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Association Between Pain and Functional Independence in Older Adults During and After Admission to Rehabilitation After an Acute Illness or Injury

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Abstract

OBJECTIVES—To investigate the association between pain and functional independence in older adults during and after admission to rehabilitation after an acute illness or injury.

DESIGN—Prospective, observational cohort study.

SETTING—One community and one Veterans Affairs rehabilitation center.

PARTICIPANTS—Individuals aged 65 and older admitted for rehabilitation after an acute illness or injury (postacute rehabilitation) (N = 245; mean age 80.6, 72% male)).

MEASUREMENTS—Pain was assessed using the Geriatric Pain Measure (GPM, score 0–100). Functional independence was measured using the motor component of the Functional Independence Measure (mFIM, score 13–91). Both scores were obtained at admission; discharge; and 3-, 6-, and 9-month follow-up. In bivariate analyses, discharge GPM and persistent pain (lasting >3 months) were evaluated as predictors of mFIM score at 9 months. Applying a multilevel modeling (MLM) approach, individual deviations in GPM scores were used to predict variations in mFIM.

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RESULTS—At admission, 210 participants (87.9%) reported pain (16.3% mild (GPM<30); 49.3% moderate (GPM: 30–69); 22.1% severe (GPM>70)); 21.3% reported persistent pain after discharge. The bivariate analyses did not find statistically significant associations between discharge GPM or persistent pain and mFIM score at 9 months, but in the MLM analysis, deviations in GPM were significant predictors of deviations in mFIM score, suggesting that, when individuals experienced above-average levels of pain (GPM > their personal mean GPM), they also experienced worse functional independence (mFIM < their personal mean mFIM).

CONCLUSION—Twenty-one percent of older adults undergoing postacute rehabilitation reported persistent pain after discharge from rehabilitation. The bivariate analysis did not find association between pain and functional independence, but MLM analysis showed that, when participants experienced more pain than their average, they had less functional independence.

Keywords

pain; aged; rehabilitation; functional independence

Pain is a frequent symptom in people who require rehabilitation after an acute illness or injury (postacute rehabilitation). In the acute hospital setting, 91% of people experience pain when receiving physical therapy after hip fracture surgery.[1] Individuals who have had a stroke may have multiple sources of pain (e.g., shoulder pain, pressure sores, injury from falls), and one-third report pain intensity as moderate to severe.[2] Similar data have been reported for individuals with spinal cord injury, in whom neuropathic pain is a major concern.[3] Once individuals are transferred from acute care to a rehabilitation setting, pain may persist. For example, 40% to 50% of individuals hospitalized for stroke rehabilitation report pain,[4,5] 82% of those hospitalized for postsurgical orthopedic rehabilitation complain of at least moderate pain,[6] and 97% of those hospitalized for rehabilitation after acute traumatic spinal cord injury report pain at least once during the rehabilitation stay.[7] Less is known about the incidence of persistent pain (lasting >3 months)[8] after postacute rehabilitation, but it could be as high as 50% after rehabilitation for surgical interventions.[9,10] Pain is generally not well controlled in older adults, and low adherence to pain treatment guidelines has been reported.[11–14]

In addition to providing rehabilitation therapies, rehabilitation units provide comprehensive assessment of and treatments for acute diseases and chronic conditions, with the purpose of improving functional independence.[15] This holistic approach includes the identification and management of factors interfering with the rehabilitation process. Previous research has identified factors that predict worse outcomes of rehabilitation in individuals recovering from medical, orthopedic, surgical, and neurological conditions. Some of these predictors include older age, cognitive impairment, pre-illness dependence in personal care activities, depression, sleep disturbances, lack of family involvement, fewer hours of physical therapy during rehabilitation, and fear of falling.[16–20] Pain has been described as an immediate and long-term predictor of poorer functional recovery at discharge from rehabilitation units as well.[6,7] Previous research has evaluated the impact of pain in the acute care setting (e.g., the role of post-operative pain).[21–23] Finally, several cross-sectional studies have reported the impact of pain on functional abilities at different times post-discharge in individuals with hip fracture and stroke.[10,24–26] This evidence supports the notion that pain is an important

problem in the care of individuals undergoing rehabilitation, but detailed studies of the potentially complex association between pain and functional outcomes of rehabilitation are scarce.

The aim of the present examination was to investigate further the role of pain as a possible predictor of functional independence, specifically, whether pain at discharge or persistent pain after discharge predicted subsequent functional independence and whether within-person variations in pain levels were related to within-person variations in functional independence in older adults during and after a stay in rehabilitation units. It was hypothesized that pain at discharge and persistent pain would be predictors of functional independence after the rehabilitation process in older adults and that pain would be concurrently associated with functional independence, such that when an older adult experienced more pain than is average for that individual, they would also experience lower levels of functional independence. To the knowledge of the authors, this is the first study to examine in detail the potential associations between pain and functional independence across multiple time points in older adults during and after a postacute rehabilitation stay.

METHODS

Study Design and Setting

This study involved a secondary analysis of data from a prospective, observational study designed to evaluate the association between sleep–wake patterns and functional recovery in older adults admitted to two postacute rehabilitation units. One unit was a community nursing home that focuses on rehabilitation. The other was an inpatient rehabilitation unit administered by the Department of Veterans Affairs (VA). Details of this protocol have been previously reported.[19] Briefly, the first unit was a free-standing, for-profit, community nursing home with 130 Medicare-certified beds that focused on short-term rehabilitation. The second unit was an inpatient rehabilitation unit located within a VA Medical Center. Both sites provided postacute rehabilitation. The VA Greater Los Angeles Healthcare System institutional review board approved the research methods. Written informed consent was obtained from participants. For those who were unable to provide consent, written informed consent was obtained from a responsible party with the assent of the participant.

Participants

All individuals admitted to the rehabilitation units (n = 966) were screened for enrollment in the study. Inclusion criteria were aged 65 and older and admitted for rehabilitation (receiving physical or occupational therapy). Exclusion criteria were residing in a nursing home before admission; transferred, died, discharged, or not identified within 1 week of admission to the unit; and judged to be unable to participate in the study because of severe medical illness (e.g., end-of-life care) or severe behavioral disorder (e.g., dementia with severe agitation identified on screening interview). Of 737 participants eligible for the study, 245 (33%) agreed to participate.

Baseline Assessments—Enrolled participants underwent assessments at admission and before discharge from the rehabilitation units. Trained research personnel collected all data.

Basic demographic information was recorded (e.g., age, sex, ethnicity, level of education), and body mass index (BMI), blood pressure, medications, reason for admission, and other clinical data were also recorded. Questionnaire assessments included the Mini-Mental State Examination (MMSE; a 20-item measure of general cognitive functioning; range 0–30; scores <24 suggesting cognitive impairment),[27] the 15-item version of the Geriatric Depression Scale (GDS-15; this abbreviated version assesses symptoms of depression; range 0–15; scores >5 suggesting depression),[28] and the Cumulative Illness Rating Scale for Geriatrics (CIRS-G; used to assess illness severity and comorbidity; range 0–56).[29]

Pain Measure—Pain was assessed using the Geriatric Pain Measure (GPM), a 24-item questionnaire specifically developed and validated for interviewer- and self-administered assessment of pain in older adults. The GPM assesses pain intensity, disengagement due to pain, pain with ambulation, and pain with strenuous and other activities. The GPM score range is 0 to 100, with higher scores indicating greater pain. Pain was assessed at admission; discharge; and 3-, 6-, and 9-month follow-up. This questionnaire has established validity and reliability in older persons with multiple medical problems.[30] For this analysis, persistent pain was defined as pain reported at discharge and 3- and 6-month follow-up. For this purpose, three GPM items were used: pain that never completely went away, pain every day, and pain several times a week. Participants were considered to have persistent pain if they answered yes to at least one of the three items at each of the three consecutive assessments (discharge, 3- and 6-month follow-up).

Functional Independence Measure

Functional independence was measured using the motor subscale of the Functional Independence Measure (mFIM) at admission; discharge; and 3-, 6-, and 9-month follow-up. [31] The mFIM is a 13-item scale (eating; grooming; bathing; dressing upper body; dressing lower body; toileting; bladder control; bowel control; transferring in and out of a bed, chair, wheelchair; transferring on and off of the toilet; transfer in and out of the bath and shower; walking or wheelchair use; and using stairs) that measures functional independence based on the need for assistance or assistive devices or aids during the performance of activities of daily living. Each activity has seven possible levels, ranging from total dependence (1) to total independence (7). The range for the total mFIM score is 13 to 91, with higher scores indicating greater functional independence. This measure is used in rehabilitation settings to assess functional limitations and change in functional status with rehabilitation therapy. As mentioned above, mFIM-trained research staff obtained admission and discharge mFIM scores from the medical records in both rehabilitation units.

Follow-Up Assessments—Follow-up assessments were conducted 3, 6, and 9 months from the date of admission and included all assessments conducted at baseline. Trained research staff conducted the assessments participants' homes (or other living location). When an in-person visit was not possible (e.g., participant had moved out of the area), the assessment was performed over the telephone.

Statistical Analysis

Descriptive statistics were calculated for all measures. Bivariate analyses were performed to evaluate whether discharge pain (discharge GPM) or persistent pain predicted functional independence (mFIM) at 9-month follow-up.

To address the second study hypothesis, total GPM score at each time point was used to predict functional independence (mFIM), applying a multilevel modeling (MLM) framework. This provided the opportunity to examine how well pain predicted functional independence within (Level 1: across time) and between (Level 2: across persons) subjects. Level 1 analysis addressed questions such as: “At an occasion on which a person reports pain that is above her or his personal average, does she or he also exhibit less functional independence?” Level 2 analysis examined questions such as: “Do people who generally experience less pain also exhibit better levels of functional independence?”

Model building was conducted in a hierarchical manner, such that the dependent variable (mFIM) was predicted using two increasingly complex models. Model 1, the null model, included no predictor estimates and was parameterized to allow for estimation of subsequent fit statistics. Model 2, the conditional model, included the addition of time variables (to model any systematic change in mFIM from admission through 9-month follow-up); time-invariant covariates of age, BMI, sex, education, comorbidity, cognition, depression, and reason for admission to rehabilitation; and intrapersonal mean-level pain and intrapersonal variability in pain.

All models were estimated under the simplest assumptions about the repeated error structure over time (homoscedasticity and independence of errors) and diagonal random error structure (heteroscedasticity and independence of observations). The models were estimated using the maximum likelihood method.[32] The ability of a model to predict functional independence better than the null model (deviance) was used as an index of goodness of fit. Improvements in predictability were determined according to the amount of reduction in within-person residual variances and between-person intercept variances from the null model. Decreases in residual and intercept variances represent a proportional reduction of the prediction error, which is analogous to the coefficient of determination (R^2) and was used as an estimate of within- and between-person effect sizes.

Statistical analyses were performed using Stata 13.1 (Stata Corp., College Station, TX) and SPSS 22 (IBM Corp., Armonk, NY). For all statistical tests, $P < .05$ indicated statistical significance.

RESULTS

The mean age of participants was 80.6 ± 7.2, 62% were male, and 79.6% were non-Hispanic white. The most common reason for admission was an orthopedic problem, followed by cardiac and neurological conditions. Other baseline characteristics of participants are described in Table 1. A detailed summary of demographic and baseline characteristic has been previously reported.[19]

Of the 245 participants initially enrolled, 130 were followed until the end of the study. The reasons for loss to follow-up were death (n = 47), refusal to participate (n = 43) and unable to be contacted (n = 25). Participants who were lost to follow-up had greater comorbidity (CIRS-G 23.7 ± 6.0 vs 21.5 ± 5.5), were more likely to be depressed (GDS 4.6 ± 3.6 vs 3.7 ± 2.8), and had poorer functional independence (mFIM 42.7 ± 12.5 vs 46.6 ± 12.1) than those followed until the end of the study, but no other significant differences in baseline characteristics listed in Table 1. Sixty-seven percent of the follow-up assessments were performed in person and 33% over the telephone. Differences in baseline characteristics and 9-month follow-up mFIM scores of these two groups were not statistically significant (data not shown). The average length of stay in the rehabilitation units was 21.0 ± 11.8 days.

At admission, 239 participants completed the GPM (97.5%), 210 of whom (87.9%) reported some level of pain. Thirty-nine participants (16.3%) had mild pain (<30 points), 118 (49.3%) had moderate pain (31–69 points), and 53 (22.1%) had severe pain (70–100 points). Consecutive GPM scores were obtained at discharge and 3- and 6- month follow-up in 131 participants, and 28 (21.3%) individuals reported persistent pain. Average participant GPM and mFIM scores over time (from admission to 9-month follow-up) are shown in Figure 1. The greatest reduction in pain intensity was observed between admission (46.2, 95% confidence interval (CI) = 42.6–49.8) and discharge (35.6, 95% CI = 31.3–39.9). Correspondingly, the greatest improvement in participants' functional independence was observed between admission (44.7, 95% CI = 43.1–46.3) and discharge (62.6, 95% CI = 60.5–64.6).

No associations were found in the bivariate analyses between discharge GPM or persistent pain and 9-month mFIM (Table 2). To confirm these results, a sensitivity analysis was performed using the 0-to-10 intensity pain item. This numerical scale was selected because of its simplicity and wide use in clinical practice and research protocols. [33] The results obtained with the sensitivity analyses were consistent with those described for the total GPM score.

Dynamic Associations Between Pain and Functional Independence

In the MLM predicting functional independence (mFIM), at the within-person level (Level 1), person-centered pain score (GPM) was a significant predictor of functional independence, suggesting that, during a measurement occasion in which an individual experienced above-average levels of pain (pain score above intrapersonal mean) she or he also experienced worse functional independence than average (lower FIM score than average intrapersonal mean). Linear time and quadratic time were also significant predictors of functional independence, suggesting that functional independence improved after hospital discharge, followed by a decline in functional independence. In the between-person analyses (Level 2), sex, education, comorbidity, and cognition were significant predictors of mFIM, suggesting that men and participants with more education, better mental status, and less comorbidity had greater functional independence. The model explained 79% of the within-person (Level 1) variance and 68% of the between-person (Level 2) variance in mFIM (representing large effect sizes, Table 3).

To highlight the association between individual deviations in pain and deviations in functional independence, the GPM and mFIM scores for two randomly selected representative participants were plotted (Figure 2). As can be seen, when participants' pain was above their own average level of pain, they experienced poorer functional independence.

DISCUSSION

Older adults undergoing postacute rehabilitation had a high prevalence of pain during and after the rehabilitation process. Almost 90% of the current sample reported experiencing pain at admission, and 21.3% reported persistent pain for at least 6 months after discharge. Moreover, the intensity of reported pain was moderate or severe in more than 70% of the admitted participants. As expected, given the proportion of participants with acute orthopedic problems, pain intensity decreased during the hospitalization stay, although the average pain intensity persisted at moderate levels at discharge, as well as at subsequent follow-up times (Figure 1). It is likely that this observation reflects difficulties in pain management in older adults.[11–13]

Contrary to the first hypothesis, statistically significant relationships were not found between discharge or persistent pain and functional independence at 9-month follow-up. Strict criteria were used to define prospectively persistent pain for longer than 3 months. One hundred thirty of the 245 participants initially enrolled (53%) were followed until the end of the study (9 months). This common difficulty of participant attrition in prospective studies involving older adults and the rate of persistent pain found could have reduced the statistical power to detect an association between pain and functional independence in the bivariate analyses. Moreover, the complex relationship between pain and functional independence cannot always be evidenced using simple statistical methods, such as bivariate analysis.

The second hypothesis was confirmed using a multilevel modeling framework. As shown in Figure 2, some participants had fluctuation in pain intensity and functional independence after discharge. The results showed that, when participants were experiencing more pain than average, they had less functional independence. The dynamic covariation observed provides a different perspective on the complex relationship between pain and functional independence. This type of association has also been reported between pain and other factors, such as sleep disturbances in older adults,[34] although to the authors' knowledge, this is the first study to find this type of relationship between pain and functional independence. These results add important information to previous research describing the association between pain and functional independence in individuals in postacute rehabilitation. [6,7,10,23–25] Beyond the rehabilitation process, pain has also been associated with future loss of function in community-dwelling older adults.[35] This large amount of evidence reflects the strong and complex association between pain and functional independence. Pain is a risk factor of poorer functional independence and a limiting factor for functional recovery after disabling events in older adults.

Some limitations to the current study should be mentioned. First, this work is a secondary analysis of a protocol designed to investigate the association between sleep disorders and functional recovery in postacute rehabilitation units. Second, although two rehabilitation

units were analyzed to increase sample size and diversity, these results should be cautiously interpreted and may not generalize to the larger population of older adults undergoing rehabilitation services. Third, as previously mentioned, loss of follow-up of participants could have affected the results of the statistical analyses. The higher baseline comorbidity and depression scores and poorer functional independence in participants lost to follow-up suggests they may have had more-severe illness than those who completed all follow-up testing. Finally, information was not collected to identify specific factors causing pain exacerbations of new possible disabling events that could have explained a reduction in functional independence after discharge.

These results could have important implications in clinical practice. Older adults have a high prevalence and a high intensity of pain during and after hospitalization in rehabilitation units. When these individuals had more pain than average, they also experienced worse functional independence. Therefore, reducing pain and preventing pain exacerbations may result in better, more-stable functional independence in older adults. Further investigations should address whether reducing pain intensity improves long-term results of rehabilitation therapy, reduces the necessity and burden of caregiving, and decreases healthcare costs related to recovery.

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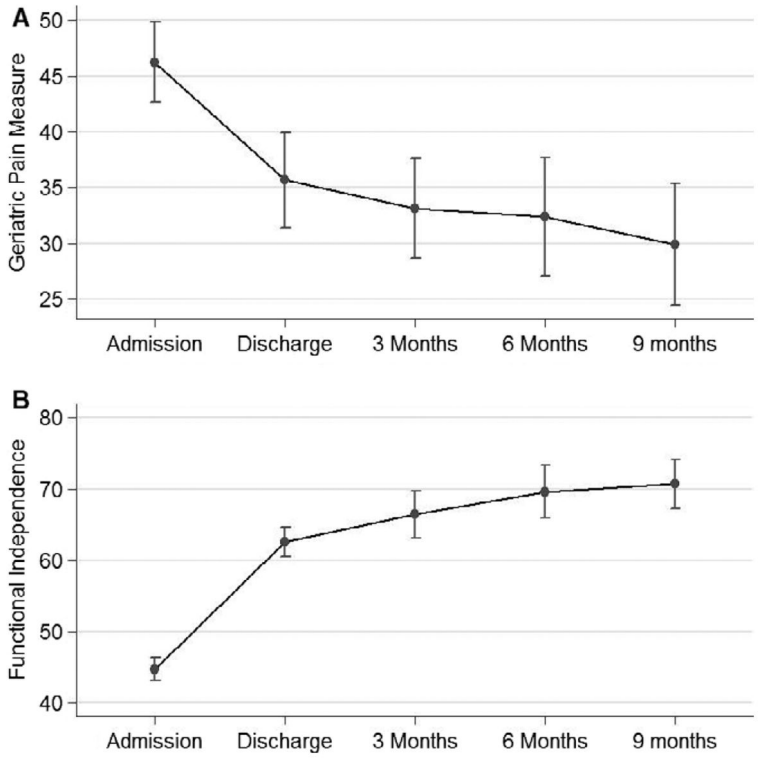

Figure 1.
Average (A) geriatric pain measure and (B) functional independence over time.

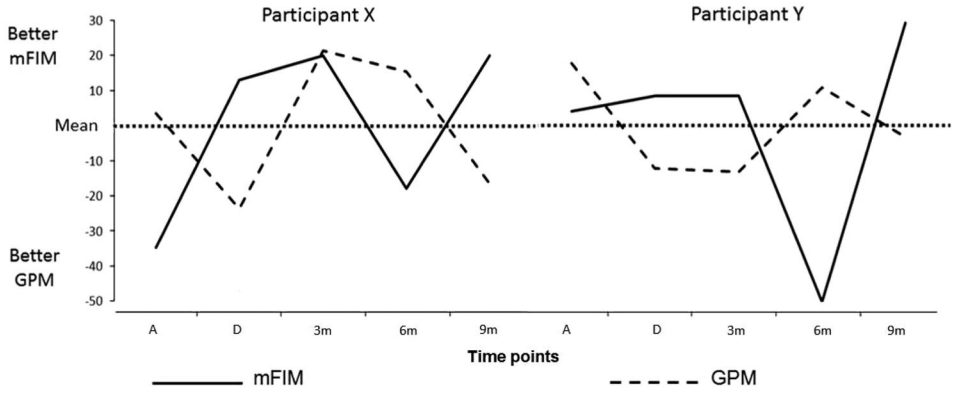

Figure 2.

Pain and functional independence covariation represented by two randomly selected participants. Values are person-mean centered such that the mean of pain and functional independence are 0 and occasion-specific pain and functional independence are individual deviations above and below person-specific average levels of pain and functioning. When pain is below intrapersonal mean levels, functional independence tends to be above intrapersonal mean levels. A = admission; D = discharge; 3 m = 3-month follow-up; 6 m = 6-month follow-up; 9 m = 9-month follow-up; GPM = Geriatric Pain Measure; mFIM = Functional Independence Measure, motor subscale.

Table 1

Participant Characteristics (N = 245)

Variable	Value
Age, mean ± SD	80.6 ± 7.2
Male, n (%)	152 (62)
Non-Hispanic white, n (%)	195 (79.6)
Reason for admission to rehabilitation, n (%)	
Orthopedic	103 (42.1)
Cardiac	32 (13.2)
Neurological	26 (10.6)
Pulmonary	6 (2.6)
Other	77 (31.5)
Body mass index, kg/m^2, mean ± SD	25.5 ± 6.2
Cumulative Illness Rating Scale-Geriatrics score (range 0–56), mean ± SD	22.6 ± 5.9
Mini-Mental State Examination score (range 0–30), mean ± SD	23.5 ± 6.2
Geriatric Depression Scale-15 score (range 0–15), mean ± SD	4.1 ± 3.3
Functional Independence Measure, motor component score (range 13–91), mean ± SD	44.7 ± 12.5
Geriatric Pain Measure score (range 0–100), mean ± SD	46.3 ± 25.5
Length of stay, days, mean ± SD	21.0 ± 11.8

SD = standard deviation.

Table 2

Correlation Between Pain and 9-Month Follow-Up of the Motor Subscale of the Functional Independence Measure (mFIM)

Predictor	**9-Month Follow-Up of mFIM**
Discharge Geriatric Pain Measure	
r	0.034
P-value (observations, n)	.70 (125)
Persistent pain	
r	0.023
P-value (observations, n)	.87 (97)

r = correlation coefficient.

Table 3

Multilevel Models Predicting Functional Independence

Effects	B	Standard Error	T- or Z-Score	*P*-Value
Fixed				
Level 1 (within person)				
Linear time	23.28	1.17	19.89	<.001
Quadratic time	−3.04	0.19	−15.57	<.001
Pain	0.04	0.02	2.18	.03
Level 2 (between person)				
Age	0.20	0.10	1.93	.05
Body mass index	0.16	0.12	1.39	.18
Sex	−6.24	1.49	−4.19	<.001
Education	−0.47	0.21	−2.25	.03
Comorbidity	−0.58	0.13	−4.35	<.001
Cognition	0.90	0.14	6.20	<.001
Depression	0.19	0.22	0.87	.38
Reason for admission	0.00	0.00	0.01	.99
Pain	0.00	0.03	−0.15	.88
Random				
Residual	68.03	5.36	12.70	<.001
Linear time	10.97	1.87	5.85	<.001
Pain	0.01	0.01	1.43	.15

Level 1 predictors (within person) vary within individuals across time and represent pain deviations at each measurement occasion. Level 2 predictors (between person) do not change across time and represent initial ratings of age, body mass index, sex, education, comorbidity, cognition, depression, reason for admission to rehabilitation, and person-mean pain.