Unravelling decline of physical functioning in acutely hospitalized older patients

From risk factors to targeted intervention

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Factors associated with step numbers in acutely hospitalized older adults: The Hospital-ADL study

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Abstract

Objectives: To determine the number of steps taken by older patients in hospital and one week after discharge; to identify factors associated with step numbers after discharge; and to examine the association between functional decline and step numbers after discharge.

Design: Prospective observational cohort study conducted in 2015–2017.

Setting and Participants: Older adults (≥ 70 years) acutely hospitalized for at least 48 hours at internal, cardiology, or geriatric wards in six Dutch hospitals.

Methods: Steps were counted using the Fitbit Flex® accelerometer during hospitalization and one week after discharge. Demographic, somatic, physical, and psychosocial factors were assessed during hospitalization. Functional decline was determined one month after discharge using the Katz-ADL index.

Results: The analytic sample included 188 participants [mean age (standard deviation) 79.1 (6.7)]. One month post discharge, 33/174 participants (19%) experienced functional decline. The median number of steps was 656 (interquartile range [IQR], 250–1146) at the last day of hospitalization. This increased to 1,750 (IQR, 675–4,114) steps one day post discharge, and to 1,997 (IQR, 938–4,098) steps seven days post discharge. Age (β = -57.93; 95% confidence interval [CI], -111.15 to -4.71), physical performance (β = 224.95; 95% CI, 117.79–332.11), and steps in hospital (β = 0.76; 95% CI, 0.46–1.06) were associated with steps post discharge. There was a significant association between step numbers after discharge and functional decline one month after discharge (β = -1400; 95% CI, -2380 to -420; P = .005).

Conclusions and Implications: Among acutely hospitalized older adults, step numbers double one day post discharge, indicating that their capacity is underutilized during hospitalization. Physical performance and physical activity during hospitalization are key to increasing the number of steps post discharge. The number of steps one week after discharge is a promising indicator of functional decline one month after discharge.

Introduction

Physical activity is very limited in hospitalized older adults,[1-5] and is associated with functional decline,[1,6-8] readmissions,[9,10] and mortality.[4,11,12] Functional decline, described as new or additional difficulties performing one or more activities of daily living (ADL),[13] is a major problem and is highly prevalent in older adults after acute hospitalization.[8,14-17] More than 30% of acutely hospitalized older adults experience functional decline at discharge, and only one-third of these adults recover their premorbid functional level one month after discharge.[14] The first month after discharge is a critical recovery period, during which new functional disabilities have a high risk of becoming permanent.[14]

To prevent functional decline, the World Health Organization (WHO) recommends keeping older adults as physically active as their abilities and conditions allow.[18] However, physical condition and the ability to be physically active are greatly affected in acutely ill older adults during hospitalization.[19] It is known that physical activity is reduced during hospitalization, but levels of physical activity after discharge have not been well studied.[20] Physical activity, defined as "any bodily movement produced by skeletal muscles that requires energy expenditure",[21] can be objectively monitored as step numbers in older adults, using accelerometers.[4,6,10,20] One study using accelerometers showed that taking less than 900 steps per day during hospitalization is associated with functional decline at discharge.[6] Several studies have shown that physical activity interventions can improve physical performance in older adults,[15,22-24] but reversing functional decline in the first month after discharge remains challenging.[15]

To optimize in-hospital and post-discharge rehabilitation strategies to prevent or reverse eventual functional decline, we need more information on the number of steps taken after discharge and how the number of steps taken relates to functional decline. A previous study[20] showed that the number of steps taken in the first week after discharge was associated with 30-day readmission in older adults, indicating that the level of physical activity soon after discharge is a physical marker of readmission risk and overall health. Based on these findings, we hypothesized that step numbers one week after discharge are associated with functional decline one month after discharge. The aims of this study were to: i) determine step numbers in hospital and up to one week after discharge in acutely hospitalized older adults; ii) identify independent predictors of step numbers after discharge; and iii) examine the association between functional decline and step numbers after discharge.

Methods

Study Participants

Participants were from the Hospital-Associated Disability and impact on daily Life (Hospital-ADL) study, a multicenter observational prospective cohort study evaluating the mechanism of hospital-associated functional decline among 401 older adults aged 70 years and over, who were acutely admitted to six Dutch hospitals for ≥ 48 hours between October 2015 and June 2017.[25] Further inclusion criteria were: 1] approval of the medical doctor; 2] Mini-Mental State Examination (MMSE) score ≥ 15;[26] and 3] sufficient understanding of the Dutch language to answer the questionnaires. Persons were excluded if they: 1] had a life expectancy of less than 3 months or 2] were dependent on help for all six basic ADLs (bathing, dressing, eating, toileting, transferring, and maintaining continence).[27] There were no further exclusion criteria regarding walking ability. To determine whether a patient was eligible for inclusion, the researcher asked the attending medical doctor for approval before approaching the patient. Participants were recruited from internal medicine, cardiology, and geriatric wards and were asked to provide written consent before inclusion. All participants gave additional consent to wear an activity tracker during hospitalization and after discharge. The study was approved by the institutional review board. The study was conducted according to the Dutch Medical Research Involving Human Subjects Act and principles of the Declaration of Helsinki (1964). Local approval was provided by all participating hospitals.

Assessments
Demographics, malnutrition, and cognitive functioning of participants were assessed at admission. Comorbidities were retrieved from medical records. Other variables in physical, functional, and psychological domains that might change during hospitalization were assessed at discharge, which was considered the most optimal time-point to identify older adults at risk of insufficient recovery post discharge. Trained researchers administered the standardized study protocol. At one month post discharge, all participants were asked to rate their functionality in performing ADLs.

Counting Steps
The primary outcome was the number of steps taken per day in hospital and up to one week after discharge. For the second and third study aims, the primary outcome was the number of steps taken post discharge. Steps were counted using the Fitbit Flex® activity tracker (Fitbit®, Inc., San Francisco); an accurate activity tracker to estimate step counts compared to the gold standard Actigraph ($r = .96$).[28] The Fitbit Flex® is worn on the non-dominant wrist[29] and is user-friendly, which limits study withdrawal.[30] The activity tracker was worn continuously from hospital admission to one week after discharge. Participants were asked to wear the device at all times, except during charging (1–2 hours per week). Step data were frequently synced to the Fitbit platform and exported at the end of the study. Step numbers were counted every 24 hours, starting at the time of discharge (e.g., discharge at 3:00 PM until 3:00 PM the next day was the first day counted after discharge) up to seven days post discharge. Steps taken in hospital were counted in the same way, backwards from the time of discharge up to the time of study

inclusion for a maximum of seven days. Incomplete days (e.g., day of inclusion) and days when no steps were counted were omitted from analyses.

Assessment of Functional Decline

We assessed functional decline based on the ability to perform basic ADLs using the Katz-ADL index score.[27] At admission, we asked participants to retrospectively rate their ability to perform ADLs during the two weeks before hospital admission. This assessment was repeated at discharge and one month after discharge. Participants were asked whether they needed assistance to perform each ADL. A summary score was calculated ranging from 0 (independent in all ADLs) to 6 (dependent on help for all ADLs). Functional decline was defined as a higher dependency on help in one or more ADLs one month after discharge compared with baseline (two weeks before admission).

Assessment of Other Variables

Potential predictors for step numbers were identified based on Fried's theoretical cycle of physical frailty.[19] Comorbidities were assessed with the Charlson comorbidity index, (range, 0–31), where higher scores indicate higher one-year mortality risk.[31] Malnutrition was assessed with the short nutritional assessment questionnaire (SNAQ), and was categorized as no malnutrition, mild malnutrition, and severe malnutrition.[32] Handgrip strength was measured three times using a dynamometer.[33,34] The highest score (in kilograms) from both hands was used. Physical performance was assessed with the short physical performance battery (SPPB), which measures walking speed, chair stand, and balance. Scores range from 0 to 12, and higher scores indicate better physical performance.[35] The number of steps taken in hospital, counted using the Fitbit Flex®, was also a potential predictor of steps taken after discharge and was calculated as an average number of steps taken during hospitalization. Functionality in performing ADLs at discharge was assessed using the Katz-ADL, and scores ranged from 0 (independent at all ADLs) to 6 (dependent on all ADLs).[27] Somatic geriatric syndromes (fear of falling, pain, fatigue, and mobility impairment), which are prevalent after discharge[36] and may impair physical activity, were assessed.[37] Fear of falling, pain, and fatigue were measured using the numeric rating scale, which is a continuous scale from 0 (no symptoms) to 10 (severe symptoms).[38,39] Mobility impairment was assessed using the Functional Ambulation Categories test; scores range from 0 to 5, with higher scores indicating greater dependency.[40] We assessed psychological geriatric syndromes (cognitive functioning, depressive symptoms, and apathy) because they are 1] highly prevalent in this population;[36] 2] associated with physical activity;[41] and 3] potential barriers for functional recovery after acute hospitalization.[42,43] Cognitive functioning was assessed with the MMSE, with a score of $\leq$ 23 indicating cognitive impairment.[44] Apathy was measured with the Geriatric Depression Scale-3A (GDS-3A) subscale of the GDS-15.[45] Depressive symptoms were measured with the GDS-15 subscale (GDS-12D).[46] Higher scores indicated more symptoms of apathy and depression (range, GDS-3A: 0–3; GDS-

12D: 0–12).[45,46]

Statistical Analyses

Statistical analyses were performed in four phases: 1] descriptive analysis; 2] linear regression analysis of potential predictors of step numbers post discharge; 3] multivariable regression analysis of potential predictors of step numbers post discharge using a backwards selection procedure; and 4] multivariable regression analysis of functional decline and step numbers post discharge. For the first study aim, baseline variables and potential predictors were described with a mean and standard deviation (SD) or median and interquartile range (IQR) for continuous variables, and a number (n) and percentage (%) for categorical variables. The primary outcome was number of steps taken per day in hospital and one week after discharge and were presented as medians and IQR. Step numbers were also presented separately for older adults with and without functional decline. We assessed potential predictors of steps numbers taken after discharge using linear mixed models because these can account for correlations between repeated step measures. Factors associated with the primary outcome ($P < .10$) were retained for further analysis. The remaining factors were included in the multivariable linear mixed models. Because of high collinearity between physical factors, we used backward elimination to identify independent predictors using a cut-off P value of .05.[47] The results are presented as an unstandardized regression coefficient (beta), 95% confidence interval (CI), and P value. To evaluate the association of functional decline with step numbers, we used linear mixed models and adjusted for the independent predictors of steps numbers. We analyzed functional decline as the independent variable to assess differences in post-discharge step numbers between older adults with and without functional decline.

Mixed linear models can handle missing values in the dependent variable – missing values in the independent variables were imputed.[48] Based on the missing value patterns and percentage of missing values, we multiply imputed 50 datasets using the multiple imputation chained equations by fully conditional specification with predictive mean matching with K of 10 to the nearest neighbor. Results were pooled using Rubin's rules and used in the linear regression analyses.[49] Sensitivity analyses were conducted to check for selection bias. All baseline variables were compared between participants included in our analyses versus participants not included in our analyses. Additionally, a complete case analysis was performed to identify all risk factors associated with the number of steps taken after discharge. All statistical analyses were performed in Stata SE/15.1 (StataCorp. 2017. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC).

Results

Of the 401 participants, 55 did not consent to wear the activity tracker and post-discharge activity measurements were not available for 158 participants (see Figure 1). In total, 188 participants were included in the analysis. The sensitivity analysis showed that participants not included in the analysis (n = 213) had a significant lower body mass index, step number during hospitalization, handgrip strength, and SPPB score. Participants not included in the analyses also had a longer hospital stay, more frequent cognitive impairment, and a higher Katz-ADL score at discharge.

The mean (SD) age of participants was 79.1 (6.7) years, 106 (56.4%) participants were male, and 169 (89.9%) were born in the Netherlands (Table 1). At discharge, 57/188 (30.3%) participants experienced functional decline. 17/48 (35.4%) of these still had functional decline one month after discharge, and nine were lost to follow-up. Of the 131 participants without functional decline at discharge, 16/126 (12.7%) had functional decline one month after discharge, and five were lost to follow-up. In total 33/174 (18.9%) of the participants experienced functional decline one month post discharge.

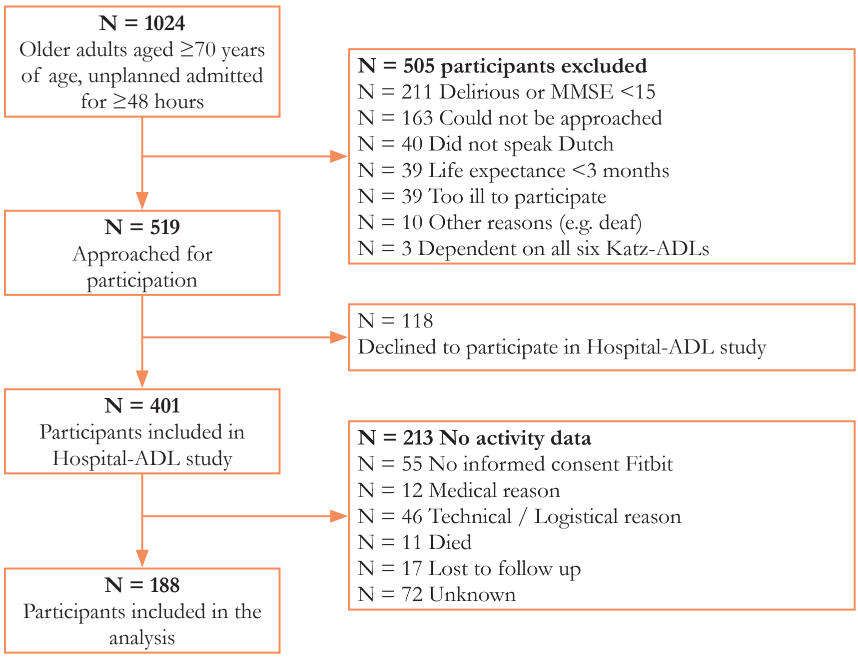


Figure 1. Derivation of the analytic sample

Table 1. Study sample characteristics during hospitalization (N = 188)

Patient characteristics	
Age, mean (SD), y	79.1 (6.7)
Male, No. (%)	106 (56.4)
BMI, * mean (SD)	22 (19-25)
Marital status, No. (%)	
Married or living together	106 (56.4)
Widow/widower	27 (14.4)
Single or divorced	55 (29.3)
Born in the Netherlands, No. (%)	169 (89.9)
Education, No. (%)	
Primary school	44 (23.4)
Elementary technical/domestic science school	42 (22.3)
Secondary vocational education	58 (30.9)
Higher level high school/third-level education	44 (23.4)
Polypharmacy, † No. (%), (n=186)	121 (65.1)
Hearing impairment, No. (%)	22 (11.7)
Vision impairment, No. (%)	20 (10.7)
Primary admission diagnosis, No. (%)	
Cardiac	60 (31.9)
Respiratory	31 (16.5)
Other	28 (14.9)
Infection	24 (12.8)
Gastrointestinal	22 (11.7)
Renal	9 (4.8)
Cancer (including hematology)	8 (4.3)
Electrolyte disturbance	6 (3.2)
Length of hospital stay, median (IQR), d	5 (4-8)
Charlson comorbidity index, ‡ median (IQR)	2 (1-3)
SNAQ, No. (%)	
No malnutrition	120 (63.8)
Mild malnutrition	10 (5.3)
Severe malnutrition	58 (30.9)
Handgrip strength, mean (SD), kg, (n=177)	28.9 (10.6)
Physical performance, § median (IQR), (n=169)	7 (4-10)
Steps taken in hospital, median (IQR), (n=166)	922 (407-1633)
Katz-ADL score,ǁ median (IQR), (n=182)	1 (0-2)
Fear of falling, median (IQR), NRS score, (n=183)	0 (0-5)

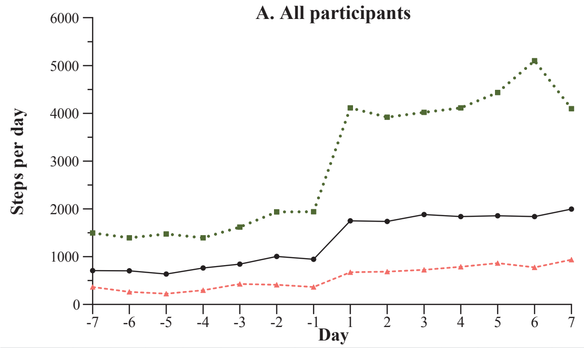
Table 1. *Continued*

Patient characteristics	
Pain, median (IQR), NRS score, (n=184)	0 (0-4)
Fatigue, median (IQR), NRS score, (n=183)	5 (2-7)
FAC, No. (%), (n=176)	
Independent	43 (22.9)
Independent on level surfaces	95 (50.5)
Dependent for supervision	28 (14.9)
Dependent for physical assistance I	4 (2.1)
Dependent for physical assistance II	2 (1.1)
Non-functional ambulation	4 (2.1)
Cognitive impairment, ** No. (%), (n=169)	13 (7.7)
Depressive symptoms, †† No. (%), (n=179)	33 (17.6)
Apathy, ‡‡ No. (%), (n=179)	96 (51.1)
Living independently after discharge, No. (%)	147 (78.2)

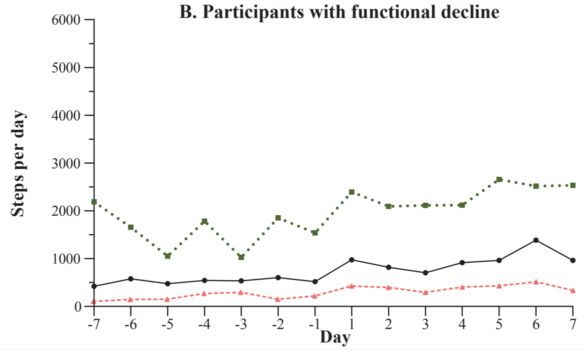
Abbreviations: SD, standard deviation; BMI, body mass index; IQR, interquartile range; SNAQ, short nutritional assessment questionnaire; ADL, activities of daily living; NRS, numeric rating scale; FAC, functional ambulation categories.
*Calculated as weight in kilograms divided by height in meters squared.
† Use of 5 or more different medications.
‡ Range of 0-31, with a higher score indicating more or severe comorbidity.
§ Assessed with the short physical performance battery. The score ranges of 0-12, a higher score indicates a better physical performance.
ǁ Ranging from 0 (independent at all ADLs) to 6 (dependent on all ADLs).
** If a score of <24 on the Mini-Mental State Examination.
†† If a score of ≥6 on the Geriatric Depression Scale.
‡‡ If a score of ≥2 on three items on the Geriatric Depression Scale.

Figure 2A shows the number of steps per day in hospital and after discharge. The median number of steps was 656 (IQR, 250–1146) on the last day before discharge and this more than doubled to a median of 1,750 (IQR, 675–4,114) steps on the first day after discharge. From the second day post discharge, the number of steps slightly increased to 1,997 (IQR, 938–4098) on the seventh day post discharge. Figures 2B and 2C show the number of steps separately for older adults with (n = 33) and without (n = 141) functional decline. In older adults with functional decline, the median was 518 (IQR, 229–1,541) steps on the last day before discharge, 978 (IQR, 437–2395) steps on the first day after discharge, and 965 (IQR, 344–2,535) steps on the seventh day after discharge. In older adults without functional decline, the median was 1,189 (IQR, 407–2,007) steps on the last day before discharge, 1,908 (IQR, 763–4,421) steps on the first day after discharge, and 2,289 (IQR, 1,222–4,727) on the seventh day after discharge.

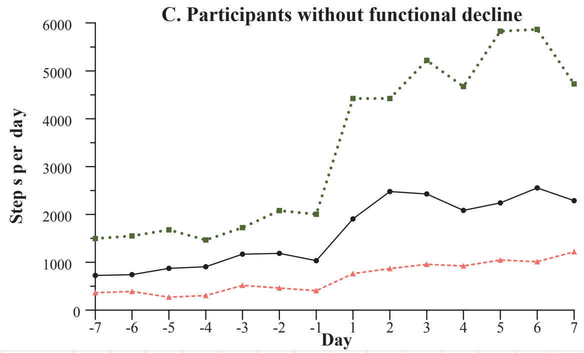
Table 2 shows the linear regression analysis of the potential predictors and the number of steps after discharge. Age, comorbidities, living independently,



p75	1497	1397	1477	1394	1620	1939	1943	4114	3918	4022	4114	4435	5099	4098
Median	710	704	639	766	843	1004	945	1750	1740	1883	1840	1858	1840	1997
p25	366	265	225	298	431	413	367	675	687	727	789	866	777	938
n =	46	56	74	92	108	132	147	103	123	146	162	167	163	157



p75	2185	1656	1053	1784	1025	1852	1541	2395	2095	2117	2119	2656	2519	2535
Median	420	579	476	544	534	605	518	978	820	707	916	964	1388	965
p25	115	160	162	281	309	162	229	437	409	308	419	444	526	344
n =	9	13	17	16	20	23	24	17	20	26	29	30	27	27



p75	1497	1551	1681	1469	1726	2080	2007	4421	4424	5220	4674	5829	5866	4727
Median	725	742	873	910	1169	1189	1037	1908	2480	2427	2086	2242	2557	2289
p25	366	390	274	305	520	463	407	763	872	958	927	1049	1014	1222
n =	31	35	49	68	79	97	111	77	93	109	121	124	125	120

Figure 2A-C. Number of steps* for (A) all participants (N = 188), (B) participants with functional decline (n = 33), and (C) participants without functional decline (N = 141)

Table 2. Univariable (model A) and multivariable (model B) linear regression analyses of predictors and step numbers after discharge

Variables*	Reference	Model A				Model B			
		β†	95% confidence interval		P value‡	β†	95% confidence interval		P value§
Age	Year	-147.68	-200.63	-94.73	<.001	-57.93	-111.15	-4.71	.03
Gender	Male	265.00	-492.3	1023.15	.49				
Charlson comorbidity index	Score	-259.92	-455.90	-63.94	.009				
SNAQ	No malnutrition								
Mild malnutrition		871.23	-770.63	2513.10	.30				
Severe malnutrition		-1292.68	-2097.45	-487.92	.002				
Handgrip strength	Kilogram	59.92	24.88	94.96	.001				
Physical performance	Score	362.57	261.96	463.19	<.001	224.95	117.79	332.11	<.001
Steps taken in hospital	Step	1.07	0.77	1.37	<.001	0.76	0.46	1.06	<.001
Katz-ADL score	Score	-560.73	-853.22	-268.23	<.001				
Fear of falling	Score	-172.00	-293.39	-50.63	.005				
Pain	Score	-64.26	-209.74	81.21	.39				
Fatigue	Score	-184.63	-324.81	-44.46	.01				
FAC	Non-functional								
Dependent for physical assistance II		-117.58	-3846.98	3611.82	.95				
Dependent for physical assistance I		365.99	-2686.08	3418.06	.81				
Dependent for supervision		794.6	-1566.12	3155.33	.51				
Independent on level surfaces		1636.18	-621.53	3893.90	.16				
Independent		4215.36	1902.45	6528.27	<.001				

Table 2. *Continued*

Variables*	Reference	Model A				Model B			
		β†	95% confidence interval		P value‡	β†	95% confidence interval		P value§
Cognitive impairment	No	-1987.33	-3422.87	-551.78	.007				
Depressive symptoms	No	-1025.03	-2002.02	-48.05	.04				
Apathy	No	-579.28	-1360.52	201.96	.15				
Living independent after discharge	No	1301.93	402.09	2201.77	.005				

Abbreviations: See Table 1. *Refer to Table 1 for definitions.
†Unstandardized regression coefficients for continuous variables are per 1-point increase.
‡ Variables with a value <.10 were retained for further analysis.
§ Using a backward selection procedure variable with a P value <.05 were included in the model.

Table 3. Unadjusted (model A) and adjusted (model B) association of functional decline after discharge with steps numbers after discharge (N = 174)

Variables*	Reference	Model A				Model B			
		β†	95% confidence interval		P value	β†	95% confidence interval		P value
Functional decline at 1-month	No functional decline	-1400	-2380	-420	.005	-671	-1668	325	.19
Age	Year					-58	-125	9	.09
Physical performance	Score					188	57	318	.005
Steps taken in hospital	Step					0.9	0.6	1.3	<.001

Abbreviations: See Table 1. *Refer to Table 1 for definitions.
†Unstandardized regression coefficients are per 1-point increase.

cognitive functioning, depressive symptoms, fear of falling, fatigue, handgrip strength, physical performance, malnutrition, functional disabilities, and steps taken in hospital had a p value < .10 and were retained for further analysis. In the multivariable linear regression analysis, we found that age (β = -57.93; 95% CI, -111.15 to -4.71), physical performance (β = 224.95; 95% CI, 117.79–332.11), and steps taken in hospital (β = 0.76; 95% CI, 0.46–1.06) were independent predictors of physical activity after discharge. This means that for every one-year increase in age, there was a reduction in steps after discharge, and for every 1-point increase in physical performance and every one-step increase in hospital, there was an increase in steps taken post discharge. These results differed slightly to the complete case analysis, which found comorbidities (β = -247.07; 95% CI, -443.84 to -50.3) to also be a significant predictor of steps taken post discharge.

Table 3 shows the unadjusted and adjusted association of functional decline one month after discharge with step numbers after discharge. Older adults with functional decline took significantly fewer steps after discharge than older adults without functional decline did (β = -1400; 95% CI, -2380 to -420; P = .005). Following adjustment for age, physical performance, and steps taken in hospital, there was no significant association between functional decline and step numbers after discharge (β = -671; 95% CI, -1667 to 325; P = .19).

Discussion

This study aimed to assess the number of steps taken by older adults in hospital up to one week after discharge, to identify factors associated with step numbers after discharge, and to determine if functional decline one month after discharge is associated with step numbers after discharge. Our results showed that the number of steps taken one day after discharge was double those taken prior to discharge. This finding suggests the physical capacity of older adults may be underused during hospitalization, regardless of their (dis)ability. Moreover, the number of steps taken slightly increased for up to seven days post discharge, but the number of steps remained low in the majority of older adults. These results demonstrated that, at a younger age, better physical performance and more steps taken in hospital were independently associated with higher post-discharge step numbers. The number of steps taken one week after discharge was significantly lower in participants with functional decline one month post discharge compared with in those who experienced no functional decline. This association was not significant after correcting for age, physical performance, and steps taken in hospital.

The median number of steps taken in hospital was consistent with results from previous studies in similar patient populations.[4,5] We found that approximately 50% of older adults did not take the recommended 900 steps per day during hospitalization, which is associated with a higher risk of functional decline at discharge.[6] Compared with a study by Fisher et al., we counted fewer steps in the first week post discharge. A possible explanation for this discrepancy is the different exclusion criteria; in our study, older adults were not excluded if they could not walk safely without assistance, which was an exclusion criterion in the study of Fisher et al.[20] Although low step numbers are common during hospitalization in our population,[4,5] the increase in step numbers that we observed immediately after discharge shows that older adults do not use their full physical capacity during hospitalization. This important finding implies that older adults can be more physically active during hospitalization and underlines the need for in-hospital interventions to stimulate physical activity.[50,51]

Our findings suggest that, of the of physical frailty factors described by Fried et al.,[19] only age,[41] physical performance, and in-hospital step numbers are predictors of post-discharge step numbers. These findings support the theory that acute illness and age-related changes can lead to loss of muscle mass and physical performance, resulting in functional decline and reduced physical activity.[19] In this light, our results suggest that particularly frail older adults, who are more likely to be functionally vulnerable to an acute illness,[52] become less active after an acute illness.[20] Offering targeted interventions to these vulnerable individuals to improve their physical performance and physical activity while they are in hospital may improve post-discharge activity levels.[15]

The present study has also shown that a large proportion of acutely hospitalized older adults experience functional decline one month after discharge.[14] We also showed that these older adults accrued significantly fewer steps in the first week after discharge compared to older adults without functional decline after discharge. This association between functional decline and physical activity has already been shown during hospitalization.[6,8] In line with the findings of Fisher et al., our results support the idea that the level of physical activity in the first week after discharge may predict recovery after acute hospitalization.[20] However, our results also suggested there is no direct association between physical activity and functional decline, and that age and physical performance may confound this relationship.[19] Further research is needed to determine whether modifiable factors like physical activity and physical performance can predict functional decline or recovery after discharge. This information may lead to the development of more effective interventions to prevent or reverse functional decline during the post-discharge recovery period.

Limitations

This study has several potential limitations. First, we aimed to include a cohort of older adults with a wide range of vulnerability. However, we had to exclude participants without post-discharge activity data, which may have resulted in selection bias; this means that participants who stayed in hospital longer, whose physical performance was poor, and who took fewer steps in hospital, and who might have been more vulnerable as a result, were excluded. This may have led to an underestimation of the observed associations and reduced the generalizability of our findings to these older, more vulnerable adults. Secondly, we assessed physical activity using the Fitbit Flex® activity tracker because of its practical applicability, user-friendly wristband, and high reliability in measuring steps. Fitbit Flex® wearing was controlled using logbooks and regular checks. However, the Fitbit Flex® does not detect non-wear time, so physical activity would have been underestimated if the participant was not wearing the tracker. A major strength of this study was the continuous assessment of physical activity during hospitalization up to the first week post discharge in a heterogeneous cohort of acutely hospitalized older adults. A large cohort of older adults with a wide range of diagnoses was included. During hospitalization, we assessed a broad set of potential predictors of physical activity.

Conclusions and Implications

This study shows that step numbers taken by acutely hospitalized older adults double immediately after discharge, indicating that the physical capacity of older persons is underutilized during hospitalization. Acutely hospitalized older adults with a younger age, better physical performance, and higher in-hospital physical activity levels have better post-discharge physical activity levels. Interventions focusing on physical performance and physical activity during hospitalization may optimize post-discharge physical activity and should continue during the critical post-discharge recovery period. The level of physical activity in the first week after discharge is a promising indicator of functional decline one month after discharge. Further research is needed to determine whether physical activity and physical performance can predict recovery after acute hospitalization.

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