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SHORT COMMUNICATION

TRANSITION FROM INPATIENT REHABILITATION TO THE HOME ENVIRONMENT IN COGNITIVELY IMPAIRED OLDER PERSONS AFTER HIP FRACTURE

Bastian ABEL, MSc[1], Tobias ECKERT, MSc[1], Rebekka POMIERSKY, MA[1,2], Anja DAUTEL, MApplSc[3], Martina SCHÄUFELE, PhD[2], Klaus PFEIFFER, PhD[3], Klaus HAUER, PhD[1] and the PROFinD2 Study Group*

From the [1]Department of Geriatric Research, AGAPLESION Bethanien Hospital Heidelberg, Geriatric Center at the University of Heidelberg, Heidelberg, [2]Faculty of Social Work, University of Applied Sciences Mannheim, Mannheim, and [3]Department of Clinical Gerontology and Geriatric Rehabilitation, Robert-Bosch-Hospital, Stuttgart, Germany

Objective: **To investigate short-term changes in clinical characteristics in the transition period between geriatric inpatient rehabilitation and independent living at home in older patients with hip/pelvic fracture and cognitive impairment.**

Design: **Longitudinal observational study.**

Subjects: **A total of 127 multi-morbid, older patients with hip/pelvic fracture and cognitive impairment.**

Methods: **Physical performance, fall-related self-efficacy, fear of falling, depressive symptoms, quality of life, and pain were assessed before discharge from geriatric inpatient rehabilitation and at home.**

Results: **During the transition period (median 18.5 days; interquartile range 14–25 days), 25 participants dropped out due to admission to a nursing home ($n = 11$), withdrawal of consent ($n = 8$), death ($n = 2$), severe disease ($n = 2$), or other reasons ($n = 2$). Physical performance improved ($p \leq 0.001$), while fall-related self-efficacy ($p = 0.040$) and fear of falling ($p = 0.004$) deteriorated. Depressive symptoms, quality of life, and pain did not change. Improvement in physical performance was associated with lower age, lower baseline physical performance, less baseline fear of falling, and living alone.**

Conclusion: **While significant improvements in physical performance indicate a high potential for further enhancements in the majority of participants following inpatient rehabilitation, a considerable subgroup dropped out, partly indicating a negative trajectory in this vulnerable patient group. Sustained physical training or promotion of activity at home may further support rehabilitation in patients with hip/pelvic fracture and cognitive impairment.**

Key words: short-term; transition; changes; physical performance; older persons.

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LAY ABSTRACT

The prognosis regarding functional recovery in older persons with hip/pelvic fracture and cognitive impairment is poor, even after inpatient rehabilitation. Therefore, the period following inpatient rehabilitation is decisive regarding whether functionally and cognitively impaired persons can live at home or will lose their autonomy. The aim of this observational study was to investigate short-term changes in several clinical characteristics in the transition period between geriatric inpatient rehabilitation and independent living at home in 127 vulnerable persons. While physical performance improved, fall-related self-efficacy and fear of falling deteriorated. Depressive symptoms, quality of life, and pain did not change. The improvements in physical performance indicate a high potential for further enhancement (e.g. by physical training or activity promotion at home) in the majority of participants. However, a considerable subgroup of 25 persons dropped out for various reasons (e.g. admission to a nursing home, death), which partly indicates a negative trajectory in this vulnerable patient group.

Correspondence address: Klaus Hauer, Department of Geriatric Research, Agaplesion Bethanien Hospital Heidelberg, Geriatric Center at the University of Heidelberg, Rohrbacher Str. 149, 69126 Heidelberg, Germany. E-mail: khauer@bethanien-heidelberg.de

Older persons with cognitive impairment are at high risk of hip/pelvic fracture (HF) (1). In consequence of such a severe injury, short- and long-term functional recovery are poor, with a high risk of dying or being admitted to long-term care within the first year after HF (2). To prevent or postpone loss of autonomy, adequate physical rehabilitation following HF is required, especially in vulnerable, older adults with cognitive impairment who have restricted participation in training programmes.

A systematic review of randomized controlled trials (RCT) and cohort studies in older persons with HF and cognitive impairment reported improvements in functional status and ambulation after different rehabilitation programmes with heterogeneous interventions, considering cognitive status, physical performance, or psychological variables as relevant predictors of rehabilitation outcome (3). However, the recording of rehabilitation outcomes within these studies was mainly limited to interview-based functional assessments, indi-

*Comprising A. Lacroix Bethanien Hospital, Heidelberg; I. Hendlmeier, University of Applied Science, Mannheim; J. Gugenhan, M. Groß, K. Rapp, C. Becker, Department of Clinical Gerontology, Robert-Bosch-Hospital, Stuttgart; J. Müller, M. Rehm, D. Rothenbacher, G. Büchele, Institute of Epidemiology and Medical Biometry, Ulm University, Ulm; H.-H. König, C. Schulz, Department of Health Economics and Health Services Research, University Medical Center, Hamburg-Eppendorf.

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cating a lack of actual physical performance measures. Studies on rehabilitation programmes (e.g. home-based or inpatient) generally vary in content and duration of intervention, observation, or duration of follow-up. As the duration of follow-up ranges from weeks to months, and sometimes even years, and is related mostly to the fracture date, accurate follow-up periods for subsequent inpatient rehabilitation post-HF are difficult to identify. Thus, the highly sensitive, short-term period immediately following inpatient rehabilitation, termed the "transition period", is crucial to retain autonomy and has hardly been studied in older adults with HF and cognitive impairment. Only one observational study in older persons with and without cognitive impairment after HF has been identified, showing that functional improvements recorded with interview-based assessments in a subgroup, had been sustained 6 weeks after discharge from inpatient rehabilitation (4). This study aimed to investigate changes in physical performance measures, psychological status and pain in the transition period between inpatient rehabilitation and home environment and to explore predictors of change in physical performance in a specific group of multi-morbid, older patients with HF and cognitive impairment.

METHODS

Study design

This longitudinal observational study used pre-intervention data from an RCT on the effects of a multifactorial, home-based treatment following inpatient rehabilitation (5). The RCT was registered and performed according to the Declaration of Helsinki (ISRCTN69957256; ethics approvals of the Medical Faculties of the Universities of Tübingen (150/2015BO1) and Heidelberg (S-256/2015)).

Study population

Older participants (age ≥65 years) with HF within the last 3 months and mild-to-moderate cognitive impairment (Mini-Mental State Examination (MMSE) score 17–26) (6) were consecutively recruited from geriatric rehabilitation wards. Further inclusion criteria were: living in the home environment or assisted living; ability to walk 4 m with or without a walking aid; absence of delirium; absence of severe somatic or mental illness; absence of terminal disease; absence of aphasia (except amnestic aphasia); absence of severe apraxia; minimum visual acuity (corrected vision, Snellen fraction >20/400); accessibility via telephone, and sufficient hearing ability for receiving phone calls; sufficient knowledge of German language; and place of residence in the greater area of Heidelberg or Stuttgart. Patients with unexpected, short-term prolongation of inpatient rehabilitation after assessment were excluded in order to prevent influence of ongoing rehabilitation.

Measurements

Measurements were performed within a few days (4±2 days) before discharge from inpatient rehabilitation (T0) and at the participants' home before home-based treatment (T1). Length of stay in inpatient rehabilitation, demographic variables, and care grade (yes vs no) were obtained from patient charts. Care grade defines benefits of the statutory German long-term care insurance in cash and in kind associated with individual, comprehensive care needs (7). There are 5 different care grades that classify the severity of the impairment (or independence, respectively), ranging from minor impairments of independence (care grade 1) up to very severe impairments (care grade 5). The respective care grade is determined by healthcare assessors of the statutory German long-term care insurance, based on an evaluation of need for care in the following domains: mobility, mental and communication skills, behaviour and psychological problems, self-sufficiency, independent handling and coping with illness or therapy-related requirements and stresses, and organizing everyday life and social contacts. Not having a care grade documents that the severity of individual impairments is not sufficient to formally receive benefits, according to the criteria of the statutory German long-term care insurance. As the distribution of the care grades in the present study was limited to care grade 2 (n=38) and care grade 3 (n=3), representing typical impairment levels of patients in geriatric rehabilitation, classification into different care grades did not seem to be appropriate. This variable was therefore dichotomized (yes=having a care grade vs no=not having a care grade).

As described in the study protocol (5), outcome measures were determined by trained assessors: cognitive (MMSE) and functional status (Barthel Index), fall-related self-efficacy (short Falls Efficacy Scale-International; FES-I short), fear of falling (Fear of Falling Questionnaire-revised; FFQ-R), depressive symptoms (Montgomery-Åsberg Depression Rating Scale; MADRS), quality of life (EuroQol™; EQ-5D), pain (Western Ontario and McMaster Universities Osteoarthritis Index; WOMAC subscale pain), physical performance (Short Physical Performance Battery; SPPB, including subtests of balance, gait, and chair rise performance; habitual gait speed and total time for the 5-chair-stand test (both based on the SPPB)), living situation (alone vs with other person(s)/assisted living), and outpatient therapy (e.g. physical therapy) between discharge and T1 (yes vs no).

Statistical analysis

Descriptive data are presented as means and standard deviations, medians and interquartile ranges (IQR), or numbers and percentages. According to the data distribution, independent-samples t-tests, Mann-Whitney U tests, and χ^2 tests were used for baseline comparison between completers and dropouts. Paired-samples t-tests and Wilcoxon singed-rank tests were used to analyse changes in outcome variables during observation. Effect sizes were calculated as Pearson's r (small ≥0.1, medium ≥0.3, large ≥0.5) or Cohen's d (small ≥0.2, medium ≥0.5, large ≥0.8) (8).

To explore predictors of change in physical performance (absolute changes (T1–T0) in SPPB total score), univariate regression analyses with following independent variables were performed: age, sex, living situation, cognitive status, functional status, care grade, outpatient therapy, duration of transition period (discharge to T1), and baseline values of physical performance measures, psychological variables, and pain. Subsequently, independent variables with p-values ≤0.1 were selected and entered into a multiple linear regression model (stepwise backward, variables with a p-value ≥0.1 were removed). The regression model is described by the corrected coefficient of determination R^2 and influences of variables are given as unstandardized (*Beta*) and standardized (β) regression coefficients. A 2-sided p-value ≤0.05 indicated statistical significance. Data analyses were performed using SPSS Statistics 25 (IBM, Armonk, NY, USA).

Table I. Participant characteristics and comparison of completer and dropout group for descriptive and clinical variables at the end of inpatient rehabilitation

Characteristics	Total sample ($n = 127$)	Completer group ($n = 102$)	Dropout group ($n = 25$)	*p*-value
Age, years, mean (SD)	84.7 (6.5)	84.5 (6.3)	85.3 (7.3)	0.593[a]
Sex, female, *n* (%)	105 (82.7)	85 (83.3)	20 (80.0)	0.693[c]
MMSE, score, mean (SD)	22.8 (2.6)	22.8 (2.7)	22.6 (2.4)	0.678[a]
Barthel Index, score, median (IQR)	80 (75–85)	80 (75–88)	75 (65–84)	**0.008**[b]
Care grade, yes, *n* (%)	41 (32.3)	27 (26.5)	14 (56.0)	**0.005**[c]
Duration of stay in inpatient rehabilitation, days, median (IQR)	22 (21–25)	22 (21–26)	22 (21–24)	0.791[b]
Living situation, alone, *n* (%)	81 (63.8)	64 (62.7)	17 (68.0)	0.624[c]
Outpatient therapy, yes, *n* (%)	–	41 (40.2)	–	–
SPPB total, score, mean (SD)	4.3 (2.0)	4.4 (2.0)	4.0 (2.2)	0.385[a]
SPPB balance, score, mean (SD)	2.4 (1.2)	2.4 (1.2)	2.3 (1.3)	0.649[a]
SPPB gait, score, median (IQR)	1 (1–2)	1 (1–2)	1 (1–1)	0.259[b]
SPPB chair rise, score, median (IQR)	0 (0–1)	0 (0–1)	0 (0–1)	0.600[b]
Habitual gait speed, m/s, mean (SD)	0.33 (0.17)	0.34 (0.17)	0.30 (0.18)	0.348[a]
5-chair-stand, s, median (IQR)	18.2 (16.1–23.9)	18.2 (15.9–23.7)	20.7 (16.2–28.8)	0.571[b]
FES-I short, score, median (IQR)	11.0 (8.0–14.0)	11.0 (9.0–14.0)	10.5 (7.8–15.3)	0.807[b]
FFQ-R, score, mean (SD)	16.1 (4.6)	16.0 (4.5)	16.7 (4.9)	0.475[a]
MADRS, score, median (IQR)	8.5 (5.0–15.0)	9.0 (5.0–14.0)	8.0 (6.0–18.5)	0.428[b]
EQ-5D, score, median (IQR)	0.79 (0.63–0.89)	0.79 (0.57–0.89)	0.75 (0.65–0.89)	0.900[b]
WOMAC, score, mean (SD)	12.7 (9.3)	13.0 (9.0)	11.2 (10.7)	0.381[a]

p-values for [a]independent-samples *t*-test; [b]Mann–Whitney *U* test, and [c]χ^2 test were applied to test for differences between completer group and dropout group at end of rehabilitation.
Bold numbers indicate significant *p*-values. Care grade defines benefits of the statutory German long-term care insurance associated with individual, comprehensive care needs (yes vs no).
SD: standard deviation, IQR: interquartile range, m/s: metres per second, MMSE: Mini-Mental State Examination (0–30 pts), SPPB: Short Physical Performance Battery (total score: 0–12 pts; subscores: 0–4 pts), FES-I short: short Falls Efficacy Scale – International (7–28 pts), FFQ-R: Fear of Falling Questionnaire Revised (6–24 pts), MADRS: Montgomery-Åsberg Depression Rating Scale (0–60 pts), EQ-5D: EuroQol-5D (0–1 pt), WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index – subscale pain (0–20 pts).

RESULTS

The mean sample included 127 older persons 84.7 years (standard deviation (SD) 6.5) with HF and mild-to–moderate cognitive impairment (MMSE 22.8±2.6 points). Twenty-five participants dropped out during the transition period of median 18.5 days (IQR 14–25 days) after discharge from rehabilitation due to nursing home admission ($n = 11$), withdrawal of consent ($n = 8$), death ($n = 2$), severe disease ($n = 2$), or other reason ($n = 2$).

Table III. Multiple linear regression analysis of predictors of change in physical performance

Independent variables	Unstandardized coefficients		Standardized coefficients		
	Beta	SE	ß	t	*p*-value
Age, years	–0.106	0.024	–0.409	–4.365	**0.000**
SPPB balance, score	–0.495	0.130	–0.356	–3.793	**0.000**
FFQ–R, score	–0.102	0.033	–0.279	–3.125	**0.002**
Living situation, alone	–0.772	0.298	–0.232	–2.594	**0.011**

Adjusted R^2: 0.261.
Figures in bold indicate significant *p*-values.
SE: standard error; SPPB: Short Physical Performance Battery; FFQ-R: Fear of Falling Questionnaire Revised.

Table II. Changes of physical performance, psychological variables, and pain in the transition from inpatient rehabilitation to the home environment

Variables	*n*	End of rehabilitation (T0)	At home (T1)	Absolute change	*p*-value	Effect size
Physical performance						
SPPB total, score, mean (SD)	102	4.4 (2.0)	5.2 (2.4)	0.9 (1.7)	**<0.001**[a]	0.52[c]
SPPB balance, score, mean (SD)	102	2.4 (1.2)	2.6 (1.2)	0.2 (1.0)	0.063[a]	0.19[c]
SPPB gait, score, median (IQR)	102	1 (1–2)	1 (1–2)	0 (0–1)	**0.001**[b]	0.24[d]
SPPB chair rise, score, median (IQR)	102	0 (0–1)	1 (0–2)	0 (0–1)	**<0.001**[b]	0.33[d]
Habitual gait speed, m/s, mean (SD)	102	0.34 (0.17)	0.39 (0.19)	0.06 (0.14)	**<0.001**[a]	0.40[c]
5-chair-stand, s, median (IQR)	38	18.0 (15.9–23.3)	16.4 (13.8–18.7)	–2.4 (–6.7–0.4)	**0.001**[b]	0.38[d]
Psychological variables & pain						
FES-I short, score, median (IQR)	95	11.0 (9.0–14.0)	11.0 (9.0–17.0)	1.0 (–2.0–4.0)	**0.040**[b]	0.15[d]
FFQ-R, score, mean (SD)	94	16.0 (4.5)	17.1 (4.7)	1.1 (3.6)	**0.004**[a]	0.30[c]
MADRS, score, median (IQR)	99	9.0 (5.0–14.0)	10.0 (6.0–16.0)	0.0 (–4.0–5.0)	0.261[b]	0.08[d]
EQ-5D, score, median (IQR)	99	0.79 (0.70–0.89)	0.79 (0.59–0.89)	0.00 (–0.10–0.10)	0.769[b]	0.02[d]
WOMAC, score, mean (SD)	100	12.9 (8.9)	12.8 (9.5)	–0.1 (8.9)	0.956[a]	0.01[c]

p-values for [a]paired-samples *t*-tests and [b]Wilcoxon singed-rank tests were applied to test for differences between end of rehabilitation and at home.
Figures in bold indicate significant *p*-values. Effect sizes are given as [c]Cohen's *d* and [d]Pearson's *r*.
[e]Retest value (T1) minus baseline value (T0).
n: sample size (persons able to perform the respective testing), SD: standard deviation, IQR: interquartile range; m/s: metres per second; SPPB: Short Physical Performance Battery (total score: 0–12 pts; subscores: 0–4 pts); FES-I short: short Falls Efficacy Scale-International (7–28 pts); FFQ-R: Fear of Falling Questionnaire Revised (6–24 pts); MADRS: Montgomery-Åsberg Depression Rating Scale (0–60 pts); EQ-5D: EuroQol-5D (0–1 pt); WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index – subscale pain (0–20 pts).

Baseline comparison between completers and dropouts revealed significant differences in care grade and functional status, but not in other characteristics (Table I).

Significant improvements occurred in almost all physical performance measures, whereas fall-related self-efficacy and fear of falling deteriorated (Table II). Effect sizes were small (SPPB gait score, habitual gait speed, FES-I short; FFQ-R) to medium (SPPB total score, SPPB chair rise score, 5-chair-stand time).

Independent predictors of improvement in physical performance (ΔSPPB total score: $R^2 = 0.261$; $p < 0.001$) were lower age, lower baseline physical performance, less baseline fear of falling, and living alone (Table III). The change in physical performance was not independently predicted by any of the following factors: sex, cognitive status, functional status, care grade, outpatient therapy, duration of transition period, fall-related self-efficacy, depressive symptoms, or pain.

DISCUSSION

Physical performance improved in the short-term transition period after inpatient rehabilitation without controlled intervention, while fall-related self-efficacy and fear of falling deteriorated. A considerable subgroup of participants dropped out.

These results, showing concurrent improvement in physical performance and deterioration in fear of falling, are somewhat contradictory, as fear of falling usually induces activity avoidance and thus negatively affects physical performance ability and recovery (9). However, the positive trend of physical performance following inpatient rehabilitation, with an improvement of 0.9±1.7 points in the SPPB total score, was clinically relevant (10), with respect to this vulnerable, older study sample, compared with the low, negative progression of variables associated with fear of falling. The slight deteriorations in fall-related self-efficacy and fear of falling, similar to findings of an earlier study following inpatient rehabilitation (11), may have been due to the change from a 24-h supportive rehabilitation setting to autonomous living at home with the challenges of everyday life not well balanced by functional status.

Besides the considerable drop out, of approximately 20% of participants, with a potential negative course in their functional status, the majority of participants improved their physical performance. Since outpatient therapy during the transition period was not associated with improvement in physical performance, as demonstrated in the regression analysis, lasting effects of the inpatient rehabilitation or an unexploited potential for physical recovery following standard geriatric rehabilitation may be potential reasons for this gain in physical performance. This assumption may be supported by the results of the regression analysis, showing that older adults with poorer performance before discharge, given that they stayed at home and did not drop out, achieved greater improvement during the transition period after inpatient rehabilitation.

Further results from the regression analysis revealed that the improvement in physical performance was also predicted by living alone and lower age. Even though living alone is generally associated with low physical performance levels in older adults (12), indicating restricted social support, the need to become more active and perform better to stay at home and maintain autonomy, may have had an impact on improvement in physical performance. As physical performance generally decreases with age in older adults (13) and higher age is negatively related with functional recovery after discharge from hospitalization (14), comparatively younger persons may have had better chances to overcome the challenges of autonomous living, thereby deriving benefits from those efforts.

In contrast to the positive trend of improved physical performance in the majority of study participants, a high-risk subgroup, defined by care grade and lower functional status, dropped out during the transition period, mostly due to nursing home admission, medical events, or death. These results are compliant with previous findings for mortality and nursing home admission within 6 months post-HF, predicted by low functional status and factors associated with care grade (15).

In conclusion, the clinically relevant improvement in physical performance in the short-term transition period from inpatient rehabilitation to home environment, without any controlled, standardized intervention, suggests lasting effects of inpatient rehabilitation, or a remaining potential for physical rehabilitation that has not been fully exploited. A prolonged rehabilitation and/or general activation at home may promote further recovery in these multi-morbid, older persons with motor and cognitive impairment. In addition, the considerable subgroup that dropped out of the study, and partly showed a negative trajectory, may benefit from further, adapted, rehabilitation to prevent, mitigate, or slow down the documented negative course.

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