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Frailty, underweight and impaired mobility are associated with institutionalisation after post-acute care

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Summary

AIMS OF THE STUDY: Post-acute care (PAC) is intended for older adult patients who are unable to return home directly after acute hospitalisation but who do not otherwise qualify for specific rehabilitation. However, data on potential predictors of PAC outcomes remain limited. Our aim was to identify patient characteristics upon admission to PAC that are associated with subsequent institutionalisation.

METHODS: Prospective cohort study enrolling 140 former acute care inpatients aged 60 and older who were referred to PAC units at nursing homes in Zurich, Switzerland.

MEASURES: Geriatric assessment at admission included Barthel Index (BI), Short Physical Performance Battery (SPPB), frailty status (Fried phenotype), nutrition and cognitive status. Logistic regression was used to determine statistically significant associations.

RESULTS: Mean age was 84.1 (standard deviation [SD] 8.6) years; 62.9% of participants were women. Mean body mass index (BMI) was 25.0 (SD 5.8) kg/m^2, with 12.1% being underweight (BMI <20 kg/m^2). Mean BI at admission was 62.1 (SD 19.1), mean SPPB score was 5.2 (SD 2.8), and 55% were frail (≥3 Fried criteria present). After a mean length of stay in PAC of 30.9 (SD 16.5) days, 48.6% were institutionalised. Patients who were frail at admission had a 2.97-fold higher (odds ratio [OR] 2.9,7 95% confidence interval [CI] 1.04–8.42), and patients who were underweight had a 4.94-fold higher (OR 4.94, 95% CI 1.11–22.01) chance of institutionalisation. Conversely, each points increment on the SBBP score lowered the likelihood of institutionalisation by 23% (OR 0.77, 95% CI 0.65–0.92).

CONCLUSIONS: Frailty, low SPPB score and being underweight at admission to PAC were significantly associated with a higher chance of subsequent institutionalisation. Strategies to improve these factors could improve PAC outcomes.

Keywords: *post-acute care, frailty, older adults, institutionalisation, inpatients, geriatric assessment*

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Introduction

Optimal care planning and improved triage practices seem vital to improving the care paths of older adults [1]. Being often dependent in one or more of their basic activities of daily living (ADL), older adult patients are frequently unable to return home after an acute hospitalisation without extensive care support. At the same time, they are often not considered as candidates for specific rehabilitation programmes. To support those patients who remain on an increased level of care after discharge from hospital [2], a federal law on post-acute care was passed in Switzerland in 2012 (Art. 25a Abs. 2 KVG) [3, 4].

Under the Swiss PAC law, patients meeting the above criteria can be referred to PAC only by their hospital physician. PAC programmes are often situated in nursing homes, and also in other settings like hospitals and inpatient rehabilitation units. They consist mainly of activating nursing care, frequent physical and occupational therapy and social care planning, following an individual treatment plan. The City of Zurich's municipal nursing homes are the largest provider of skilled nursing care in Switzerland and offer PAC at designated PAC units in three nursing homes. In general, patients stay for up to 10 weeks, and their discharge location is discussed by a multi-professional team led by a board-certified geriatrician. However, assessment of ideal PAC candidates and admission triage is currently not standardised, and no robust predictors for successful discharge (i.e., patients returning home) have been established [5].

Identifying potential predictors of an undesirable discharge location (i.e., permanent institutionalisation) following PAC could improve therapeutic arrangements and care

transitions. In one earlier study, which included 2754 patients aged 65 and older with an increased care level, Seematter-Bagnoud et al. identified cognition as the strongest predictor of impaired functional recovery [6]. In addition, Abrahamsen et al. reported low mobility, impaired ADL and cognitive deficits to be the most important factors adversely correlated with the ability to return home after PAC [7].

As an important age-associated syndrome, frailty has been linked to multiple negative health outcomes in older adults [8]. Generally defined as a disproportionate decline of functional capacity, frailty can lead to premature dependency, institutionalisation and/or death [8–10]. A recent review reported large knowledge gaps regarding frailty in PAC settings [11]. In particular, the literature on frailty as a predictor of permanent institutionalisation after PAC appears to be very limited. In summary, our study aimed to use a comprehensive geriatric assessment, including ADL, mobility and physical function, frailty, and social status, to identify patient characteristics at admission to PAC in a nursing home setting that are associated with subsequent institutionalisation.

Methods

Study design, patients and setting

For this prospective, observational cohort study, data collection took place at four PAC units designated for temporary stays, located at three nursing homes operated by the municipality of the City of Zurich, between August and September 2016. Patients were referred to PAC from local acute-care hospitals by their hospital physicians. We asked all consecutive patients in the given period to provide written informed consent. When necessary, consent was obtained from designated proxies. The competent ethics committee of the Canton of Zurich approved our study (BASEC No. 2016-01069).

The City of Zurich's PAC programme consists of one-to-one training sessions with a physical therapist five times a week, occupational therapy during the first few days and continuing as needed, and activating nursing care (i.e., goal-directed instruction and training of ADL). The programme aims to discharge patients after between 2 and 8 weeks, but can last for up to 10 weeks. Interdisciplinary team meetings, including therapists, nurses and social workers, take place twice a week and are supervised by a board-certified geriatrician. Treatment and discharge options are discussed both at these meetings and also with the patient and their family [12].

Outcome, data collection and variables

The primary outcome was subsequent institutionalisation, defined as any discharge not back home. Data was collected from the electronic health records (EHR) of each participating nursing home. Information regarding age, gender, weight, height, referring hospital, specialty during hospital stay, length of stay (LOS) at PAC unit and discharge location was collected.

We considered all health measures being used at the study centers as candidate variables. Physical performance measures were gathered from routine comprehensive geriatric assessments (CGA) at admission and discharge. These were conducted and scored by trained professionals from interdisciplinary teams at the PAC units. The CGA consisted of the basic assessments of the University of Zurich Geriatric Network's "core set library".

Physical function and mobility performance were measured at admission and discharge using the Short Physical Performance Battery (SPPB) [13] plus a standardised handgrip strength test using a Martin Vigorimeter (KMS Martin Inc., Tuttlingen, Germany). ADL were assessed using the Barthel Index (BI) [14] at both admission and discharge. Cognitive function was assessed at admission by the Mini-Mental State Examination (MMSE) [15] and a standardised clock-drawing test (CDT) [16]. Nutritional status was assessed using the Mini Nutritional Assessment (MNA) [17]. Being underweight was defined as a body mass index (BMI) <20 kg/m^2, as has been suggested for older adults by previous investigations [18], and obesity as a BMI >30 kg/m^2, as defined by the World Health Organization [19]. Delirium screening was performed routinely at admission using the Delirium Observational Score (DOS) [20]. Frailty was operationalised according to an adapted Fried frailty phenotype, a widely used operationalisation for frailty screening [8, 21]. The five components of the Fried phenotype are muscle strength, weight loss, fatigue, slowness and low activity level. Patients are categorised as robust (no positive criteria), pre-frail (1–2 positive criteria) or frail (≥3 positive criteria) [8]. For polypharmacy, the number of medications at admission and discharge was recorded. Information about living situation prior to hospital admission, the prior use of skilled home nursing services and level of formal education was also obtained. All data were recorded in paper case report forms (CRF) and entered into a database system. Two of the authors (TT and MT) performed comprehensive double data entry of the paper forms into two separate databases which were subsequently compared, and any inconsistencies were resolved.

Statistical analysis

Two separate statistical models were built using logistic and stepwise logistic regression, one using the variables assessed at admission to PAC and a second using the change in variables between admission and discharge. Both models used all the baseline variables only assessed upon PAC admission (living status [home alone, home with family/friend, home with a spouse, unknown], education level [tertiary, secondary or apprenticeships, obligatory (nine years), less than obligatory, unknown], nursing status [none, personal care, household, personal and household], MMSE, clock drawing test, MNA, and frailty status [robust, pre-frail, frail]) as candidate variables. Furthermore, for SPPB, handgrip strength, BI and numbers of medications, Model 1 "Admission" used the data collected at admission and Model 2 "Change" used the differences between the variables at admission and at discharge. Both models used BMI category (<20 kg/m^2 = underweight, 20–30 kg/m^2 = normal weight, >30 kg/m^2 = obesity) as assessed at admission.

All these variables were evaluated as candidate parameters to be associated with the likelihood of institutionalisation. Candidate categorical variables (living status, educational level, nursing status, frailty status and BMI category) were

transformed into binary variables to allow a more compact final model.

Candidate variables were eliminated from the multivariable-adjusted logistic regression models in stepwise analysis if they resulted in p-values >0.1. This process was repeated until no further improvement was possible. All p-values were two-sided, and statistical significance was set at $p \leq 0.05$.

The logistic models were adjusted for age, gender, LOS, treating nursing home, referring hospital, treating specialty during hospitalisation and delirium status upon PAC admission. For stratification, we used Student's t-test for continuous variables and a χ^2 test for categorical variables. The p-values are two-sided.

Data were analysed using the Software R, version 3.3.6 (R Foundation for Statistical Computing, Vienna, Austria). Variables missing fewer than ten entries were imputed using the mean. Variables with ten or more missing values were completed with multiple imputation using the MICE package (version 2.4.3) for R.

Results

We invited a total of 162 consecutive patients to participate in our investigation. Inclusion criteria were an age of 60 years or older and living in the community prior to hospital admission. Three patients did not meet the criteria for PAC, one died shortly after admission and 18 declined to give informed consent. The remaining 140 patients were included in the present analysis.

The baseline characteristics stratified for outcome are presented in table 1. A total of 65 (46.4%) patients entered PAC from internal medicine departments, 39 (27.4%) from surgical specialties and 17 (12.1%) from acute geriatric care. In 19 cases (13.6%), the referring specialty was not known. The five most frequent diagnosis groups at admission to PAC were fractures (n = 28), infections (n = 18, excluding pneumonia or exacerbated COPD), gait disorders (n = 17), cognitive impairment including dementia (n = 15) and heart disease (n = 11).

Of the 140 patients included, 72 (51.4%) were discharged home, 48 (34.3%) went into long-term nursing care, nine (6.4%) entered a retirement home, one (0.7%) went into a rehabilitation clinic, eight (5.7%) were readmitted to acute care, and for two patients (1.4%) the discharge location

Table 1: Participant characteristics by discharge location

	Total (n = 140)	Institutionalisation (n = 68)	Home (n = 72)	p-value
Female gender, % (n)	62.9 (88)	64.7 (44)	61.1 (44)	0.79
Age, years (SD)	84.1 (8.6)	85.9 (7.4)	82.5 (9.3)	0.018
Length of stay d (SD)	30.9 (16.5)	33.3 (14.9)	28.7 (17.7)	0.09
Prior living status*, % (n)				0.68
Home alone	62.1 (87)	64.2 (43)	61.1 (44)	
Home with family/friend	5.7 (8)	4.5 (3)	6.9 (5)	
Home with spouse	31.4 (44)	31.3 (21)	31.9 (23)	
Home care†, % (n)				0.30
None	47.1 (66)	39.7 (27)	54.2 (39)	
Personal care	15.7 (22)	16.2 (11)	15.3 (11)	
Housekeeping	24.3 (34)	27.9 (19)	20.8 (15)	
Both	11.4 (16)	13.2 (9)	9.7 (7)	
Education‡, % (n)				0.69
Tertiary education	5.7 (8)	5.9 (4)	5.6 (4)	
Secondary education	55.7 (78)	51.5 (35)	59.7 (43)	
Obligatory education (9 years)	26.4 (37)	26.5 (18)	26.4 (19)	
Less	5.7 (8)	7.4 (5)	4.2 (3)	
Frailty§, % (n)				**0.003**
Robust (0 points)	19.3 (27)	7.4 (5)	30.6 (22)	
Pre-frail (1–2 points)	22.1 (31)	22.1 (15)	22.2 (16)	
Frail (>2 points)	55.0 (77)	67.6 (46)	43.1 (31)	
Barthel Index, score (0–100) (SD)	62.1 (19.1)	55.7 (18.4)	68.3 (17.6)	**<0.001**
SPPB sum score (0–12) (SD)	5.2 (2.8)	4.2 (2.9)	6.1 (2.5)	**<0.001**
Handgrip strength kPa (SD)	40.1 (13.7)	36.9 (13.5)	43.1 (13.3)	**0.006**
MMSE, total score (0–30) (SD)	24.1 (4.4)	22.9 (4.4)	25.1 (4.0)	**0.002**
CDT, total score 0–7) (SD)	4.6 (2.0)	4.1 (2.0)	5.0 (1.8)	**0.004**
MNA, score (0–14) (SD)	8.7 (2.7)	7.9 (2.6)	9.4 (2.6)	**0.001**
DOS, score (0–13) (SD)	0.74 (1.23)	0.9 (1.3)	0.6 (1.2)	0.071
BMI category, % (n)				0.13
Obese (>30 kg/m^2)	14.3 (20)	11.8 (8)	16.7 (12)	
Underweight (<20 kg/m^2)	12.1 (17)	17.6 (12)	6.9 (5)	
Number of drugs (SD)	8.4 (3.9)	8.1 (3.8)	8.6 (3.9)	0.44

SPPB = Short Physical Performance Battery; BMI = body mass index; MMSE = Mini-Mental State Examination; CDT = clock drawing test; MNA, Mini Nutritional Assessment; DOS = Delirium Observation Scale Data (n = 140) are crude means (± SD) or n (%). Differences between home and institutionalisation were assessed using Student's t-test for continuous variables and a χ^2 test for categorical variables; p-values are two-sided; statistical significance was set at p <0.05. * Number of unknown living status was one in "institutionalisation"; † Number of unknown care status was two in "institutionalisation"; ‡ Number of unknown education levels were six in "Institutionalisation" and three in "home"; § Frailty using Fried Frailty Phenotype, Number of unknown frailty status was three in "home" and two in "Institutionalisation"

was unknown. Thus, a total of 68 (48.6%) patients were defined as being institutionalised following PAC.

Stratified by outcome, the participants discharged home were younger (82.5 [SD 9.3] vs 85.8 [SD 7.4] years of age), less frail (mean Fried score 2.3 [SD 1.3] vs 3.1 [SD 1.2]) and demonstrated better mobility (SPPB score 6.1 [SD 2.47] vs 4.21 [SD 2.85]). Stratified by gender, the groups differed only with respect to living situation and handgrip strength ($p < 0.001$).

The logistic regression Model 1 "Admission" included the SPPB score, presenting frailty and a BMI <20 kg/m^2 (table 2). Being frail was associated with a nearly three-fold increase in the likelihood of being institutionalised upon discharge (odds ratio [OR] 2.97, 95% confidence interval [CI] 1.04–8.42), whereas each point increase in the SPPB was associated with a 23% lower likelihood (OR 0.77, 95% CI 0.65–0.92) of institutionalisation. Furthermore, a BMI below 20 kg/m^2 was associated with an approximately five-fold increase in the likelihood of institutionalisation (OR 4.94, 95% CI 1.11–22.01).

Our Model 2 "Change" included frailty status and Δ-Barthel-Index (Δ-BI = BI at discharge − BI at admission). A five-point increase in the BI (smallest possible change) was associated with a 20% decrease in the likelihood of being institutionalised (one-point OR 0.96, 95% CI 0.92–0.99), while being frail (Fried score ≥3) was associated with a four-fold increase in the likelihood of being institutionalised (OR 3.99, 95% CI 1.55–10.29).

Discussion

In this study we investigated potential risk factors associated with subsequent institutionalisation measured upon admission to and before discharge from PAC in a cohort of 140 older adults referred from acute hospital care. Our models show a significant association of subsequent institutionalisation with frailty status (Fried phenotype), impaired activities of daily living (BI), mobility and physical performance (SPPB) and nutritional status (BMI), both at admission and before discharge from PAC.

Our results are in line with previous studies that have identified better physical performance and higher independence in activities of daily living (Barthel Index) [7, 22] as beneficial factors for PAC outcomes. In our study, the greater the change in the BI during the stay, the greater the likelihood of a return to home: the smallest possible improvement in BI of five points decreased the likelihood of institutionalisation by 20%. The SPPB score at admission had a similar effect.

To our knowledge, our study is the first to associate low BMI with negative outcomes after PAC. However, outside of PAC, there is an established association of low BMI with higher mortality in elderly patients [23, 24]. Our finding of frailty leading to a three- to four-fold increase in the likelihood of subsequent institutionalisation is higher than what has been reported previously for community-dwelling older adults [25]. While we also observed a higher prevalence of frailty in our PAC patients (58.6%) compared to earlier reports for community-dwelling older adults [26], 41.4% of the patients in our study were either robust or pre-frail. To our understanding, this finding suggests that frailty is not just a characteristic of the general PAC patient, but a potential predictor for patients being at risk of further loss of independence and subsequent institutionalisation after PAC. In earlier studies, cognitive status has also been identified as an important factor influencing institutionalisation in older adults [6, 7]. Conversely, our models were not able to confirm this finding in our PAC scenario.

Several limitations of our study must be recognised. The comprehensive geriatric assessment was used continuously in the participating PAC units' interdisciplinary meetings to determine each patient's next treatment measures. Consequently, some correlation between the final functional results and the discharge destination, as is the case in our Model 2 "Change", is to be expected. Notably, we did not consider admission diagnoses from charts as predictors of discharge location. Therefore, their influence on discharge location after PAC is not included in our analysis. However, we postulate that disease burden is reflected by the functional limitations and frailty status we assessed through the CGA upon PAC admission. Furthermore, our study covered a relatively small number of patients over a short period, without a follow-up after PAC. It also did not include a control group, which would have allowed us to compare the effect of the program on outcome with the

Table 2: Predictive models for institutionalisation

Model 1 "Admission"			Model 2 "Change"		
	OR (95% CI)	**p-value**		**OR (95% CI)**	**p-value**
Present frailty (Fried ≥3)	2.97 (1.04–8.42)	**0.04**	Present frailty (Fried ≥3)	3.99 (1.55–10.29)	**0.004**
SPPB (sum score 0–12)	0.77 (0.65–0.92)	**0.004**	Δ-Barthel-Index	0.96 (0.92–0.99)	**0.02**
Low BMI (<20 kg/m^2)	4.94 (1.11–22.01)	**0.04**			
MMSE (total score, 0–30)	0.91 (0.81–1.02)	0.09			
Living alone	2.23 (0.83–6.02)	0.11			
Adjusted for:					
Gender (female)	0.49 (0.18–1.31)	0.15	Gender (female)	0.67 (0.28–1.63)	0.38
Age (years)	1.06 (0.99–1.13)	0.07	Age (years)	1.06 (1.00–1.12)	0.07
Length of stay (d)	1.01 (0.98–1.04)	0.52	Length of stay (d)	1.03 (1.00–1.06)	0.05
Care facility	*	0.28	Care facility	*	0.06
Admitting hospital	*	0.07	Admitting hospital	*	0.02
Referring specialty	*	0.41	Referring specialty	*	0.62
DOS (score 0–13)	1.16 (0.80–1.68)	0.44	DOS	1.39 (0.98–1.97)	0.07

OR = odds ratio; CI = confidence interval; DOS = Delirium Observation Scale; BMI = body mass index; SPPB = Short Physical Performance Battery; MMSE = Mini-Mental State Examination Data (n = 140) are OR (95% CI) of being institutionalised regression models, p-values are two-sided; statistical significance was set at $p < 0.05$. * Subcategories for categorical variables and their odds ratios were left out to keep the table compact. Δ-Barthel-Index is difference in BI between admission and discharge.

outcomes for a population not receiving PAC. Unfortunately, it was not possible to record the individual adjustments to the treatment plan of each patient in a structured way. We also lacked data concerning prior hospitalisation other than the treating hospital and the specialty. Lastly, discharge destination was only evaluated immediately after PAC, and we lacked information on whether some patients returned home after an extended stay at a nursing home. Finally, we did not collect information about the kind of social support individual care providers living with a participant (i.e. spouse, family members, etc.) delivered prior to the acute hospitalisation leading to PAC admission.

On the other hand, our study has several strengths. To the best of our knowledge, we provide the first data on potential predictors of PAC outcomes for older adult patients from Switzerland. We conducted our study under real-life conditions at three nursing homes, using an unselected and heterogeneous population of older adults. Furthermore, we comprehensively characterised our participants, including information about their living situation, use of professional home care, level of education, frailty status, physical performance, nutrition and mental health, thus investigating not only medical but also socio-economic factors.

Our findings may help to identify patients at high risk of further loss of autonomy and to optimise their care by counterbalancing these risk factors. Specific interventions could reduce these risk factors, as earlier studies have shown that impaired mobility can be improved significantly with multifactorial interventions such as home exercise and case management [27], and interventions including improvement of nutritional status can also improve frailty and increase BMI in vulnerable older adults [28, 29]. However, whether such interventions would be effective in a PAC setting is not well established and should be addressed in future clinical trials.

In summary, frailty status, physical function and low BMI at admission to PAC were significantly associated with the subsequent institutionalisation of older adult patients after acute hospitalisation. As our study was limited in size and follow-up duration and had no control, future studies expanding on our short-term risk model predicting the immediate discharge location after PAC and investigating whether the identified factors also predict institutionalisation in the long-term, as well as whether strategies to improve frailty status, physical function and nutrition at designated PAC units could reduce the risk of institutionalisation after discharge from PAC, are warranted.

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