European Journal of Physical and Rehabilitation Medicine 2023 December;59(6):743-53
DOI: 10.23736/S1973-9087.23.07900-5

ORIGINAL ARTICLE

Predictive factors for home discharge after femoral fracture surgery: a prospective cohort study

Intonia H. CHOW [1, 2], Tiev MILLER [2, 3, 4], Marco Y. PANG [2] *

[1]Department of Physiotherapy, Queen Elizabeth Hospital, Kowloon, Hong Kong; [2]Department of Rehabilitation Sciences, Hong Kong Polytechnic University, Kowloon, Hong Kong; [3]International Collaboration on Repair Discoveries, Faculty of Medicine, University of British Columbia (UBC), Vancouver, Canada; [4]Division of Physical Medicine and Rehabilitation, Faculty of Medicine, University of British Columbia (UBC), Vancouver, Canada

*Corresponding author: Marco Y. Pang, Department of Rehabilitation Sciences, Hong Kong Polytechnic University, 11 Yuk Choi Rd., Kowloon, Hong Kong.
E-mail: marco.pang@polyu.edu.hk

ABSTRACT

BACKGROUND: Femoral fractures require protracted hospitalization and often preclude return to pre-fracture levels of mobility, function and prior residential status following hospital discharge. Early prediction of rehabilitation and discharge potential in patients with femoral fracture would optimize discharge planning.

AIM: To identify predictive factors of discharge destination during the early phase of femoral fracture rehabilitation.

DESIGN: Prospective cohort design.

SETTING: Acute and postoperative rehabilitation hospital settings.

POPULATION: Data from 109 participants (65 women [59.6%]) admitted for unilateral femoral fracture were included.

METHODS: Sociodemographic information, hip pain severity during gait (Numeric Pain Rating Scale), mobility (Elderly Mobility Scale), activities of daily living (Modified Barthel Index), cognition (Mini-Mental State Examination [MMSE]), exercise self-efficacy (Self-Efficacy for Exercise Scale), amount of physiotherapy received, and caregiver availability were assessed pre- and/or postoperatively. Discharge destination was assessed via telephone interviews 6 weeks after discharge from acute care. Receiver operating characteristic curves were used to determine optimal cut-off scores for all outcomes based on discharge destination. Outcomes demonstrating a significant area under the curve were entered as dichotomous independent variables (*i.e.*, above or below ROC-derived cut-off values) in subsequent logistic regression analyses to determine predictors of discharge destination.

RESULTS: SEE Score ≥53 (odds ratio [OR]=5.975, 95% confidence interval [CI]=1.674-21.333, P=0.006), female sex (OR=3.421, 95% CI=1.187-9.861, P=0.023), ≥8 physiotherapy sessions (OR=4.633, 95% CI=1.559-13.771, P=0.006), MMSE Score ≥17 (OR=3.374, 95% CI=1.047-10.873, P=0.042), and caregiver availability (OR=3.766, 95% CI=1.133-12.520, P=0.030) were identified as significant predictors of home discharge.

CONCLUSIONS: Exercise self-efficacy, female sex, more physiotherapy rehabilitation training, better pre-operative cognitive function, and caregiver availability emerged as important predictors of home discharge following femoral fracture.

CLINICAL REHABILITATION IMPACT: These findings are highly translational and may be useful for informing clinical guidelines and policy decisions regarding rehabilitation potential and discharge pathway selection during early hospitalization following femoral fracture surgery.

(*Cite this article as:* Chow IH, Miller T, Pang MY. Predictive factors for home discharge after femoral fracture surgery: a prospective cohort study. Eur J Phys Rehabil Med 2023;59:743-53. DOI: 10.23736/S1973-9087.23.07900-5)

KEY WORDS: Hip fractures; Health care surveys; Patient discharge; Rehabilitation; Disability evaluation.

Femoral fractures require protracted hospitalization and are considered a significant global health concern.[1-3] Some individuals may become dependent after sustaining a femoral fracture and are unable to regain pre-fracture levels of mobility and function. Others are unable to return to pre-fracture residential status following hospital discharge, despite successful surgery and subsequent rehabilitation.[4] Although transdisciplinary management of femoral fractures is important for optimizing both acute and long-term outcomes, the feasibility of a comprehensive approach in clinical practice remains challenging.[5, 6] Early prediction of rehabilitation potential and discharge destination in patients with femoral fracture are essential and would help to improve discharge planning. Identifying modifiable factors that predict successful discharge to pre-fracture residential status can also guide clinicians in treatment planning.[7-20]

Previous studies have identified several significant predictors of successful discharge to pre-fracture residential status (*e.g.*, younger age, better pre-fracture function, mobility, cognition, fewer comorbidities at admission, receiving physiotherapy training).[7-19] However, patient data collected in these studies were often obtained via indirect reporting (*e.g.*, family members or proxy representatives) rather than direct assessment (*i.e.*, face-to-face), which compromises the validity of these results.[16, 20] Some studies included patients with fractures at different skeletal sites rather than femoral fractures alone. On the other hand, other studies recruited patients with femoral neck region fractures only, thus limiting the generalizability of the results. In real-world clinical situations, fractures also occur in other regions of the proximal femur.[7, 9, 10, 15, 17, 18] Although patients with cognitive impairment were included in a few studies, cognition was not assessed using standardized and validated outcome measures.[12, 20] Approximately half of the studies included in a recent systematic review examining the impact of cognitive impairment on outcomes after hip surgery did not involve the use of standardized and validated cognitive assessments.[21]

In addition, research on other potentially relevant factors (*e.g.*, hip pain severity, social support, self-efficacy) is currently lacking. Previous studies suggest greater self-efficacy to engage in exercise may be an important determinant of long-term mobility and functional recovery following femoral fracture surgery.[22, 23] Although effective pain management and social support after fracture are important during preoperative planning,[24] the influence these factors have on postoperative discharge destination remains unknown. Therefore, further research is warranted to identify the most clinically relevant predictors of discharge destination among patients following femoral fracture surgery.

This prospective cohort study aimed to identify relevant factors (*i.e.*, sociodemographic, physical, cognitive, psychosocial, environmental) during the early phase of rehabilitation (*i.e.*, first two postoperative days) that were predictive of discharge destination among patients with femoral fracture.

Materials and methods

Study design and setting

Ethical approval was granted by the Human Subjects Ethics Sub-committee of the Hong Kong Polytechnic University (Protocol Number: HSEARS20160624003, Approval: August 22, 2016) and by the Research Ethics Committee of the Hospital Authority (Kowloon Central Cluster/ Kowloon East Cluster, Reference Number: KC/KE-16-0210/ER-3, Approval: January 24, 2017). All study procedures were conducted in accordance with the Declaration of Helsinki for human studies. Written informed consent was obtained from each participant prior to study commencement. An attending physiotherapist performed all participant assessments. Two researchers (one with PhD qualification in rehabilitation science, one a professor with expertise in biostatistics) assisted with off-site data analysis.

Various sociodemographic and clinical assessments were documented preoperatively and postoperatively during hospitalization by a physiotherapist. A standardized integrated multidisciplinary clinical pathway for fragility fractures of the femur was implemented for all recruited participants, which involved daily training for transfer and ambulation as early as postoperative day 1 or 2 in medically stable patients without postoperative complications. The same pathway was also implemented in rehabilitation hospital settings in accordance with the integrated documentation policy of the hospital authority. In patients with *in-situ* wound drainage, early mobilization training was initiated following drain removal. In addition, all participants received postoperative physiotherapy involving airway clearance, pain management, exercises for edema control, joint mobilization, muscle strengthening, bed mobility training, as well as patient and caregiver education. All physiotherapy sessions were administered by a licensed physiotherapist with 8+ years of experience in femoral fracture rehabilitation, which included structured exercise and ambulation training conducted in the ward (approximately 30 minutes) and physiotherapy gymnasium settings (45-60 minutes). Participants were permitted to walk with an aid (*i.e.*, stick, quadripod, frame, rollator, or elbow crutches) or unaided during therapy sessions under the supervision of the physiotherapist.

The number of physiotherapy and occupational therapy sessions was noted throughout acute hospital stay. Final discharge destination at 6 weeks post-operation was confirmed via telephone interview. Measures collected during hospitalization were used to predict discharge destination at 6 weeks post-operation.

Sample size estimation

The estimation method for logistic regression described by Hsieh was used to calculate the sample size for the present study.[25] Based on previous studies, odds ratios (OR) of potential predictors of home discharge after femoral fracture ranged from 1.96-3.17 (male sex: 1.96, requiring companion for outdoor activity: 2.27, age: 1.79, chronic systemic comorbidity: 1.77, dementia: 3.17).[12, 18] After considering these findings, an estimated OR of 2.0 was used.

Overall event proportions (P) (*i.e.*, percentage of participants who could not be discharged home after femoral fracture) reported in previous studies were as high as P=43%,[10] P=41.4%,[12] and P=40% (females).[17] Therefore, P=0.4 (*i.e.*, 40% of participants) was considered a suitable estimation. Based on an OR=2.0 and P=0.4, an estimated sample size of 76 was required for the multiple logistic regression analysis. 76 was then divided by a factor of 1-ρ2, where ρ represents the multiple correlation coefficient of a specific covariate relative to other remaining covariates. The level of function required to perform activities of daily living (ADL) has been identified as a major predictor of home discharge in patients with femoral fractures (ADL: ρ=-0.515).[9] Based on a desired power of 0.80, alpha of 0.05 and an attrition rate of 10%, a minimum of 92 participants was required for the analysis.

Participants

Participants were recruited from a local acute care hospital. The inclusion criteria were: 1) hospital admission due to unilateral femoral fracture; 2) having undergone surgical treatment for unilateral femoral fracture; 3) aged ≥65 years; and 4) able to follow verbal commands. The exclusion criteria were: 1) femoral fractures treated conservatively; 2) inability to walk before femoral fracture; 3) pathological femoral fractures (caused by disease instead of an injury such as benign lesions, underlying metabolic abnormalities); 4) femoral fractures associated with malignancy; 5) associated injuries such as upper extremity or pelvic fractures; 6) major concomitant injuries such as multiple trauma secondary to automobile accidents; 7) rheumatoid arthritis; 8) inability or refusal to provide informed consent; and 9) delayed hospital admission after fracture (>24 hours).

Preoperative measurements

Demographic (*e.g.*, age, sex) and other relevant data (*e.g.*, past medical history, presence of caregiver, walking aid use) were collected at hospital admission (*i.e.*, preoperation) via patient medical records and interviews with a physiotherapist. The following preoperative assessments have demonstrated sufficient reliability, validity, and sensitivity and were also conducted after admission.[26-30]

Pre-fracture health status

The Functional Comorbidity Index (FCI) was used to assess pre-fracture health status. The FCI is a population-based general comorbidity index used to adjust for the effect of comorbidity on physical function.[26, 31] It includes 18 diagnoses and is calculated by adding the number of "yes" responses, with higher scores indicating greater comorbidity (*i.e.*, 0= no comorbidity; 18= highest number of comorbidities). All relevant information was collected via interviews or retrieved from patient medical records after hospital admission and prior to femoral fracture surgery.

Pre-fracture functional ability

The Modified Barthel Index (MBI) was used to assess functional ability in performing various ADLs such as feeding, wheelchair/bed transfer, personal toilet hygiene (personal care), toilet transfers, bathing, walking, stair climbing, dressing, and bladder and bowel control.[29] Each performance item was rated using specified points assigned to each level or ranking, indicating the level of assistance required. Item scores are aggregated to obtain a maximum score of 100. A higher total score is associated with a greater degree of functional independence.

Cognition

The Mini-Mental State Examination (MMSE) was used to assess global cognition.[27] An MMSE score of 30 indicates no impairment. Scores ranging from 26-30 are considered normal in the general population.[27] Scores ranging from 20-25 indicate mild cognitive impairment and difficulty in performing instrumental (I)ADLs, (*e.g.*, shopping, finances, administering medication, meal preparation). Scores ranging from 10-19 indicate moderate cognitive impairment, suggesting an inability to live independently and difficulty performing basic IADLs (*e.g.*, grooming, dressing, toileting). Scores ranging from 0-9 indicate severe cognitive impairment, and difficulty with all basic IADLs (*e.g.*, eating, walking).[27]

Hip pain level

The Numeric Pain Rating Scale (NPRS) is a patient-reported outcome that was used to evaluate hip pain severity on an 11-point numeric scale from 0-10 (0=no pain, 10=worst pain).[32, 33] It is easy to administer in clinical settings and suitable for use in elderly populations.[34, 35]

Postoperative measures collected on the day of the second gait training session

Based on our previous clinical experience, we observed that compared with the first gait training session, participants showed better transfer ability and less wound pain during ambulation at the time of the second gait training session. This suggests that outcome measures obtained at the time of the second gait training may more accurately reflect postoperative recovery status. Therefore, MBI and NPRS were again measured on the day of the second postoperative gait training session by a physiotherapist. In addition, the Elderly Mobility Scale (EMS), and the Self-Efficacy for Exercise (SEE) Scale were assessed on the same day. These assessments have also demonstrated sufficient reliability, validity, and sensitivity.[36-40]

Postoperative mobility status

The EMS was used to evaluate mobility based on 7 functional activities including bed mobility, transfers, locomotion, balance and key position changes. Scores range from 0 (totally dependent) to 20 (independent mobility in a hospital setting).

Postoperative exercise self-efficacy

The SEE Scale was used to evaluate patient confidence to continue exercising despite physical limitations and perceived barriers. The scale includes 9 situations affecting exercise participation (*i.e.*, effects of weather, boredom, pain when exercising, exercising alone, lack of pleasure in exercising, being busy with other activities, tiredness, stress, and depression). Patients were asked to rate their confidence to engage in exercise on an 11-point numeric scale (0=not confident; 10=very confident). Responses were summed to calculate a total SEE score (ranging from 0-90), with higher scores indicating greater exercise self-efficacy.[38]

Six-week postoperative follow-up interview

Discharge status

A telephone interview was conducted at 6 weeks post-operation to obtain information on discharge destination. It is common that the length of stay (LOS) was approximately 10 days in acute hospital settings and 1 month in convalescent settings for patients who underwent surgical fixation of femoral fractures. Therefore, 6 weeks post-operation was selected as a suitable time point for assessing discharge destination to avoid the potential for missing or contaminated data due to confounding factors associated with a longer follow-up period.

Statistical analysis

All analyses were performed using SPSS software (version 27, IBM Corp., Armonk, NY, USA). Descriptive statistics were used to determine measures of central tendency and variability for all variables. The dependent variable was discharge destination (*i.e.*, whether or not participants were discharged back to their original residence 6 weeks after femoral fracture surgery). Mann-Whitney U or Pearson's χ^2 tests were used to compare participant characteristics between-groups (*i.e.*, discharged home or not discharged home), depending on the level of data (*i.e.*, continuous *vs.* nominal). Receiver operating characteristic (ROC) curves were used to determine optimal cut-off scores for all primary outcomes assessed preoperatively (*i.e.*, FCI, MMSE, MBI, and NPRS at rest) and postoperatively (*i.e.*, amount of PT/OT, LOS, MBI, EMS, NPRS, SEE) based on discharge destination. Outcomes demonstrating a significant area under the curve (AUC) were entered as dichotomous (*i.e.*, above or below ROC-derived cut-off values), independent variables in the univariate logistic regression analysis to determine potential predictors of the dependent variable (*i.e.*, discharge destination). Age, sex, and significant dichotomous outcomes identified in the univariate analysis were subsequently entered as independent variables in the multiple logistic regression analysis (enter method) to determine predictors of discharge destination. The magnitude of association between predictors and discharge destination were reported as OR and 95% confidence intervals (CI). Goodness of fit was determined using Hosmer and Lemeshow (H-L) tests with values of $P \leq 0.05$ indicating poor model fit.[41]

Results

Participant characteristics

A flowchart outlining participant recruitment, screening, enrollment, and treatment pathway selection is provided in Figure 1. A total of 368 patients with unilateral femoral fracture were admitted between March 2017 and March

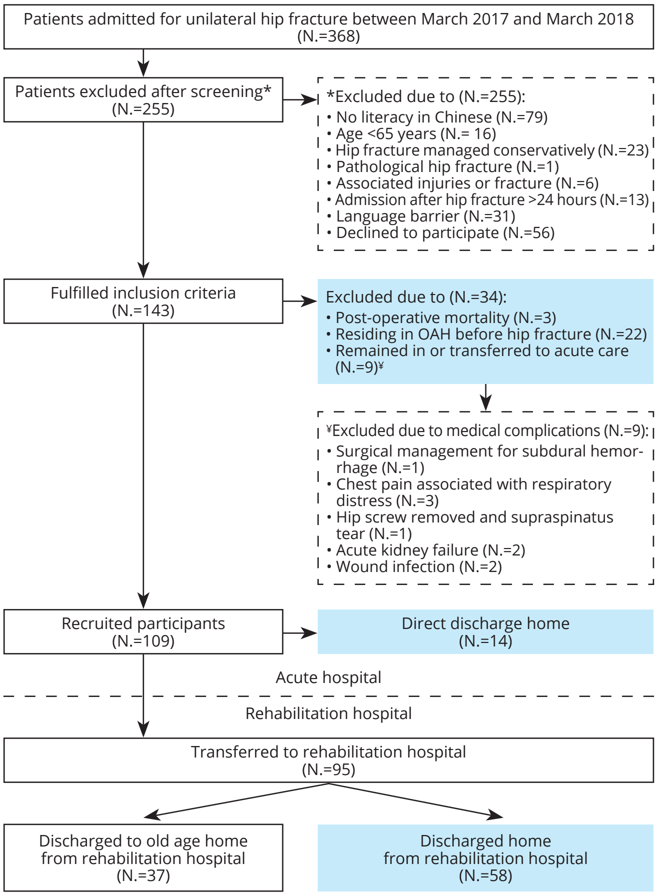

Figure 1.—Flowchart of participant recruitment, screening, enrolment & clinical treatment pathway.

2018 and screened for eligibility. A total of 225 patients were ineligible or declined to participate. Therefore, a total of 143 individuals were recruited. Of these individuals, 34 were subsequently excluded from the analysis for various reasons (Figure 1). Finally, a total of 109 participants (65 women [59.6%], mean age=83.2±6.9 years) were included in all subsequent analyses. A total of 72 participants (66.1%) were discharged home at the time of follow-up (56=discharged home from the rehabilitation hospital, 14=discharged directly home following acute care), and 37 participants (33.9%) were unable to return home. Of the patients recruited, 14 were sent directly home from the acute care unit. Demographic and clinical characteristics for these participants are presented in Table I. Gamma nail fixation was the most common surgical procedure performed (54.1%). Average postoperative acute hospital LOS was 8.6±4.9 days. The mean timing of the first and second postoperative gait training session was 1.5±0.9 and 2.6±1.0 days after surgery, respectively. Most participants regained postoperative walking ability at 6 weeks (97.2%).

Between-group comparisons

A summary of between-groups comparisons for all variables included in subsequent ROC and regression analyses is provided in Supplementary Digital Material 1, Supplementary Table I. For outcomes assessed preoperatively, MMSE scores were significantly higher among individuals discharged home compared to those who were unable to return home (P=0.004). The proportion of individuals with an available caretaker prior to surgery was also significantly greater among those discharged home (P=0.029). For outcomes assessed postoperatively, the number of physiotherapy sessions, MBI, EMS, and SEE scores were significantly greater among individuals discharged home (P≤0.041), while NPRS scores were significantly higher among individuals unable to return home (P=0.005).

AUC and ROC analysis

A summary of AUC analyses and ROC-derived optimal cut-off values for continuous variables assessed pre- and postoperatively is provided in Table II. MMSE was the only preoperatively assessed outcome demonstrating a significant AUC (0.667, P=0.004, cut-off score=16.5). For outcomes assessed postoperatively, number of physiotherapy sessions (AUC=0.632 P=0.024, cut-off score=7.50), MBI (AUC=0.662, P=0.006, cut-off score=54.50), EMS (AUC=0.663, P=0.006, cut-off score=4.50), NPRS (AUC=0.665, P=0.005, cut-off score=6.25) and SEE (AUC=0.620, 0.041, cut-off score=52.50) demonstrated significant AUC.

Univariate Logistic Regression Analysis

A summary of univariate logistic regression analyses is provided in Table III. MSSE (OR=2.643, 95% CI=1.151-6.065, P=0.022), number of physiotherapy sessions (OR=2.300, 95% CI=1.020-5.186, P=0.045), MBI (OR=3.626, 95% CI=1.410-9.324, P=0.008), EMS (OR=3.126, 95% CI=1.342-7.280, P=0.008), NPRS (OR=0.419, 95% CI=0.177-0.990, P=0.047), SEE (OR=3.690, 95% CI=1.369-9.950, P=0.010), and caregiver availability (OR=2.962, 95%CI=1.098-7.989, P=0.032) were associated with discharge destination.

Multiple Logistic Regression Analysis

A summary of the multiple logistic regression analysis is provided in Table IV. Overall, the model was sig-

Table I.—*Demographic and clinical characteristics assessed pre- and postoperatively.*

Variable	All participants (N.=109)	Discharged home (N.=72, 66.1%)	Not discharged home (N.=37, 33.9%)
Assessed preoperatively			
Age (years)	83.2±6.9	82.4±7.4	84.8±5.5
Sex (male/female)	44(40.4)/65(59.6)	25(34.7)/47(65.3)	19(51.4)/18(48.6)
Body Mass Index (kg/m²)	22.5±3.2	23.1±3.2	21.5±2.9
Marital status (single/married/divorced/married, spouse deceased)	3(2.8)/51(46.8)/3(2.8)/52(47.7)	2(2.8)/36(50.0)/2(2.8)/32(44.4)	1(2.7)/15(40.5)/1(2.7)/20(54.1)
Number of medications per participant	3.8±2.4	3.6±2.1	4.0±2.6
Fracture side (left/right)	55(50.5)/54(49.5)	39(54.2)/33(45.8)	16(43.2)/21(56.8)
Fracture site (femoral neck/trochanter)	48(44.0)/61(56.0)	36(50.0)/36(50.0)	12(32.4)/25(67.6)
Pre-fracture residency (lift-landing flat/non-lift-landing flat/ground floor)	97(89.0)/5(4.6)/7(6.4)	65(90.3)/3(4.2)/4(5.6)	32(86.5)/2(5.4)/3(8.1)
Number of assistants needed when walking (0/1)	107(98.2)/2(1.8)	70(97.2)/2(2.8)	37(100.0)/0(0.0)
Pre-morbid walking status (unaided/cane/quadripod/frame/rollator)	40(36.7)/50(45.9)/9(8.3)/5(4.6)/5(4.6)	31(43.1)/30(41.7)/5(6.9)/3(4.2)/3(4.2)	9(24.3)/20(54.1)/4(10.8)/2(5.4)/2(5.4)
Caregiver availability (no/yes)	20(18.3)/89(81.7)	9(12.5)/63(87.5)	11(29.7)/26(70.3)
FCI (pre-fracture) (0-18)	1.1±1.3	1.2±1.4	1.0±0.9
NPRS (at rest) (0-10)	2.5±3.1	2.6±3	2.4±3.3
MBI (0-100)	96.1±7.7	95.9±8.4	96.4±5.9
MMSE (0-30)	19.8±6.7	21.1±6.6	17.3±6.2
Assessed postoperatively			
Operation type (gamma nail fixation/dynamic femoral screw fixation/AO screw fixation, Austin Moore arthroplasty/bipolar femoral arthroplasty/unipolar femoral arthroplasty) (n)	59(54.1)/2(1.8)/10(9.2)/17(15.6)/13(11.9)/8(7.3)	35(48.6)/2(2.8)/8(11.1)/8(11.1)/12(16.7)/7(9.7)	24(74.9)/0(0)/2(5.4)/9(24.3)/1(2.7)/1(2.7)
Timing of 1st gait training session (post-op days)	1.5±0.9	1.4±0.7	1.5±1.1
Timing of 2nd gait training session (post-op days)	2.6±1.0	2.6±0.9	2.6±1.1
†Number of assistants needed when walking (0/1/2) (n)	64(58.7)/35(32.1)/10(9.2)	49(68.1)/20(27.8)/3(4.2)	15(40.5)/15(40.5)/7(18.9)
Number of PT sessions	9.0±5.1	9.7±5.4	7.5±3.9
Number of OT sessions	3.5±1.9	3.7±2.0	3.0±1.5
NPRS (0-10)	5.2±2.5	4.7±2.5	6.0±2.0
EMS (0-20)	4.0±3.1	4.6±3.2	2.5±2.8
MBI (0-100)	48.6±13.1	50.9±13.2	44.0±11.6
SEE (0-90)	38.7±24.4	42.2±24.8	31.8±22.2
LOS (days) (acute hospital pre-operation)	2.4±2.3	2.6±2.6	1.9±1.3
LOS (days) (acute hospital post-operation)	8.6±4.9	9.2±5.6	7.6±3.2
§LOS (days) (rehabilitation hospital post-operation)	31.3±22.1 (N.=95)	29.3±24.7 (N.=58)	35.2±15.5 (N.=37)
Postoperative mobility at 6 weeks (walk unaided/stick/quadripod/frame/rollator/wheelchair)	0(0.0)/18(16.5)/8(7.3)/52(47.7)/28(25.7)/3(2.8)	0(0.0)/17(23.6)/6(8.3)/34(47.2)/13(18.1)/2(2.8)	0(0.0)/1(2.7)/2(5.4)/18(48.6)/15(40.5)/1(2.7)

All values are provided in mean±sd, frequencies (N.) or proportions (%).
AO: Arbeitsgemeinschaft für Osteosynthesefragen; EMS: Elderly Mobility Scale; FCI: Functional Comorbidity Index; LOS: Length of Stay; MBI: Modified Barthel Index; MMSE: Mini-Mental State Examination; NPRS: Numeric Pain Rating Scale; OT: Occupational Therapy; PT: Physiotherapy; SEE: Self-Efficacy for Exercise Scale.
†Number of assistants needed when walking after femoral fracture surgery (*i.e.*, the number of physiotherapist and physiotherapy assistants for inpatient settings or the number of family members/relatives/friends/old age home assistants needed for home/old age home settings); §LOS for 95 patients admitted to a rehabilitation hospital until discharged home or to an old age home.

nificant (χ^2=36.800, P≤0.001) and demonstrated that female sex (OR=3.421, 95% CI=1.187-9.861, P=0.023), ≥8 physiotherapy sessions (OR=4.633, 95% CI=1.559-13.771, P=0.006), MMSE Score ≥17 (OR=3.374, 95% CI=1.047-10.873, P=0.042), SEE Score ≥53 (OR=5.975, 95% CI=1.674-21.333, P=0.006) and caregiver availability (OR=3.766, 95% CI=1.133-12.520, P=0.030) were significant predictors of postoperative home discharge in patients after femoral fracture surgery. These predictors fit the model well (H-L test: χ^2=5.437, P=0.710) explaining approximately 40% of the variance in discharge destination (Nagelkerke R^2=0.397) and correctly classifying 77.1% of the participants included in the analysis.

Discussion

This was the first study to show that greater exercise self-efficacy (*i.e.*, higher SEE scores) was independently associated with home discharge after femoral fracture surgery and acute rehabilitation. Preoperative cognitive function

TABLE II.—*Optimal cut-off scores of independent variables for predicting home discharge.*

Variable	AUC	SE	P	95% CI		ROC Curve Coordinates		
				Lower	Upper	Score	Sensitivity	Specificity -1
Assessed preoperatively								
Medications (total)	0.551	0.058	0.388	0.438	0.663	4.5	0.278	0.162
MMSE	0.667	0.052	0.004*	0.565	0.770	16.5	0.736	0.514
FCI (pre-fracture)	0.498	0.056	0.980	0.388	0.609	1.5	0.292	0.250
NPRS (at rest)	0.514	0.059	0.818	0.399	0.628	3.5	0.306	0.243
MBI (pre-fracture)	0.515	0.054	0.787	0.408	0.622	99.0	0.616	0.550
Assessed postoperatively								
Total number of physiotherapy sessions	0.632	0.056	0.024*	0.522	0.742	7.5	0.583	0.378
Total number of occupational therapy sessions	0.596	0.059	0.102	0.481	0.711	2.5	0.806	0.595
LOS	0.538	0.056	0.525	0.427	0.648	8.5	0.431	0.306
MBI	0.662	0.053	0.006*	0.559	0.765	54.5	0.458	0.189
EMS	0.663	0.054	0.006*	0.557	0.769	4.5	0.569	0.297
NPRS	0.665	0.053	0.005*	0.561	0.768	6.25	0.405	0.208
SEE	0.620	0.055	0.041*	0.512	0.728	52.5	0.417	0.162

A total of 72 participants were discharged home at the time of follow-up, and a total of 37 participants were unable to return home.
95% CI: 95% Confidence Interval; AUC: Area Under the Curve; EMS: Elderly Mobility Scale; FCI: Functional Comorbidity Index; LOS: Length of Stay; MBI: Modified Barthel Index; MMSE: Mini-Mental State Examination; NPRS: Numeric Pain Rating Scale; SE: Standard Error; SEE: Self-Efficacy for Exercise Scale; ROC: Receiver Operating Characteristic
*P≤0.05 statistically significant area under the curve.

TABLE III.—*Univariate logistic regression for predicting home discharge.*

Variables	Odds Ratio	95% CI		P
		Lower	Upper	
MMSE score (reference group: <17)	2.643	1.151	6.065	0.022*
Total number of physiotherapy sessions (reference group: <8 physiotherapy sessions)	2.300	1.020	5.186	0.045*
Postoperative MBI score (reference group: MBI Score <55)	3.626	1.410	9.324	0.008*
Postoperative EMS score (reference group: EMS Score <5)	3.126	1.342	7.280	0.008*
Postoperative NPRS score (reference group: NPRS Score <7)	0.419	0.177	0.990	0.047*
Postoperative SEE Score (reference group: SEE Score <53)	3.690	1.369	9.950	0.010*
Caregiver availability (reference group: no caregiver)	2.962	1.098	7.989	0.032*

A total of 72 participants were discharged home at the time of follow-up, and a total of 37 participants were unable to return home.
95% CI: 95% Confidence Interval; EMS: Elderly Mobility Scale; H-L: Hosmer and Lemeshow; MBI: Modified Barthel Index; MMSE: Mini-Mental State Examination; NPRS: Numeric Pain Rating Scale; SEE: Self-Efficacy for Exercise Scale
*P<0.05 statistically significant predictor variable; †Nagelkerke R^2.

TABLE IV.—*Predictors of home discharge (multivariate logistic regression).*

Variables	Omnibus		H-L Test		†R^2	Overall	Odds Ratio	95% CI		P
	χ^2	P	χ^2	p		Classification (%)		Lower	Upper	
Model Summary	36.000	≤0.001	5.437	0.710	0.397	77.1				
Age							1.017	0.930	1.113	0.709
Sex (reference group: male)							3.421	1.187	9.861	0.023*
Total number of physiotherapy sessions							4.633	1.559	13.771	0.006*
Postoperative NPRS Score (reference group: NPRS Score <7)							0.386	0.127	1.176	0.094
Postoperative EMS Score (reference group: EMS Score <5)							2.054	0.561	7.515	0.277
MMSE score (reference group: MMSE Score <17)							3.374	1.047	10.873	0.042*
Postoperative SEE Score (reference group: SEE Score <53)							5.975	1.674	21.333	0.006*
Postoperative MBI Score (reference group: MBI Score <55)							1.346	0.312	5.811	0.690
Caregiver availability (reference group: no caregiver)							3.766	1.133	12.520	0.030*

A total of 72 participants were discharged home at the time of follow-up, and a total of 37 participants were unable to return home
95% CI: 95% Confidence Interval; EMS: Elderly Mobility Scale; H-L: Hosmer and Lemeshow; MBI: Modified Barthel Index; MMSE: Mini-Mental State Examination; NPRS: Numeric Pain Rating Scale; SEE: Self-Efficacy for Exercise Scale
*P<0.05 statistically significant predictor variable; †Nagelkerke R^2.

(MMSE scores), postoperative function, mobility, exercise self-efficacy (MBI, EMS, SEE scores) and the number of postoperative physiotherapy sessions were greater among individuals discharged home, while postoperative pain (NPRS scores) was greater among individuals unable to return home. In subsequent multivariate analyses, female sex, a greater number of physiotherapy sessions, better preoperative cognitive function (*i.e.*, higher MMSE scores) and caretaker availability emerged as significant predictors, and are discussed in detail below, while the effects of other factors were diminished.

Exercise self-efficacy as a predictor of discharge destination

Greater postoperative exercise self-efficacy was associated with a 5.9-fold higher likelihood of home discharge. A study by Zhang *et al.* reported that self-efficacy (*i.e.*, SEE) during a home-based rehabilitation program had an indirect effect on long-term mobility at 9 months following femoral fracture.[22] A recent meta-synthesis examining factors that influence well-being after femoral fracture highlights the importance of self-efficacy in enhancing progress during rehabilitation and in making lifestyle modifications that support adapted physical activity.[23] To our knowledge, this is the first study to demonstrate the predictive value of exercise-related confidence in determining home discharge after femoral fracture. Our findings suggest that increasing self-confidence to engage in exercise during rehabilitation, despite physical limitations and perceived obstacles, may help facilitate home discharge following femoral fracture surgery.

Sex as a predictor of discharge destination

Compared with men, women showed a 3.4-fold higher likelihood of direct home discharge. This is in agreement with findings reported in previous studies.[10, 18, 19] A study by Salar *et al.* involving 1044 participants with femoral neck fracture showed that women had a 1.3-fold higher likelihood of direct home discharge.[19] In a cohort of 573 participants, Nanjayan *et al.* reported that men showed a 1.6-fold higher likelihood of postoperative change in discharge destination (*i.e.*, alternate to pre-fracture residential setting) after femoral neck fracture.[18] Deakin *et al.* also showed that men had a 2.5-fold higher likelihood of discharge to an alternative location following femoral fracture.[10]

In a large retrospective study examining function after femoral fracture rehabilitation, Semel *et al.* reported that men were transferred to acute care more frequently and demonstrated less functional independence after rehabilitation than women.[42] This suggests men may require more preoperative care or are more likely to develop postoperative complications, which may alter discharge destination. The Nottingham Femoral Fracture Score, a scoring system used to predict mortality and early discharge after femoral fracture,[17] includes male sex as a weighted scoring item. Although families comprising "old-old" individuals (*i.e.*, couples aged >85 years) are becoming more common, women are likely to live longer and require less disability-related assistance than men.[43] In considering the population under study, the conventional role assumed by elderly Chinese women involves the care of their lifelong partners and other family members (*e.g.*, child care), and assuming the responsibility of daily household chores (*e.g.*, cleaning, meal preparation).[44] As the importance of this role remains culturally intrinsic, elderly Chinese women may be reluctant to seek extra-familial assistance (*e.g.*, home care aid, nurse).[45] Hence, elderly Chinese women are presumably more emotionally eager to be discharged home rather than being institutionalized after femoral fracture surgery.

Amount of physiotherapy as a predictor of discharge destination

In the present study, a greater number of physiotherapy sessions after femoral fracture was associated with a 4.6-fold higher likelihood of direct home discharge. Previous evidence also indicates a higher likelihood of direct home discharge from acute in-patient settings[11] and greater functional independence during transfers, bed mobility and ambulation among individuals who received >1 physiotherapy session per day.[11, 46] Early mobilization (*e.g.*, as early as first day post-operation), and more frequent physiotherapy sessions (twice per day) also led to shorter hospital LOS and higher return to pre-admission residential status (94%) compared to standard care alone (83.9%).[46] A systematic review of femoral fracture rehabilitation practices among the elderly found that intensive physiotherapy was associated with shorter LOS in acute care settings and more favorable discharge destination among patients with femoral fractures and concurrent mild-to-moderate dementia.[8] Thus, our findings further substantiate the importance of early postoperative physiotherapy to facilitate home discharge.

Cognitive function as a predictor of discharge destination

Varying degrees of cognitive impairment are frequently observed in elderly people with femoral fracture.[21] This study showed that better preoperative cognitive function was associated with a 3.3-fold greater likelihood of direct home discharge. Overall, the study participants showed moderate cognitive impairment (*i.e.*, MMSE=19) which was comparable to the level of cognitive function reported for older people with femoral fracture in previous studies.[47, 48] Previous studies also showed that patients with cognitive impairment require longer LOS in rehabilitation settings, and are less likely to be discharged directly to pre-admission residential status than those without preoperative cognitive impairment.[14, 49] Herschkovtiz *et al.* found that those with better cognitive function had better postoperative functional recovery at discharge.[14] This suggests that early preoperative screening for dementia and cognitive impairment severity remains important for planning postoperative discharge.

Caregiver availability as a predictor of discharge destination

In the present study, patients with an available caregiver showed a 3.7-fold greater likelihood of home discharge compared to those without a caregiver. Beaupre *et al.* also reported that patients with poor social support (*i.e.*, limited contact with others outside their home) showed a 4.2-fold higher likelihood of institutionalization 6 months after femoral fracture compared to those with a high level of social support (*i.e.*, frequent phone or personal contact and availability of a social network consisting of >3 individuals).[50] Similarly, Vochteloo *et al.* found a two-fold greater likelihood of alternate discharge destination among elderly patients without a partner.[51] Early preoperative inventory of social support and caregiver availability is important to facilitate optimal discharge planning.

Clinical implications

This study used a comprehensive battery of assessments to evaluate sociodemographic, physical, cognitive, psychosocial, environmental factors and their association with successful home discharge in the early phase of rehabilitation following femoral fracture surgery. There are several important clinical implications. First, our findings may help facilitate follow-up care and discharge planning through early identification of individuals who are likely to be discharged home following femoral fracture surgery. Specifically, individuals with MMSE scores ≥17, postoperative SEE scores ≥53 and available caregivers may have greater potential for home discharge after femoral fracture surgery. In contrast, individuals with preoperative MMSE scores <16, postoperative SEE scores <52 and no caregivers may be less suitable for home discharge. Planning for these individuals may involve transfer to a convalescence setting for further inpatient rehabilitation and/or old age home placement.

Second, despite physical limitations and perceived barriers associated with postoperative recovery,[23] confidence to engage in exercise (*i.e.*, exercise self-efficacy) may be an important mediating factor in improving long-term mobility and function after femoral fracture.[22] Prior to discharge, support and encouragement from therapists and caregivers to engage in exercise may help to instill confidence, thereby optimizing functional recovery during inpatient rehabilitation.

Third, caregiver availability was a significant predictor of home discharge. Caregiver availability is important in promoting functional recovery and resuming ADLs after discharge.[52] Therefore, structured training is essential to equip caregivers with the necessary skills to assist in this capacity.[53]

Finally, the amount of physiotherapy received in acute care is an important modifiable factor that may facilitate home discharge. Physiotherapy involves gait training, joint mobilization and muscle strengthening exercises, as well as pain management, which are instrumental in maximizing functional independence and minimizing fall risk. In this study, 8 sessions of physiotherapy or more during acute hospital stay was associated with a higher likelihood of home discharge. As the average postoperative hospital LOS was 8.6 days, adequate inpatient physiotherapy (*i.e.*, approximately 1 session for every day spent in postoperative acute care prior to discharge) may be important for optimizing functional recovery and independence prior to returning home.

Limitations of the study

This study has several limitations which affect the generalizability of the results. The sample size of the present study was small and all participants were recruited from a single acute care hospital. Additionally, of the individuals screened after admission for unilateral femoral fracture (N.=368), more than half were excluded for various reasons (N.=255) (*e.g.*, age, time of admission, declined to participate, etc.). Discharge destination and mortality after femoral fracture surgery are also strongly influenced by regional factors (*e.g.*, local healthcare organization and policy, availability of social support, length of stay), which may vary substantially between healthcare authorities and hospitals.[54, 55] Currently, there are no intermediate discharge solutions in the country where the study was conducted and discharge destination was restricted to either direct home discharge or discharge to an old age home, thus limiting the analyses performed. Multi-centered trials are needed to improve the prediction model and generalizability of the findings. Our study may have been underpowered to detect significant associations with certain predictor variables. For example, although pain (NPRS) during walking, as well as mobility (EMS) and function (MBI) scores demonstrated a statistically significant AUC, their predictive contributions were diminished in the multivariate regression analysis. Although the number of physiotherapy sessions and exercise self-efficacy (SEE) demonstrated the strongest association with home discharge in the model, this relationship does not imply a causal link between treatment dose and acute or long-term postoperative outcomes. Furthermore, the overall ability of the model to predict the variance in discharge destination was low (*i.e.*, R^2=0.397). The model was also underpowered to accommodate the inclusion of other categorical variables (*i.e.*, fracture/surgery type), which may influence functional recovery and discharge.[56, 57] Future studies involving larger cohorts are warranted to validate the model. Finally, data on other patient characteristics (*e.g.*, nutritional status, education, culture) that may influence the outcome were not collected.

Conclusions

Female sex, better preoperative cognitive function, more physiotherapy rehabilitation training, and caregiver availability were independently associated with successful home discharge following femoral fracture surgery. The association observed between greater exercise self-efficacy and home discharge was also a novel finding of this study. This evidence may help to facilitate more effective postoperative discharge planning and follow-up care for individuals after femoral fracture surgery.

References

1. Chau PH, Wong M, Lee A, Ling M, Woo J. Trends in hip fracture incidence and mortality in Chinese population from Hong Kong 2001-09. Age Ageing 2013;42:229–33.

2. Deakin DE, Boulton C, Moran CG. Mortality and causes of death among patients with isolated limb and pelvic fractures. Injury 2007;38:312–7.

3. White SM, Griffiths R. Projected incidence of proximal femoral fracture in England: a report from the NHS Hip Fracture Anaesthesia Network (HIPFAN). Injury 2011;42:1230–3.

4. Cameron ID, Chen JS, March LM, Simpson JM, Cumming RG, Seibel MJ, *et al.* Hip fracture causes excess mortality owing to cardiovascular and infectious disease in institutionalized older people: a prospective 5-year study. J Bone Miner Res 2010;25:866–72.

5. de Sire A, Invernizzi M, Baricich A, Lippi L, Ammendolia A, Grassi FA, *et al.* Optimization of transdisciplinary management of elderly with femur proximal extremity fracture: A patient-tailored plan from orthopaedics to rehabilitation. World J Orthop 2021;12:456–66.

6. Tugni C. Rehabilitation effects in patients with total hip replacement: a systematic review and meta-analysis. Minerva Ortop Traumatol 2019;70.

7. Chiu KC. Predictors of old-age-home placement in Hong Kong Chinese elderly persons after hip fracture. Asian J Gerontol Geriatr 2007;2:69–77.

8. Chudyk AM, Jutai JW, Petrella RJ, Speechley M. Systematic review of hip fracture rehabilitation practices in the elderly. Arch Phys Med Rehabil 2009;90:246–62.

9. Cree AK, Nade S. How to predict return to the community after fractured proximal femur in the elderly. Aust N Z J Surg 1999;69:723–5.

10. Deakin DE, Wenn RT, Moran CG. Factors influencing discharge location following hip fracture. Injury 2008;39:213–8.

11. Guccione AA, Fagerson TL, Anderson JJ. Regaining functional independence in the acute care setting following hip fracture. Phys Ther 1996;76:818–26.

12. Hagino T, Ochiai S, Sato E, Watanabe Y, Senga S, Haro H. Prognostic prediction in patients with hip fracture: risk factors predicting difficulties with discharge to own home. J Orthop Traumatol 2011;12:77–80.

13. Harada ND, Chun A, Chiu V, Pakalniskis A. Patterns of rehabilitation utilization after hip fracture in acute hospitals and skilled nursing facilities. Med Care 2000;38:1119–30.

14. Hershkovitz A, Kalandariov Z, Hermush V, Weiss R, Brill S. Factors affecting short-term rehabilitation outcomes of disabled elderly patients with proximal hip fracture. Arch Phys Med Rehabil 2007;88:916–21.

15. Jackson JP, Whisner S, Wang EW. A predictor model for discharge destination in inpatient rehabilitation patients. Am J Phys Med Rehabil 2013;92:343–50.

16. Kagaya H, Takahashi H, Sugawara K, Dobashi M, Kiyokawa N, Ebina H. Predicting outcomes after hip fracture repair. Am J Phys Med Rehabil 2005;84:46–51.

17. Moppett IK, Wiles MD, Moran CG, Sahota O. The Nottingham Hip Fracture Score as a predictor of early discharge following fractured neck of femur. Age Ageing 2012;41:322–6.

18. Nanjayan SK, John J, Swamy G, Mitsiou K, Tambe A, Abuzakuk T. Predictors of change in 'discharge destination' following treatment for fracture neck of femur. Injury 2014;45:1080–4.

19. Salar O, Baker PN, Forward DP, Ollivere BJ, Weerasuriya N, Moppett IK, *et al.* Predictors of direct home discharge following fractured neck of femur. Ann R Coll Surg Engl 2017;99:444–51.

20. Al-Ani AN, Samuelsson B, Tidermark J, Norling A, Ekström W, Cederholm T, *et al.* Early operation on patients with a hip fracture improved the ability to return to independent living. A prospective study of 850 patients. J Bone Joint Surg Am 2008;90:1436–42.

21. Viramontes O, Luan Erfe BM, Erfe JM, Brovman EY, Boehme J, Bader AM, *et al.* Cognitive impairment and postoperative outcomes in patients undergoing primary total hip arthroplasty: A systematic review. J Clin Anesth 2019;56:65–76.

22. Chang FH, Latham NK, Ni P, Jette AM. Does self-efficacy mediate functional change in older adults participating in an exercise program after hip fracture? A randomized controlled trial. Arch Phys Med Rehabil 2015;96:1014–1020.e1.

23. Rasmussen B, Uhrenfeldt L. Establishing well-being after hip fracture: a systematic review and meta-synthesis. Disabil Rehabil 2016;38:2515–29.

24. Martinez-Reig M, Ahmad L, Duque G. The orthogeriatrics model of care: systematic review of predictors of institutionalization and mortality in post-hip fracture patients and evidence for interventions. J Am Med Dir Assoc 2012;13:770–7.

25. Hsieh FY. Sample size tables for logistic regression. Stat Med 1989;8:795–802.

26. Groll DL, To T, Bombardier C, Wright JG. The development of a comorbidity index with physical function as the outcome. J Clin Epidemiol 2005;58:595–602.

27. Vertesi A, Lever JA, Molloy DW, Sanderson B, Tuttle I, Pokoradi L, *et al.* Standardized Mini-Mental State Examination. Use and interpretation. Can Fam Physician 2001;47:2018–23.

28. Ferraz MB, Quaresma MR, Aquino LR, Atra E, Tugwell P, Goldsmith CH. Reliability of pain scales in the assessment of literate and illiterate patients with rheumatoid arthritis. J Rheumatol 1990;17:1022–4.

29. Fricke J, Unsworth CA. Inter-rater reliability of the original and modified Barthel Index, and a comparison with the Functional Independence Measure. Aust Occup Ther J 1997;44:22–9.

30. Gallasch CH, Alexandre NM. The measurement of musculoskeletal pain intensity: a comparison of four methods. Rev Gaúcha Enferm 2007;28:260–5.

31. Levine CG, Weaver EM. Functional comorbidity index in sleep apnea. Otolaryngol Head Neck Surg 2014;150:494–500.

32. Jensen MP, McFarland CA. Increasing the reliability and validity of pain intensity measurement in chronic pain patients. Pain 1993;55:195–203.

33. Rodriguez CS. Pain measurement in the elderly: a review. Pain Manag Nurs 2001;2:38–46.

34. Gagliese L, Turk DC, Melzack R. Handbook of pain assessment. New York, NY: The Guilford Press; 2002.

35. Jensen MP, Karoly P. Self-report scales and procedures for assessing pain in adults. Handbook of pain assessment. Third Edition. New York, NY: The Guilford Press; 2011. p. 19-44.

36. Lee LL, Perng SJ, Ho CC, Hsu HM, Lau SC, Arthur A. A preliminary reliability and validity study of the Chinese version of the self-efficacy for exercise scale for older adults. Int J Nurs Stud 2009;46:230–8.

37. Nolan J, Remilton L, Green M. The Reliability and Validity of the Elderly Mobility Scale in the Acute Hospital Setting. Internet J Allied Health Sci Pract 2008;6.

38. Resnick B, Jenkins LS. Testing the reliability and validity of the Self-Efficacy for Exercise scale. Nurs Res 2000;49:154–9.

39. Smith R. Validation and Reliability of the Elderly Mobility Scale. Physiotherapy 1994;80:744–7.

40. Spilg EG, Martin BJ, Mitchell SL, Aitchison TC. A comparison of mobility assessments in a geriatric day hospital. Clin Rehabil 2001;15:296–300.

41. Hosmer DW, Lemeshow S, Sturdivant RX, Ebooks C. Applied logistic regression. Third Edition. Hoboken, NJ: Wiley; 2013.

42. Semel J, Gray JM, Ahn HJ, Nasr H, Chen JJ. Predictors of outcome following hip fracture rehabilitation. PM R 2010;2:799–805.

43. Shaw LB, Antonopoulos R. Differing Prospects for Women and Men: Young Old-Age, Old Old-Age, and Eldercare. In: Papadimitriou DB, editor. Government Spending on the Elderly. London: Palgrave Macmillan; 2007. p. 123-38.

44. Xu A, Xia Y. The Changes in Mainland Chinese Families During the Social Transition: A Critical Analysis. J Comp Fam Stud 2014;45:31–53.

45. Lan PC. Subcontracting Filial Piety: Elder Care in Ethnic Chinese Immigrant Families in California. J Fam Issues 2002;23:812–35.

46. Swanson CE, Day GA, Yelland CE, Broome JR, Massey L, Richardson HR, *et al.* The management of elderly patients with femoral fractures. A randomised controlled trial of early intervention versus standard care. Med J Aust 1998;169:515–8.

47. Bliemel C, Lechler P, Oberkircher L, Colcuc C, Balzer-Geldsetzer M, Dodel R, *et al.* Effect of Preexisting Cognitive Impairment on In-Patient Treatment and Discharge Management among Elderly Patients with Hip Fractures. Dement Geriatr Cogn Disord 2015;40:33–43.

48. Mariconda M, Costa GG, Cerbasi S, Recano P, Orabona G, Gambacorta M, *et al.* Factors Predicting Mobility and the Change in Activities of Daily Living After Hip Fracture: A 1-Year Prospective Cohort Study. J Orthop Trauma 2016;30:71–7.

49. Seematter-Bagnoud L, Frascarolo S, Büla CJ. How much do combined affective and cognitive impairments worsen rehabilitation outcomes after hip fracture? BMC Geriatr 2018;18:71.

50. Beaupre LA, Cinats JG, Senthilselvan A, Scharfenberger A, Johnston DW, Saunders LD. Does standardized rehabilitation and discharge planning improve functional recovery in elderly patients with hip fracture? Arch Phys Med Rehabil 2005;86:2231–9.

51. Vochteloo AJ, van Vliet-Koppert ST, Maier AB, Tuinebreijer WE, Röling ML, de Vries MR, *et al.* Risk factors for failure to return to the prefracture place of residence after hip fracture: a prospective longitudinal study of 444 patients. Arch Orthop Trauma Surg 2012;132:823–30.

52. Wu LC, Chou MY, Liang CK, Lin YT, Ku YC, Wang RH. Association of home care needs and functional recovery among community-dwelling elderly hip fracture patients. Arch Gerontol Geriatr 2013;57:383–8.

53. Crotty M, Whitehead C, Miller M, Gray S. Patient and caregiver outcomes 12 months after home-based therapy for hip fracture: a randomized controlled trial. Arch Phys Med Rehabil 2003;84:1237–9.

54. Medin E, Goude F, Melberg HO, Tediosi F, Belicza E, Peltola M; EuroHOPE study group. European Regional Differences in All-Cause Mortality and Length of Stay for Patients with Hip Fracture. Health Econ 2015;24(Suppl 2):53–64.

55. Beaupre LA, Wai EK, Hoover DR, Noveck H, Roffey DM, Cook DR, *et al.* A comparison of outcomes between Canada and the United States in patients recovering from hip fracture repair: secondary analysis of the FOCUS trial. Int J Qual Health Care 2018;30:97–103.

56. Walsh ME, Sorensen J, Blake C, Johnsen SP, Kristensen PK. Geographic variation in hip fracture surgery rate, care quality and outcomes: a comparison between national registries in Ireland and Denmark. Arch Osteoporos 2022;17:128.

57. Lee D, Jo JY, Jung JS, Kim SJ. Prognostic Factors Predicting Early Recovery of Pre-fracture Functional Mobility in Elderly Patients With Hip Fracture. Ann Rehabil Med 2014;38:827–35.

Conflicts of interest
The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Funding
This research did not receive any specific grants from funding agencies in the public, commercial, or non-profit sectors. Support of manpower and infrastructure were provided by Queen Elizabeth Hospital.

Authors' contributions
Intonia H. Chow, Tiev Miller and Marco Y. Pang contributed to the conception or design of the manuscript, and the acquisition, analysis and interpretation of the data; Intonia H. Chow drafted the initial manuscript; Tiev Miller and Marco Y. Pang critically revised all subsequent versions of the manuscript. All authors read and approved the final version of the manuscript.

Acknowledgements
We are grateful for the guidance and expertise provided by Dr. Wilson Li and Dr. Kin Bong Lee in the Department of Orthopedics and Traumatology at Queen Elizabeth Hospital and Dr. Andy Chan, Dr. Polly Lau, Ms. Daisy Chan, Ms. Nora Fu, and Ms. Boogie Yung in the Physiotherapy Department at Queen Elizabeth Hospital.

History
Article first published online: September 26, 2023. - Manuscript accepted: September 5, 2023. - Manuscript revised: August 3, 2023. - Manuscript received: January 31, 2023.

Supplementary data
For supplementary materials, please see the HTML version of this article at www.minervamedica.it