

## Poor Activities of Daily Living Function Reflect Poor Quality of Life after Hip Fracture Surgery for Geriatric Patients

### Abstract

**Introduction:** With the aging of the population, hip fractures have become a major public health issue in the elderly. It is important to examine the loss of activities of daily living (ADL) and the quality of life (QoL) among the elderly after repair of hip fracture. The correlation between ADL and QoL over time after hip fracture surgery was also our major concern. **Methods:** A prospective study enrolling 117 geriatric patients undergoing hip fracture surgery in a tertiary medical center was conducted between 2017 and 2018. All participants were evaluated with the EuroQoL-5D for assessing QoL and the Barthel index for measuring ADL function at baseline, 3-and 6-month follow-ups after hip fracture surgery. **Results:** The mortality rate among geriatric patients after hip fracture surgery was 5.5% at 3 months and 9.1% at 6 months. In addition, both ADL function and QoL significantly deteriorated after 6 months of follow-up without improvement with time. After the 6-month follow-up, only 20% of geriatric patients undergoing repair for hip fracture were able to recover baseline ADL. The QoL at the 6-month follow-up was correlated with both cross-sectional and longitudinal ADL function after repair for hip fracture among geriatric patients. **Conclusion:** Functional impairment is common among geriatric patients after hip fracture surgery. Poor ADL could predict and reflect poor QoL after the 6-month follow-up. More emphasis should be put on preventing functional loss after hip fracture surgery in order for better QoL among geriatric patients undergoing hip fracture surgery.

**Keywords:** *Activities of daily living, hip fracture, quality of life*

### Introduction

The incidence of hip fracture – one of the fractures linked with osteoporosis – has been rising along with the aging of the population, and has critical implications with regard to functional dependence, social costs, and death.<sup>[1,2]</sup> According to the literature, the early mortality rate within 30 days after hip fracture surgery was up to 6%–7.5% in elderly patients.<sup>[3,4]</sup> The main causes of death were pneumonia and urinary tract infections resulting from prolonged immobility after hips fracture surgery.<sup>[5]</sup> In addition, functional loss among geriatric patients after hip fracture surgery was also a critical issue for care-providers. Less than half of the geriatric patients were able to regain preinjury functional abilities 2 years after hip fracture surgery.<sup>[6]</sup> In the long-term care insurance system, motor impairment after hip fracture was also correlated with the service time provided to assist with activities of daily living (ADL).<sup>[7]</sup> Monthly

care costs were also correlated with walking ability in elderly patients after surgical treatments for hip fractures.<sup>[8]</sup> With the increasing number of hip fracture events as aging populations rise, without doubt, more attention should be paid to the functional outcome and care of geriatric patients after hip fracture.

Patient-reported health-related quality of life (QoL) is an important outcome measurement when assessing QoL after hip fracture surgery.<sup>[9-11]</sup> According to a report from the Norwegian hip fracture register, hip fractures dramatically affect patients' health-related QoL, with sustained deterioration even 1 year after the fracture.<sup>[12]</sup> Separate use of the descriptive profile of the EuroQoL Group's (EQ-5D) is informative when assessing QoL after hip fracture surgery.<sup>[12]</sup> Moreover, recovery of ambulatory ability and independence in ADL after surgery is also an important objective outcome measurement. Approximately half of the patients regained ambulatory ability at their prefracture levels

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: [reprints@medknow.com](mailto:reprints@medknow.com)

**How to cite this article:** Chang WT, Kuo YJ, Huang YY, Tsai MJ, Chen YP. Poor Activities of Daily Living Function Reflect Poor Quality of Life after Hip Fracture Surgery for Geriatric Patients. *Soc Health Behav* 2019;2:41-6.

Wei-Ting Chang<sup>1,2</sup>,  
Yi-Jie Kuo<sup>1,3</sup>,  
Yu-Yun Huang<sup>4</sup>,  
Ming-Jr Tsai<sup>5</sup>,  
Yu-Pin Chen<sup>1,3</sup>

<sup>1</sup>Departments of Orthopedic Surgery and <sup>2</sup>Nursing, Wan Fang Hospital, Taipei Medical University, <sup>3</sup>Department of Orthopedic Surgery, School of Medicine, College of Medicine, Taipei Medical University, Taipei, <sup>4</sup>Department of Nursing & Graduate Institute of Nursing, Chang Gung University of Science and Technology, Kweishan, Taoyuan, <sup>5</sup>Department of Orthopedic Surgery, Puli Christian Hospital, Nantou, Taiwan

### Address for correspondence:

Dr. Yu-Pin Chen,  
Department of Orthopaedic Surgery, Wan Fang Hospital, School of Medicine, College of Medicine, Taipei Medical University, No. 111, Sec. 3, Xinglong Rd., Wenshan Dist., Taipei 116, Taiwan.  
E-mail: [99231@w.tmu.edu.tw](mailto:99231@w.tmu.edu.tw)

### Access this article online

Website: [www.shbonweb.com](http://www.shbonweb.com)

DOI: 10.4103/SHB.SHB\_1\_19

### Quick Response Code:



within 6 months after surgery.<sup>[13]</sup> Patients who were older, cognitively impaired, and who had multiple comorbidities were predictably worse for functional recovery after hip fracture surgery.<sup>[14]</sup> Nevertheless, the correlation between ADL and QoL among geriatric patients after hip fracture surgery still leaves space to be explored.

The aim of this study was to estimate the ADL and QoL after hip surgery for geriatric patients with hip fracture. The correlation between ADL and QoL and other associated predictors were also evaluated to highlight the outcomes in geriatric hip fracture population.

## Methods

### Study design

Patients diagnosed with a hip fracture and receiving operations in Wan Fang Hospital, Taipei, Taiwan, from December 2017 to April 2018, were prospectively enrolled. All patients who seemed to be eligible for inclusion were contacted by the researchers and received detailed information. Further eligibility for enrollment was determined by applying the following inclusion and exclusion criteria. Qualified patients included men and women 60 years of age or above, who had suffered hip fracture including femoral neck or peritrochanteric fractures, receiving an operation including hemiarthroplasty or internal fixation with intramedullary nailing, *in situ* cannulated screws or dynamic hip screws. Excluded were patients who received hip surgery owing to other diseases except for primary hip fracture, including osteoarthritis, trauma, tumor, or infection as well as avascular necrosis of the femoral heads.

Basic demographic data, including age, gender, fracture type, and surgical methods, were collected for each patient according to their medical records. Once the participants had consented to be enrolled, all participants completed questionnaires to evaluate metrics by interviewing the patients and their families at baseline (during the admission for surgery) using the following: the short portable mental status questionnaire (SPMSQ) for screening dementia, the EQ5D for assessing QoL, and the Barthel index (BI) for measuring ADL function. At 3- and 6-month follow-ups after surgery for hip fracture, questionnaires, including the EQ5D and BI, were repeatedly evaluated among all the participants. The entire protocols and instrumentation were approved by the ethical committee at Taipei Medical University, and the ethical approval was registered as TMU-JIRB N201709053. All participants consented to the study and data publication.

### Instruments

The SPMSQ is a simple, 10-item cognitive screening instrument including items to test orientation to time and place, memory, current event information (date, day of the week, name of this place, phone number, date of

birth, age, name of current and previous prime minister, and mother's maiden name), and calculation (subtract 3s starting with number 20). The total number of errors, which are correlated with clinical diagnosis of organic brain impairment or dementia, is recorded with a range from 0 to 10 with a cutoff of three or more errors for clinical or neuropsychological diagnosis.<sup>[15]</sup> The sensitivity of the SPMSQ was reported to be 55%–86% and the specificity from 94% to 99%.<sup>[16–18]</sup> The Chinese version of the SPMSQ had also been validated in earlier studies, in which the Cronbach's alpha in the present sample was 0.69.<sup>[19]</sup>

The EQ5D is one of the internationally used instruments for health-related QoL.<sup>[20]</sup> In this study, we used the EQ-5D-3 L with three level scales in the health state description. The EQ-5D-3 L is based on five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each item has three levels of severity: no problems, some problems, or major problems. We used the Chinese version of the EQ5D in this study with high levels of agreement (intraclass correlations coefficients >0.75) and convergent validity (Pearson's correlation coefficients >0.95) with different versions of the EQ5D from value sets of the United Kingdom, Japan, and Korea.<sup>[21]</sup>

The BI is an ordinal scale used to measure performance in activities of ADL.<sup>[22]</sup> The BI scores 0–100 with ten variables describing ADL and mobility. A higher number is associated with a greater likelihood of being able to live at home with a degree of independence following discharge from the hospital. The good reliability of the BI has been investigated in major clinical settings relevant to older people and poststroke patients.<sup>[23]</sup> The BI was also shown to accurately assess functional recovery in patients who undergo hemiarthroplasty after a femoral neck fracture.<sup>[24]</sup> The Chinese version of BI was validated with moderate to excellent agreement between raters for individual items ( $\kappa$  range, 0.53–0.94) and the total score (intraclass correlations coefficients = 0.94).<sup>[25]</sup>

### Statistical analysis

We analyzed the participants' demographic and clinical characteristics using mean and standard deviation (SD), except for gender, which was analyzed using frequency and percentage. We used two repeated measures analysis of variances with Bonferroni adjustments to examine the trajectory of the QoL (assessed using EQ5D) and ADL function (assessed using BI) for participants in the 6-month follow-up. Finally, we constructed two multiple linear regression models to understand the relationship between ADL functions on QoL. For the first regression, we used the EQ5D score at the 3-month follow-up as the dependent variable, the BI score at the 3-month follow-up as the independent variable, and at baseline we used the EQ5D score, age, gender (reference group: male), body mass index (BMI), and SMAPQ score as controlled variables.

For the second regression, we used the EQ5D score at the 6-month follow-up as the dependent variable; all the other variables (including independent and controlled variables) were the same as those in the first regression. The controlled variables were determined based on a previous study,<sup>[12,26,27]</sup> and all controlled variables were included in the regression model regardless they were significant. In addition, the regressions were estimated using ordinary least squares estimator.

### Results

Overall, 117 patients with hip fracture were eligible for enrollment [Figure 1]. The average age was 82.10 (10.77) with a mean BMI of 22.29 (3.69) [Table 1]. The majority of the participants were female (72.6%). In addition, femoral neck fractures and peritrochanteric fractures accounted for 59.8% and 40.25, respectively; nearly 42.7% of participants received hemiarthroplasty; 52.3% were treated with internal fixation. Among these 117 patients, the mean EQ5D and BI scores at baseline were 0.78 (0.23) and 83.00 (23.75), respectively. The mean errors in SPMSQ were 4 (3.72). Seven patients died within the 6-month follow-up period: Two patients died of upper gastrointestinal bleeding, five patients died from pneumonia. After surgery, the overall mortality rate for geriatric hip fracture patients was 5.5% (5/90) for those who completed 3-months follow-ups and 9.1% (7/77) for those who completed 6-months follow-up.

Among the 117 participants, 88 patients completed the postoperative 3-month follow-up and 70 patients completed both the 3-and the 6-month follow-ups. For the 88 participants with the 3-month follow-up, their mean (SD) age was 81.89 (11.46) with a mean BMI of 21.96 (3.93). In addition, slightly more than one-fifth of the participants were males ( $n = 19$ , 21.6%). Their mean EQ5D score was 0.76 (0.24) at baseline, 0.61 (0.24) at the 3-month follow-up. The BI score was 81.02 (25.58) at baseline,

60.85 (31.50) at the 3-month follow-up, and the SPMSQ score was 4.15 (3.76) at baseline. The 70 participants who had completed both the 3- and the 6-month follow-ups displayed similar characteristics. Their mean age was 82.46 (12.28), with a mean BMI of 21.87 (4.07). Furthermore, slightly more than one-fifth of the participants were males ( $n = 15$ , 21.4%). Their mean EQ5D score was 0.72 (0.25) at baseline, 0.58 (0.24) at the 3-month follow-up, and 0.57 (0.28) at the 6-month follow-up. The BI score was 76.64 (26.83) at baseline, 56.14 (32.14) at the 3-month follow-up, and 56.74 (33.85) at the 6-month follow-up. The SPMSQ score was 4.74 (3.77) at baseline [Table 2].

**Table 1: Participants baseline characteristics (n=117)**

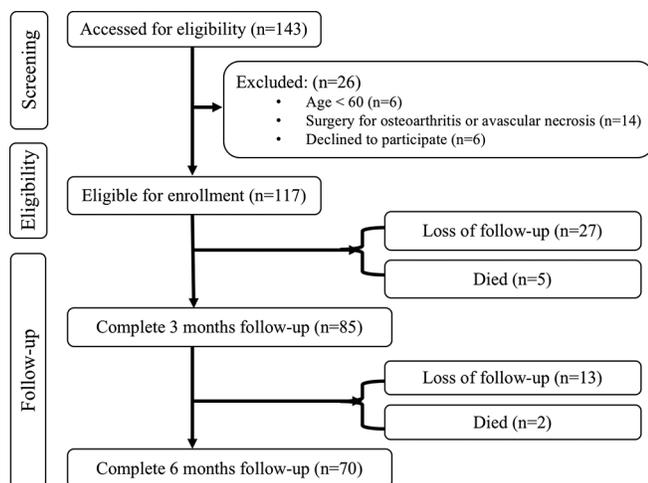
	Mean±SD
Age (year)	82.10±10.77
Gender (female)	85±72.6 <sup>a</sup>
Height (cm)	155.34±7.37
Weight (kg)	53.98±10.55
BMI (kg/m <sup>2</sup> )	22.29±3.69
Fracture type	
Femoral neck fracture	70±59.8 <sup>a</sup>
Peritrochanteric fracture	47±40.2 <sup>a</sup>
Surgical methods	
Hemiarthroplasty	50±42.7 <sup>a</sup>
Internal fixation	67±57.3 <sup>a</sup>
EQ5D score	0.78±0.23
BI score	83.00±23.75
SPMSQ errors	4±3.72

<sup>a</sup>Reported using,  $n$  (%). QoL: Quality of life, EQ5D: EuroQol five-dimensional questionnaire, 3 levels, BI: Barthel index, SPMSQ: Short portable mental status questionnaire, BMI: Body mass index, SD: Standard deviation

**Table 2: Characteristics for participants with follow-up**

	Mean±SD	
	Participants with 3-months follow-up (n=88)	Participants with 6-months follow-up (n=70)
Age (year)	81.89±11.46	82.46±12.28
Gender (male) <sup>a</sup>	19 (21.6)	15 (21.4)
Height (cm)	154.39±6.88	154.36±6.56
Weight (kg)	52.45±10.46	52.21±10.68
BMI (kg/m <sup>2</sup> )	21.96±3.93	21.87±4.07
EQ5D score at baseline	0.76±0.24	0.72±0.25
EQ5D score at 3 months	0.61±0.24	0.58±0.24
EQ5D score at 6 months	-	0.57±0.28
BI score at baseline	81.02±25.58	76.64±26.83
BI score at 3 months	60.85±31.50	56.14±32.14
BI score at 6 months	-	56.74±33.85
SPMSQ errors at baseline	4.15±3.76	4.74±3.77

<sup>a</sup>Reported using,  $n$  (%). QoL: Quality of life, EQ5D: EuroQol five-dimensional questionnaire, 3 levels, BI: Barthel index, SPMSQ: Short portable mental status questionnaire, BMI: Body mass index, SD: Standard deviation



**Figure 1: A flowchart depicting the number of patients who were assessed for eligibility, who were enrolled, who completed follow-ups**

The participants had significantly decreased QoL between baseline and the 3-month follow-up ( $P = 0.008$  using Bonferroni adjustment); no statistically significant difference in the QoL between the 3-month and 6-month follow-ups ( $P = 1.000$  using Bonferroni adjustment). Similar findings were shown in the participants' ADL function: BI score was significantly decreased between baseline and the 3-month follow-up ( $P < 0.001$  using Bonferroni adjustment), and there was no significant difference in the BI score between the 3-and the 6-month follow-ups ( $P = 1.000$  using Bonferroni adjustment). Moreover, after hip fracture repair, 20% (14/70) of geriatric patients were able to return to baseline ADL levels after the 6-month follow-up. Regression models additionally showed that ADL function was highly associated with QoL among our participants in both cross-sectional (standardized coefficient = 0.807,  $P < 0.001$ ) and longitudinal (standardized coefficient = 0.681,  $P < 0.001$ ) designs after controlling for potential confounders [Tables 3 and 4].

### Discussion

Owing to the increasing prevalence, loss of independence, and high mortality, hip fractures are a major concern of public healthcare providers.<sup>[28]</sup> In the last two decades, more

and more attention has been paid to mortality, functional loss as well as QoL among geriatric patients with hip fractures.<sup>[29]</sup> In this study, we reported 3-and 6-month mortality rates among geriatric patients after surgery for hip fracture were 5.5% and 9.1%, respectively. In addition, after hip fracture surgery, both ADL function and the QoL were significantly deteriorated after 6 months of follow-up, without improvement over time. Only 20% of geriatric patients with hip fracture were able to recover baseline ADL after 6-month follow-up. The QoL was correlated with both cross-sectional and longitudinal ADL function after hip fracture surgery.

According to the literature, after hip fracture surgery, the reported mid-term mortality rate within three and 6 months varied, with ranges from 9.6% to 12.1% and 8.3% to 29.1%, respectively.<sup>[30-32]</sup> In this study, the reported mortality rates among geriatric hip fracture patients within both three and 6 months after hip fracture surgery were relatively lower than that reported from other studies. In our institution, the lower mortality rate might be attributable to easy accessibility for medical services and robust health policies for surgical repair within 48 h for hip fracture (in our institution almost all hip fracture patients receive surgery within 48 h after admission; data were not presented), since evidence has revealed that hip fracture patients with early surgical repair within 48 h had fewer complications and lower mortality rate than the group undergoing surgery with longer surgical delay.<sup>[33]</sup>

Nevertheless, even with lower mid-term mortality rates after hip fracture surgery, our study revealed that geriatric patients undergoing hip fracture surgery were significantly deteriorated in ADL after surgery. The deterioration in ADL was not recovered even after 6-months follow-up. Tanaka *et al.* reported that 37.2% of patients with hip fracture did not recover their ADL at 6 months after surgery to levels before fracture.<sup>[27]</sup> Factors, including age, type of fracture, and prehabilitation ADL were predictors for a decline in ADL at 6 months after surgery.<sup>[27]</sup> Compared to the treatment with internal fixation, surgical intervention with joint replacement was also reported to provide a better functional outcome for patients with hip fracture.<sup>[34]</sup> However, this study revealed that, after repair for hip fracture, up to 80% of geriatric patients could not regain their baseline ADL after 6-months follow-up. The possible reasons for relatively poor ADL after hip surgery among our geriatric patients were older age (mean 82.10 years in our study vs. 80.8 years in the study reported by Tanaka *et al.*) and a higher percentage of internal fixation instead of joint replacement (57.5% for internal fixation in our study vs. 42% in the study reported by Tanaka *et al.*).<sup>[27]</sup> Our finding of poor ADL recovery after hip fracture surgery also echoed the report from Moerman *et al.* that less than one-third of hip fracture patients could return to prefracture levels of ADL after 1-year follow-up.<sup>[35]</sup> With the improvement in survival rates rather than in functional recovery after hip

**Table 3: Associations between activity daily living function on quality of life at 3 months after surgery**

	EQ5D at 3 months			
	Coefficient	SE	Standard coefficient	P
EQ5D at baseline	-0.073	0.076	-0.072	0.34
Age	-0.001	0.001	-0.070	0.32
Gender (reference:male)	-0.035	0.040	-0.059	0.39
BMI	0.003	0.004	0.044	0.52
SPMSQ errors at baseline	0.002	0.005	0.038	0.61
BI at 3 months	0.006	0.001	0.807	<0.001

$R^2=0.637$ , Adjusted  $R^2=0.610$ . QoL: Quality of life, EQ5D: EuroQol five-dimensional questionnaire, 3 levels, BI: Barthel index, SPMSQ: Short portable mental status questionnaire, BMI: Body mass index, SE: Standard error

**Table 4: Effects of activity daily living function on quality of life**

	EQ5D at 6 months			
	Coefficient	SE	Standard coefficient	P
EQ5D at baseline	0.034	0.111	0.031	0.76
Age	-0.002	0.002	-0.096	0.32
Gender (reference:male)	-0.059	0.062	-0.088	0.35
BMI	-0.004	0.006	-0.056	0.56
SPMSQ errors at baseline	-0.001	0.007	-0.014	0.89
BI at 3 months	0.006	0.001	0.681	<0.001

$R^2=0.467$ , Adjusted  $R^2=0.417$ . QoL: Quality of life, EQ5D: EuroQol five-dimensional questionnaire, 3 levels, BI: Barthel index, SPMSQ: Short portable mental status questionnaire, BMI: Body mass index, SE: Standard error

fracture surgery among geriatric patients, highlighting the potential burdens for public health issues, more attention should be paid to the dependence of these geriatric patients undergoing hip fracture surgery.

In addition, our study revealed that QoL among geriatric patients undergoing hip fracture surgery was significantly deteriorated after 6-months follow-up. Our finding was consistent with a report from the Norwegian Hip Fracture Register that a hip fracture has a dramatic impact on patients' QoL and that the deterioration in QoL was also sustained 1 year after the fracture.<sup>[12]</sup> Moreover, we further found that poor ADL could longitudinally predict as well as crosssectionally reflect the worse QoL among geriatric patients undergoing repair for hip fracture. Considering the evidence of the effectiveness of a physical exercise intervention program in improving functional mobility in older adults after hip fracture,<sup>[36]</sup> more effort should be made to construct robust rehabilitation programs for geriatric hip fracture patients to prevent loss of ADL resulting in decline of QoL after hip fracture surgery.

Interestingly, a high percentage of comorbidities including dementia among geriatric patients with hip fracture was also a clinical dilemma and might affect the functional outcome and mortality after hip fracture.<sup>[37]</sup> Dementia is currently regarded as one of the important factors negatively affecting the ability to return to ADL independence and QoL.<sup>[14,34]</sup> Nevertheless, the severity of dementia, which was defined by the errors on the SPMSQ, could not show the significant correlation with the loss of ADL and QoL in our study. SPMSQ was reported to be not an ideal independent factor to predict functional outcome after hip fracture without considering functional status prior to fracture.<sup>[26]</sup> The relatively small sample size might have also contributed to the insignificant correlation between dementia and the functional outcome in our study. Further study with other assessments of dementia scale and a larger sample size might be necessary to clarify the association between the severity of dementia and the outcome after hip fracture surgery.

The study has some limitations. First, the representativeness of our sample is relatively small and questionable because we recruited only 117 elderly participants from the same institution, who might not represent the geriatric population undergoing hip fracture surgery throughout Taiwan. Second, there was a potential selection bias because we included different proximal femur fracture patterns including femoral neck or peritrochanteric fracture, and different surgical management including hemiarthroplasty or internal fixation with intramedullary nailing, *in situ* cannulated screws or dynamic hip screws. Different fracture patterns and management might affect the functional outcome after hip fracture surgery. Third, we only discussed outcomes after mid-term follow-up for 6 months, which might not reflect the recovery of function after long-term follow-up. In

addition, the fact that 34.1% (40/117) of the patients failed to be followed at 6-months follow-up might be a concern to corroborate our findings. However, even with these limitations, this study importantly highlights the severity of functional loss among geriatric patients undergoing hip fracture surgery, resulting in poor QoL after 6-months follow-up.

## Conclusion

Functional impairment is common among geriatric patients after hip fracture surgery. Poor ADL could predict and reflect poor QoL after 6-months follow-up. More emphasis should be directed toward conducting rehabilitation programs to prevent the loss of function after hip fracture surgery in order for better QoL in geriatric patients undergoing hip fracture surgery.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## References

1. Lesić A, Jarebinski M, Pekmezović T, Bumbasirević M, Spasovski D, Atkinson HD, *et al.* Epidemiology of hip fractures in belgrade, serbia montenegro, 1990-2000. *Arch Orthop Trauma Surg* 2007;127:179-83.
2. Melton LJ 3<sup>rd</sup>. Epidemiology of hip fractures: Implications of the exponential increase with age. *Bone* 1996;18:121S-125S.
3. Palmer A, Taitsman LA, Reed MJ, Nair BG, Bentov I. Utility of geriatric assessment in the projection of early mortality following hip fracture in the elderly patients. *Geriatr Orthop Surg Rehabil* 2018;9:2151459318813976.
4. Nijmeijer WS, Folbert EC, Vermeer M, Slaets JP, Hegeman JH. Prediction of early mortality following hip fracture surgery in frail elderly: The almelo hip fracture score (AHFS). *Injury* 2016;47:2138-43.
5. Koh GC, Tai BC, Ang LW, Heng D, Yuan JM, Koh WP, *et al.* All-cause and cause-specific mortality after hip fracture among chinese women and men: The Singapore Chinese Health Study. *Osteoporos Int* 2013;24:1981-9.
6. Magaziner J, Hawkes W, Hebel JR, Zimmerman SI, Fox KM, Dolan M, *et al.* Recovery from hip fracture in eight areas of function. *J Gerontol A Biol Sci Med Sci* 2000;55:M498-507.
7. Kim YH, Kwon CH, Shin HI. Validity of motor impairment scale in long-term care insurance system of Korea. *Ann Rehabil Med* 2013;37:403-12.
8. Abe K, Inage K, Yamashita K, Yamashita M, Yamamaoka A, Norimoto M, *et al.* Correlation between walking ability and monthly care costs in elderly patients after surgical treatments for hip fractures. *Ann Rehabil Med* 2018;42:569-74.
9. Enocson A, Pettersson H, Ponzer S, Törnkvist H, Dalén N, Tidermark J, *et al.* Quality of life after dislocation of hip arthroplasty: A prospective cohort study on 319 patients with femoral neck fractures with a one-year follow-up. *Qual Life Res* 2009;18:1177-84.
10. Keating JF, Grant A, Masson M, Scott NW, Forbes JF. Randomized comparison of reduction and fixation, bipolar hemiarthroplasty, and total hip arthroplasty. *Treatment of*

- displaced intracapsular hip fractures in healthy older patients. *J Bone Joint Surg Am* 2006;88:249-60.
11. Leonardsson O, Rolfson O, Hommel A, Garellick G, Åkesson K, Rogmark C, *et al.* Patient-reported outcome after displaced femoral neck fracture: A national survey of 4467 patients. *J Bone Joint Surg Am* 2013;95:1693-9.
  12. Gjertsen JE, Baste V, Fevang JM, Furnes O, Engesaeter LB. Quality of life following hip fractures: Results from the Norwegian hip fracture register. *BMC Musculoskelet Disord* 2016;17:265.
  13. Fukui N, Watanabe Y, Nakano T, Sawaguchi T, Matsushita T. Predictors for ambulatory ability and the change in ADL after hip fracture in patients with different levels of mobility before injury: A 1-year prospective cohort study. *J Orthop Trauma* 2012;26:163-71.
  14. Tang VL, Sudore R, Cenzer IS, Boscardin WJ, Smith A, Ritchie C, *et al.* Rates of recovery to pre-fracture function in older persons with hip fracture: An observational study. *J Gen Intern Med* 2017;32:153-8.
  15. Pfeiffer E. A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. *J Am Geriatr Soc* 1975;23:433-41.
  16. Fillenbaum GG, Landerman LR, Simonsick EM. Equivalence of two screens of cognitive functioning: The short portable mental status questionnaire and the orientation-memory-concentration test. *J Am Geriatr Soc* 1998;46:1512-8.
  17. Albert M, Smith LA, Scherr PA, Taylor JO, Evans DA, Funkenstein HH, *et al.* Use of brief cognitive tests to identify individuals in the community with clinically diagnosed Alzheimer's disease. *Int J Neurosci* 1991;57:167-78.
  18. Erkinjuntti T, Sulkava R, Wikström J, Autio L. Short portable mental status questionnaire as a screening test for dementia and delirium among the elderly. *J Am Geriatr Soc* 1987;35:412-6.
  19. Chi I, Boey KW. Hong Kong validation of measuring instruments of mental health status of the elderly. *Clin Gerontol* 1993;13:35-51.
  20. EuroQol Group. EuroQol – A new facility for the measurement of health-related quality of life. *Health Policy* 1990;16:199-208.
  21. Wu C, Gong Y, Wu J, Zhang S, Yin X, Dong X, *et al.* Chinese version of the EQ-5D preference weights: Applicability in a Chinese general population. *PLoS One* 2016;11:e0164334.
  22. Mahoney FI, Barthel DW. Functional evaluation: The barthel INDEX. *Md State Med J* 1965;14:61-5.
  23. Sainsbury A, Seebass G, Bansal A, Young JB. Reliability of the barthel index when used with older people. *Age Ageing* 2005;34:228-32.
  24. Unnanuntana A, Jarusriwanna A, Nepal S. Validity and responsiveness of barthel index for measuring functional recovery after hemiarthroplasty for femoral neck fracture. *Arch Orthop Trauma Surg* 2018;138:1671-7.
  25. Hsueh IP, Lee MM, Hsieh CL. Psychometric characteristics of the barthel activities of daily living index in stroke patients. *J Formos Med Assoc* 2001;100:526-32.
  26. Dubljanin-Raspopović E, Marković-Denić L, Matanović D, Grajić M, Krstić N, Bumbaširević M, *et al.* Is pre-fracture functional status better than cognitive level in predicting short-term outcome of elderly hip fracture patients? *Arch Med Sci* 2012;8:115-22.
  27. Tanaka R, Umehara T, Fujimura T, Ozawa J. Clinical prediction rule for declines in activities of daily living at 6 months after surgery for hip fracture repair. *Arch Phys Med Rehabil* 2016;97:2076-84.
  28. Salkeld G, Cameron ID, Cumming RG, Easter S, Seymour J, Kurrle SE, *et al.* Quality of life related to fear of falling and hip fracture in older women: A time trade off study. *BMJ* 2000;320:341-6.
  29. Smith T, Pelpola K, Ball M, Ong A, Myint PK. Pre-operative indicators for mortality following hip fracture surgery: A systematic review and meta-analysis. *Age Ageing* 2014;43:464-71.
  30. Frisch NB, Wessell N, Charters M, Greenstein A, Shaw J, Peterson E, *et al.* Hip fracture mortality: Differences between intertrochanteric and femoral neck fractures. *J Surg Orthop Adv Spri* 2018;27:64-71.
  31. Bellelli G, Mazzola P, Morandi A, Bruni A, Carnevali L, Corsi M, *et al.* Duration of postoperative delirium is an independent predictor of 6-month mortality in older adults after hip fracture. *J Am Geriatr Soc* 2014;62:1335-40.
  32. Bellelli G, Carnevali L, Corsi M, Morandi A, Zambon A, Mazzola P, *et al.* The impact of psychomotor subtypes and duration of delirium on 6-month mortality in hip-fractured elderly patients. *Int J Geriatr Psychiatry* 2018;doi: 10.1002/gps.4914. [Epub ahead of print].
  33. Sircar P, Godkar D, Mahgerefteh S, Chambers K, Niranjana S, Cucco R, *et al.* Morbidity and mortality among patients with hip fractures surgically repaired within and after 48 hours. *Am J Ther* 2007;14:508-13.
  34. Alexiou KI, Roushias A, Varitimidis SE, Malizos KN. Quality of life and psychological consequences in elderly patients after a hip fracture: A review. *Clin Interv Aging* 2018;13:143-50.
  35. Moerman S, Mathijssen NM, Tuinebreijer WE, Nelissen RG, Vochteloo AJ. Less than one-third of hip fracture patients return to their prefracture level of instrumental activities of daily living in a prospective cohort study of 480 patients. *Geriatr Gerontol Int* 2018;18:1244-8.
  36. Lima CA, Sherrington C, Guaraldo A, Moraes SA, Varanda RD, Melo JA, *et al.* Effectiveness of a physical exercise intervention program in improving functional mobility in older adults after hip fracture in later stage rehabilitation: Protocol of a randomized clinical trial (REATIVE study). *BMC Geriatr* 2016;16:198.
  37. Mitchell R, Harvey L, Brodaty H, Draper B, Close J. Hip fracture and the influence of dementia on health outcomes and access to hospital-based rehabilitation for older individuals. *Disabil Rehabil* 2016;38:2286-95.