shown that failure to regain function 3 months after hospital discharge predicted institutionalization of patients within 12 months.[19] Likewise, Sleiman et al. demonstrated that inability to recover baseline functional status during hospitalization was a factor associated with a higher risk of death at 3 months after hospital discharge.[20] In another cohort of older adults (mean age 77.9 years) with follow-up at 5 years, age and deterioration of the IADL were associated with mortality at 5 years after hospitalization.[22]

Our study seems to indicate that, in patients with previously impaired functional status, the decline observed 15 days after could possibly be a consequence of the body's inability to adapt to the events that caused hospitalization due to a low functional reserve, together with factors associated to hospitalization, such as prolonged immobilization. Moreover, in patients with preserved functional status, the severity of the pathology at the time of hospitalization, expressed by SAPS 3, could in turn determine the impact on mortality. Hence, the slight decline in functional status that was observed in this sub-group could thus be a consequence of the acute condition that led to hospitalization. These patients appear to present with a higher functional reserve and better recovery capacity. On the other hand, complications during hospitalization appear to have an effect on mortality, but our study was not adequately powered to assess such relationship.

Our study presents with several limitations. First, we did not include patients with surgical admissions nor stroke. We specifically decided to exclude these subgroups of patients since there is extensive data on their trajectories and may have distinct underlying mechanisms for change in functional status and recovery. However, this may impact the generalizability of our results. Second, our observational design may render our effect estimates to be subject to either residual or unmeasured confounding. However, we have used robust regression methods based on subject matter knowledge, present consistent sensitivity analysis and had information available on a-priori considered confounders owing to the prospective nature of our study. Third, the fact that we included patients from a single centre may also affect the generalizability of our results. However, our hospital takes care of a broad population of patients with varied socio-economic backgrounds likely improving the generalizability to other settings in our country and Latin America.

Conversely, our study has several strengths. Namely, this was a prospective cohort study allowing for the specific collection of relevant variables. Moreover, we had a specially trained group of researchers and low loss to follow-up, decreasing the risks of selection bias. Finally, to our knowledge, this is the first study evaluating the association between functional status and outcomes in elderly patients in Argentina.

Conclusion

Impaired functional status, measured by autonomy in IADL prior to hospital admission is associated with increased risk of death during one-year follow-up after discharge in elderly patients. Patients who are discharged from hospital and regain their functional status appear to have better outcomes. Further studies should, 1) evaluate the usefulness of the VIDA score in decision-making regarding patient-centered outcomes and 2) assess the potential to reverse the decreased functionality associated with hospitalization and the potential reduction in long- term outcomes.

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