CE

The Influence of Presurgical Factors on the Rehabilitation Outcome of Patients Following Hip Arthroplasty

João Lindo Simões[1,2], Soraia Soares[2], Pedro Sa-Couto[3], Carla Lopes[2], Daniela Magina[2], Elsa Melo[2], David Voegeli[4], Isabel Bolhão[5]

Abstract

Purpose: The aims of this study were to evaluate the relationship between sociodemographic information, anthropometric values, clinical and presurgery factors, and length of stay (LOS) in older adult patients undergoing total hip arthroplasty (THA) and to predict which factors can delay the start of the rehabilitation program and increase the corresponding LOS.

Methods: A prospective cohort study was conducted in an orthopedic inpatient unit with 40 patients undergoing THA.

Findings: The Morse Fall Scale scores and pain intensity scores delayed the commencement of the rehabilitation program. Gender and social support were important determinants of LOS and rehabilitation outcome following THA. The weight of the lower limb without osteoarthritis followed by pain intensity and overweight patients also influenced LOS.

Conclusions/Clinical Relevance: Functional outcomes after THA are variable, and the rehabilitation process is an important factor to regain their normal level of physical functioning. This factor can have an impact in the discharge of patients, in resource allocation and in health care of older adult patients.

Keywords: Osteoarthritis; hip arthroplasty; rehabilitation; length of stay; nurses.

Definition of Terms

Osteoarthritis (OA), which is also known as osteoarthrosis or degenerative joint disease, is a progressive disorder of the joints caused by gradual loss of cartilage and resulting in the development of bony spurs and cysts at the margins of the joints. OA results from deterioration or loss of the cartilage that acts as a protective cushion between bones, particularly in weight-bearing joints such as the knees and hips. As the cartilage is worn away, the bone forms spurs, areas of abnormal hardening, and fluid-filled pockets in the marrow known as subchondral cysts. As the disorder progresses, pain results from deformation of the bones and fluid accumulation in the joints. The pain is relieved by rest and made worse by moving the joint or placing weight on it.

Length of stay (LOS) is defined as length of an inpatient episode of care, calculated from the day of admission to the day of discharge and based on the number of nights spent in hospital. The average LOS after total hip replacement ranges from 4 to 5 days (Foote, Panchoo, Blair, & Bannister, 2009). Thus, it is considered a “short” or “lengthy” LOS if the patient stays hospitalized less or more than this average of days, respectively.

Introduction

Osteoarthritis (OA) is one of the most prominent causes of disability in older adults, being the fourth in women and the eighth in men (Gross & Muir, 2016). Total hip arthroplasty (THA) in patients experiencing OA is one of the most successful and cost-effective interventions, offering reliable relief from pain, as well as improvement in physical function and quality of life (Nilsdotter, 2002). Pain is the principal indication for hip replacement, and significant relief may be seen as early as 1 week after surgery (Min et al., 2016). Quality of life after surgery approximates to that of a healthy reference population, with improvements in energy levels, sleep, and social and

Correspondence: *João Lindo Simões, School of Health Sciences, University of Aveiro, Campus Universitário de Santiago, Agras do Crasto, Edifício 30, 3810-193 Aveiro, Portugal. E-mail: jflindo@ua.pt*

1 Center for Health Technology and Services Research, Porto, Portugal

2 School of Health Sciences, University of Aveiro, Aveiro, Portugal

3 Centre for Research and Development in Mathematics and Applications, Department of Mathematics, University of Aveiro, Aveiro, Portugal

4 Faculty of Health Sciences, University of Southampton, Southampton, UK

5 Orthopaedic Department, Centro Hospitalar do Baixo Vouga EPE, Aveiro, Portugal

Cite this article as:
Simões, J. L., Soares, S., Sa-Couto, P., Lopes, C., Magina, D., Melo, E., Voegeli, D., & Bolhão, I. (2019). The influence of presurgical factors in the rehabilitation outcome of patients following hip arthroplasty. *Rehabilitation Nursing, 44*(4), 189-202. doi: 10.1097/rnj.0000000000000126

sexual function also being observed (Keswani et al., 2016). Overall oxygen demand during activity is decreased and walking ability improves, with most of these improvements being seen within 3 months of surgery (Keisu et al., 2001). These gains in quality of life allow large numbers of patients to retain their independence and function more actively in society.

The demographic shift toward an aging population and the high prevalence of OA in older adults will lead to an increased demand for THA in the future. The projections for 2030, based on these demographic changes, predict an increase of 80% in total hip replacements (Adunsky, Fleissig, Levenkrohn, Arad, & Noy, 2002). Therefore, to inform future health policy and the development of effective patient rehabilitation programs, the factors that might impede rehabilitation should be assessed. For example, according to Sadr Azodi, Bellocco, Eriksson, and Adami (2006), patients undergoing THA with a high body mass index (BMI) spent up to 7% longer in hospital. This study also showed that smoking and obesity substantially increased the risk of systemic complications after THA, therefore increasing length of stay (LOS) and consequent costs to the healthcare system. The authors further suggest that greater attention should be paid to these factors when preparing patients for surgery.

Surgical technique is extremely important in determining implant performance and consequently in rehabilitation and LOS (Gross & Muir, 2016; Phruetthiphat et al., 2016). Two of the most commonly used approaches are the anterolateral (modified Watson-Jones) and the posterior (Southern, Moore, Gibson, or posterolateral) approaches (Palan, Beard, Murray, Andrew, & Nolan, 2009). Surgical approach, preparation of the implant bed, and cementing techniques all reflect on implant survival (Gross & Muir, 2016).

Complications following hip replacement surgery are uncommon and can usually be prevented with careful postoperative management. Complications can occur during surgery (fractures—typically of the femur, aseptic loosening, injury to the surrounding nerves or blood vessels—i.e., sciatic nerve palsy and change in leg length) and in the immediate postoperative period (blood clots, infection, dislocation of the artificial hip joint; Williams et al., 2002).

With respect to the anesthetic technique used, THA is amenable to a variety of regional anesthesia techniques and general anesthesia. A systematic review by Macfarlane, Prasad, Chan, and Brull (2009) does suggest that regional anesthesia reduces postoperative pain and also nausea and vomiting. Therefore, knowledge of the type of anesthetic technique used becomes important, because it may allow the early start of the rehabilitation program and reduce LOS.

According to Shabat, Mann, Nyska, and Maffulli (2005), most studies on hip replacement have concentrated on the indications for surgery or related factors, implant survival/surgical procedures, and health-related quality of life. However, there are studies that have focused on understanding the factors that impact on LOS and rehabilitation potential. From these studies, numerous factors emerge, which may be grouped into the following categories:

1. *Sociodemographic factors*: age (Arinzon, Fidelman, Zuta, Peisakh, & Berner, 2005), gender (Rolland et al., 2004), marital status (Lin & Kaplan, 2004), presence of social support (Beaupre et al., 2005), and living condition, that is, alone or with others (Fortin et al., 1999).
2. *Physical functionality factors*: sensory impairment—hearing and vision (Arinzon et al., 2005), preoperative weakness (Arinzon et al., 2005), preoperative functional status (Moncada, Andersen, Franckowiak, & Christmas, 2006), risk of fall (Moncada et al., 2006), and history of joint overuse (Botha-Scheepers et al., 2006).
3. *Psychological factors*: preoperative cognitive function (Moncada et al., 2006), depression status (Fredman, Hawkes, Black, Bertrand, & Magaziner, 2006), and delirium or incident cognitive injury (Bitsch, Foss, Kristensen, & Kehlet, 2006).
4. *Anthropometric factors*: obesity (Botha-Scheepers et al., 2006), nutritional status (Lieberman, Friger, & Lieberman, 2006), and decrease in muscle mass(Graf, 2006).
5. *Presurgical clinical factors*: medical comorbidities (Patrick, Knoefel, Gaskowski, & Rexroth, 2001), admission albumin levels (Mizrahi, Fleissig, Arad, Blumstein, & Adunsky, 2007), risk of developing pressure ulcers (Lindholm et al., 2008), repeated trauma and hormone disorders (Altman, Hochberg, Moskowitz, & Schnitzer, 2000), history of joint injury (Botha-Scheepers et al., 2006), and susceptibility genetics (Botha-Scheepers et al., 2006).
6. *Rehabilitation factors:* time between surgery and the start of the rehabilitation program (Sandy & Ganz, 2004), measures to prevent pressure ulcers (Lindholm et al., 2008), and previous physical exercise program (Justo et al., 2011).
7. *Surgical factors*: type of hip surgery—elective or urgent (Haentjens, Autier, Barette, & Boonen, 2005), surgical technique—anterolateral and the posterior approaches (Palan et al., 2009), surgical approach, preparation of the implant bed (Crawford, & Murray, 1997), cementing techniques (Phruetthiphat et al., 2016), and anesthetic technique used (Macfarlane et al., 2009).

According to Barrera-Cadenas and Hernández-Vaquero (2011) in the study of the outcomes of arthroplasties, it is advisable to consider the possible influence that the prior history of the patient may have on the results. Currently, there are several studies that have focused on the study of the factors that impact inpatient rehabilitation and LOS after THA (Arinzon et al., 2005; Beaupre et al., 2005;

Botha-Scheepers et al., 2006; Caracciolo & Giaquinto, 2005; Fortin et al., 1999; Fredman et al., 2006; Haentjens et al., 2005; Harada, Chun, Chiu, & Pakalniskis, 2000; Kennedy, Hanna, Stratford, Wessel, & Gollish, 2006; Lieberman et al., 2006; Lin & Kaplan, 2004; Saleh, Kassim, Yoon, & Vorlicky, 2002; Yeung, Davis, & Soric, 2010). However, these studies did not address, in a combined way, all the factors (internal and external) that may influence the time to the beginning of the rehabilitation process and the LOS.

Several models of inpatient rehabilitation after THA exist and vary according to the healthcare system in operation but include rehabilitation beds in acute care hospitals or specialized geriatric units and convalescent care beds. Rehabilitation is designed to facilitate the return of elderly patients to their premorbid status to the greatest possible extent: that patients can benefit from rehabilitation programs (Coulter, Scarvell, Neeman, & Smith, 2013; McGilton, Mahomed, Davis, Flannery, & Calabrese, 2009; Putman et al., 2010) and that postoperative rehabilitation is integral to the successful outcome of THA (Smith et al., 2016; Sonoda et al., 2016).

Methods

Aims

The aims of the study are (1) to evaluate the relationship between sociodemographic and anthropometric information and LOS of inpatients following primary THA, (2) to evaluate the relationship between clinical and presurgery factors and LOS in patients undergoing THA, and (3) to predict which factors can delay the start of the rehabilitation program. Identifying these predictors of rehabilitation beginning and LOS will facilitate improvements in care processes by informing care planning and more effective resource allocation. These changes may ultimately translate into improved system efficiencies and patient outcomes.

Design

This was a prospective cohort study of patients who underwent THA and were admitted to the postoperative rehabilitation program instituted in the orthopedic inpatient unit of a public hospital in Aveiro (Centro Hospitalar do Baixo Vouga, E.P.E., Unidade de Aveiro), Portugal.

Participants

All older adult patients admitted for an elective THA due to OA and/or prosthesis revision in the period between April 1 and September 30, 2014, were eligible to be recruited into the study and identified from an administrative database. Inclusion criteria consisted of the following: patients aged 60 years or older, THA planned for OA, admitted to the postoperative rehabilitation program instituted in the orthopedic inpatient unit, ability to ambulate independently (with or without mobility aids), and ability to fully or partially weight bare prior to surgery. Patients that developed disorientation and/or confusion or that developed severe systemic complications following surgery were excluded from the study. Forty-six patients over 60 years old were hospitalized in the orthopedic inpatient unit for an elective THA during the study period and eligible for recruitment. Of these, three patients declined to take part in the study, and three others were withdrawn after developing disorientation, leaving a total sample group of 40.

Description of the Standard Patient-Centered Rehabilitation Model of Care

Staff of the orthopedic inpatient unit involved in this study developed an integrated practice-based model of care (Figure 1). This is based on a modification of the McGilton et al. (2009) framework, where patients begin a standard patient-centered rehabilitation model of care during their hospital stay. This model aims to provide an optimal rehabilitation setting at the appropriate time for patients following THA. The innovative aspects of this model include the following: (1) early commencement of rehabilitation; (2) individualized assessments and interventions focused on the patients' remaining abilities; (3) assessments for dementia, delirium, and depression within the first 3 days of admission to rehabilitation; (4) patient-centered goals that involve input from patients and their families; (5) individualized rehabilitation care at the bedside if necessary; (6) a focus on care strategies that minimize behavioral and cognitive symptoms related to cognitive impairment; and (7) education and support to healthcare providers and facilities to implement the model of care (McGilton et al., 2009).

In our model, the primary goal of nursing care in patients following a THA is to maximize their functioning, (Shabat et al., 2005) with a secondary goal of discharging patients back to their previous environment. Outcomes related to patients' functioning include improvement in patient's mobility level during inpatient rehabilitation and a return to pre-OA functional ability.

All patients were assessed and treated within 48–72 hours postsurgery, and medically stable patients were assisted to move around as per their activity tolerance. Following the admission assessments, the team and the patient established mutually agreeable rehabilitation goals and the treatment plan for his or her inpatient stay. Patients were also instructed to perform exercises independently as appropriate for their conditions. Mobility

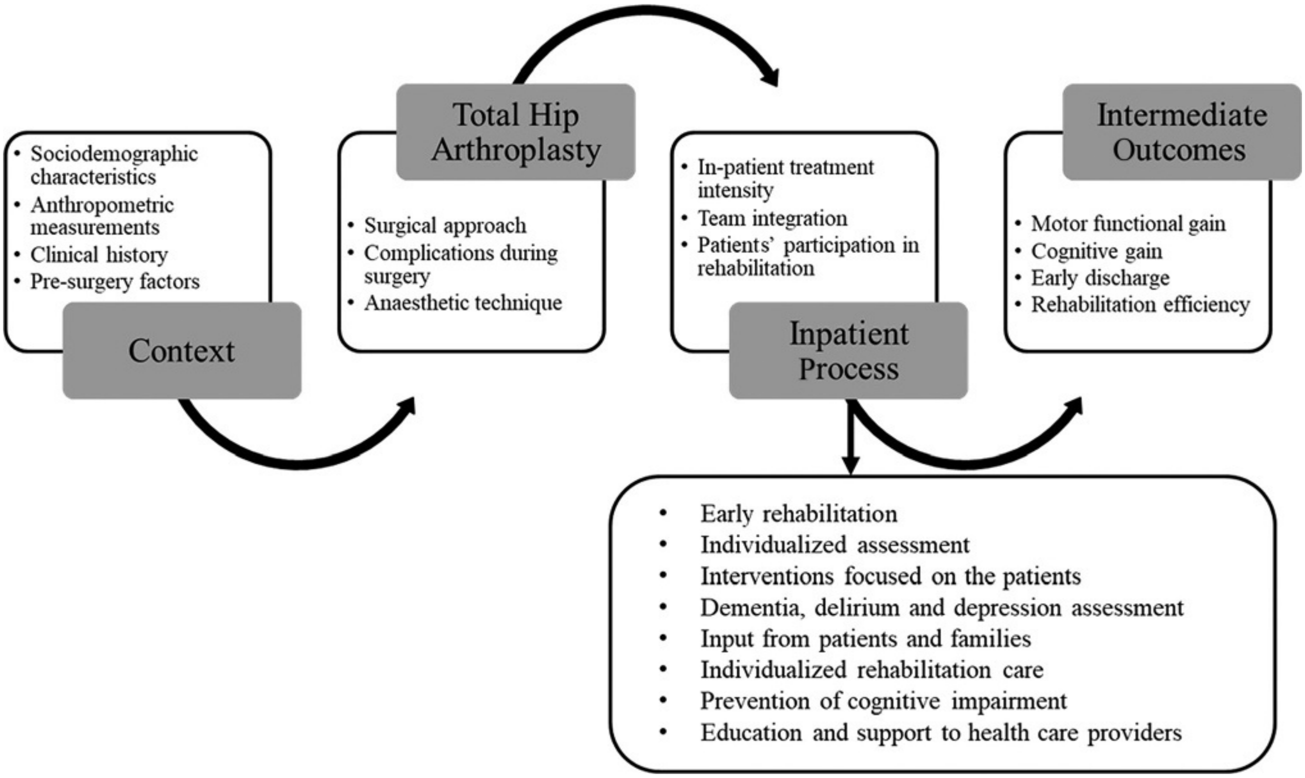

Figure 1. Patient-centered rehabilitation model of care.

training was incorporated into the nursing care plan and integrated into patients' activities of daily living. This process is guided by the patient-centered rehabilitation model of care, which includes four stages, namely, context, THA, inpatient process, and intermediate outcomes (Figure 1 and Table 1). The plan of care for each patient was specific but with similar overarching goals according to the individual needs of each patient.

Data Collection

Data collection for each patient was undertaken at the time of hospital admission and at the time of hospital discharge. Before the participants' assessment, permission to collect data was requested. Three nurses with relevant clinical experience (rehabilitation nurses with a minimum of 5 years of experience) were assigned to perform the assessments of systemic and contextual data of the patients included in the study. They were trained on how to score patients with the scales of the data collection instrument and the data recording process before commencing the study. Data from each patient for the various stages of evaluation were not collected by the same nurse. The time of day assessments were conducted at random, according to the availability of the patient, the nurses, the ward organization, and surgery time.

The data collection instrument and variables recorded that might influence LOS were based on those most frequently described in the literature, already addressed.

Patient sociodemographic characteristics included in the data collection instrument were age, gender, marital status, education level, number of household members, and residence area. Clinical data included comorbidities, vital signs (heart rate, respiratory rate, blood pressure, body temperature, and pain), and clinical chemistry data (hemoglobin, hematocrit, platelets, prothrombin time, fasting glucose, creatinine, and urea). Anthropometric parameters included BMI and body composition analysis. These parameters were evaluated by the bioelectrical impedance analysis (BIA) using a Seca medical Body Composition Analyzer (mBCA) 515. The BIA measurement by the Seca mBCA has already been validated in older adults with chronic illness (Peres, Lento, Baluz, & Ramalho, 2012). According to this study, an eight-electrode, segmental multifrequency BIA is a valid tool to estimate body composition compared to the validity and precision of other two-compartment reference methods. On the basis of the objectives of this study, the parameters that were considered important were fat mass and fat-free mass, total skeletal muscle mass, and the skeletal muscle mass of each upper and lower limb.

The data obtained through the application of the selected scales included mental status (Mini-Mental State

Table 1 Patient-centered rehabilitation model of care: Justification of the variables

Stages	Categories	Justification
Context	Sociodemographic characteristics Anthropometric measurements Clinical history Presurgery factors	In the study of the outcomes of arthroplasties, it is advisable to consider the possible influence that the prior history of the patient may have on the results.
THA	Surgical approach	The information about surgical approach is important for the adaptation of rehabilitation strategies and the appropriateness of patient positioning, with the objective of minimize the risk of dislocation.
	Complications during surgery	About complications following hip replacement surgery, it is important to understand these complications or potential risks of these occurring before the beginning of the rehabilitation program because they can influence the rehabilitation strategies used.
	Anesthetic technique	Knowledge of the type of anesthetic technique used becomes important because it may allow the early start of the rehabilitation program and reduce LOS.
Inpatient process	Inpatient treatment intensity Team integration Patient's participation in rehabilitation	Functional rehabilitation after THA is accepted as the standard and essential treatment. The aim is to maximize a person's functionality and independence and minimize complications such as hip dislocation, wound infection, deep vein thrombosis, and pulmonary embolism. The rehabilitation approach used has four components: therapeutic exercise, transfer training, gait training, and instruction in the activities of daily living (e.g., stair climbing, bending, and walking). Its intensity and sequence are adapted to the profile of each patient.
Assessment of intermediate outcomes at patient discharge	Motor functional gain Cognitive gain Early discharge Rehabilitation efficiency	Among the various outcomes of rehabilitation, the elderly patient's functional condition at the end of the process is the most valuable outcome to assess in this population (Lieberman et al., 2006). This is because the functional condition represents an integrated summation of many factors that affect the elderly patient's physical and mental health. It also has the strongest effect on the patient's well-being and is critically important in assessing his or her degree of dependence on the close environment and the community (Lieberman et al., 2006). Motor functional gain and cognitive gain at discharge was calculated by the difference between the patient's functional and cognitive status at inpatient admission and discharge. The discharge setting was important to optimize the postoperative rehabilitation outcomes (Yeh, Chen, & Liu, 2005). Nursing professionals, in this regard, are obliged to understand the factors that can influence the rehabilitation process because they play a vital role in helping the patients to regain health, improve quality of life, and reduce the social costs incurred.

Note. LOS = length of stay; THA = total hip arthroplasty.

Examination [MMSE] and Geriatric Depression Scale [GDS]) and functional status (Functional Independence Measure [FIM] Scale, Morse Fall Scale [MFS], and Braden Scale). Also, the time interval from surgery to beginning of the rehabilitation program and LOS was obtained from patient records.

Validity and Reliability

The data collection instrument and variables recorded that might influence LOS were based on those most frequently described in the literature.

Cognitive impairment was assessed using the MMSE (Folstein, Folstein, & McHugh, 1975), a widely used instrument shown to have validity and reliability in the evaluation of cognitive function in the elderly population (Lopez, Charter, Mostafavi, Nibut, & Smith, 2005). It includes tests of orientation, attention, memory, language, and visual-spatial skills.

The presence and likelihood of developing depression were evaluated with the GDS. This scale was developed as a self-report instrument to screen for clinical depression among older adults (Yesavage et al., 1983). This scale has been tested and used extensively in the older population, showing its reliability (Yesavage et al., 1983). A cutoff score of 10 was adopted as the criteria for the presence of depression in this study (scores of 0–10 should be considered normal and 11 or more as a possible indicator of depression; Hickie & Snowdon, 1987; Yesavage et al., 1983).

The FIM Scale was used in order to assess physical and cognitive disability (Hamilton, Granger, Sherwin, Zielezny, & Tashman, 1987). Items are scored on the level of assistance required for an individual to perform activities of daily living. The scale includes 18 items, of which 13 items are physical domains based on the Barthel Index and 5 items are cognitive items. Each item is scored from 1 to 7 based on the level of independence, where 1 represents *total dependence* and 7 indicates *complete independence*. The FIM motor function subscale's total score ranges from 13 to 91, with higher scores indicating higher levels of independence. The FIM cognitive function subscale's total score is the sum of the scores for all cognitive items, which can range from 5 (requiring total assistance) to 35 (complete independence; Turner-Stokes, Nyein, Turner-Stokes, & Gatehouse, 1999).

In order to assess the risk of falls, the MFS was used, because it is designed to predict the physiological falls of hospitalized patients (Morse, Morse, & Tylko, 2010). The instrument consists of the following six variables: history of falling, presence of a secondary diagnosis, use of ambulatory aids (such as a cane, wheelchair, or walking frame), administration of intravenous therapy, types of gait, and mental status. The total score ranged from 0 to 125. Higher scores indicate greater chances of falling. Scores from 0 to 24 indicate no risk, scores from 25 to 50 indicate low risk, and scores higher than 50 indicate high risk of falling (Morse et al., 2010).

In order to assess the risk of pressure ulcer development, the Braden Scale was used because the major pressure ulcer risk in these patients is immobility (Baumgarten et al., 2012). Older adult patients undergoing THA constitute a high-risk population given their potential for long periods of immobility and the presence of other pressure ulcer risk factors (e.g., friction and shear). However, characteristics of the care provided to these patients may also contribute to higher ulcer risk. The Braden Scale total score ranges from 6 to 23 and is composed of six factor subscales: Sensory Perception, Moisture, Activity, Mobility, Nutrition, and Friction/Shear Forces. According to national guidelines, patients who have a Braden Scale score of ≤16 have an increased risk of developing pressure ulcers, and patients who have a Braden Scale score of >16 have a minimal risk of developing pressure ulcers.

Ethical Considerations

The hospital's ethics committee gave full ethical approval, and the study was registered with the hospital's research office, thus fulfilling local research governance requirements (Process No. 040954). All participants gave informed written consent before inclusion into the study. They were assured that there was no obligation to take part and that their care would not be affected if they declined to participate. All data were confidential and kept securely in locked filing cabinets and password-protected computers.

Data Analysis

The data were analyzed using the Statistical Package for Social Science (SPSS) 21.0 for Windows, and the level of significance used was .05. Summary statistics are reported as mean and standard deviation values for continuous variables or as counts and percentages for categorical variables. Considering the body composition variables as dependent variables (BMI, fat mass, skeletal muscle mass, lower limb with OA weight, and lower limb without OA weight), differences among levels of sociodemographic and clinical characteristics (listed in Tables 2 and 3) were assessed using an independent *t* test or analysis of variance (ANOVA) if the assumptions of normality and/or homogeneity of variance were verified. If these assumptions could not be met or the presence of small sample sizes, the corresponding nonparametric test was used (Mann–Whitney test). Multivariate Cox's regression, hazard ratios (HRs) adjusted for gender (Rolland et al., 2004) and age (Arinzon et al., 2005), and their corresponding 95% confidence intervals were used to measure the effect of selected outcome time variables (LOS and time period between surgery and beginning of rehabilitation program) in the binary variable "patient discharge" (yes/no). Spearman's rank correlation coefficient was used to measure the correlation between the LOS and time period between surgery and beginning of the rehabilitation program.

Results

Participants' Sociodemographic and Clinical Characteristics

Table 2 presents the sociodemographic characteristics of patients included in the study. From the total group of 40 patients, 58% were male and 42% female, with a group mean age of 67 ± 9 years, the majority being under 75 years old (75%). A high proportion (79%) was classified as being overweight. Regarding body composition, the mean value of fat mass was 37%, the mean value of fat-free mass was 63%, and the mean value of skeletal muscle mass was 22.3%.

Table 3 shows the clinical characteristics of patients included in the study at admission. All vital signs, except for pain and systolic blood pressure, were within the

Table 2 Sociodemographic characteristics of patients included in the study (*N* = 40)

Variables	*n* (%)
Gender	
Male	23 (57.5)
Female	17 (42.5)
Age (years, *M* ± *SD*)	67.4 ± 9.0
≤65	16 (40.0)
66–74	14 (35.0)
≥75	10 (25.0)
Education level	
Low (≤4 years)	33 (82.5)
Moderate (5–12 years)	5 (12.5)
High (>12 years)	2 (5.0)
Marital status	
Married/civil union	28 (70.0)
Widowed/divorced	12 (30.0)
Number of household members	
Lives alone	6 (15.0)
Lives with the family	34 (85.0)
Residence area	
Rural	30 (75.0)
Urban	10 (25.0)
BMI (kg/m^2, *M* ± *SD*, *n* = 39)	28.8 ± 4.6
Underweight (<18.5)	1 (2.6)
Normal (18.5–24.9)	7 (17.9)
Overweight (≥25.0)	31 (79.5)
Waist circumference (cm, *M* ± *SD*)	102.7 ± 13.4
Body composition (*M* ± *SD*)	
Fat mass (%, *n* = 35)	37.0 ± 10.7
Fat-free mass (%, *n* = 35)	63.0 ± 10.7
Skeletal muscle mass (kg, *n* = 31)	22.3 ± 6.3
Lower limb with osteoarthritis weight (kg, *n* = 31)	7.3 ± 1.9
Lower limb without osteoarthritis weight (kg, *n* = 31)	7.5 ± 1.9

normal range: heart rate (72.2 ± 12.1 bmp), respiratory rate (17.4 ± 1.6 cpm), systolic blood pressure (140.5 ± 20.2 mm Hg), diastolic blood pressure (75.9 ± 10.1 mm Hg), tympanic body temperature (36.5 ± 0.4 °C). Generally, patients had 2.18 ± 1.47 comorbidities diagnosed, the most common being hypertension (as evidenced by the blood pressure values), Type 2 diabetes mellitus, dyslipidemia, and hypercholesterolemia affecting 67.5% (*n* = 27), 30.0% (*n* = 12), 25.0% (*n* = 10), and 20% (*n* = 8) of the studied patients, respectively. With respect to fasting blood glucose levels, 60.0% (*n* = 24) of the studied patients had higher ranges, which relates to the prevalence of Type 2 diabetes mellitus in the study group, and 30% (*n* = 12) of the patients had undergone hip surgery previously. Clinical laboratory data results showed that most of the patients were within normal range, with the exception of hemoglobin. Low hemoglobin levels were present in 22.7% (*n* = 5) of male patients (<13.5 g/dl) and 25.0% (*n* = 4) of female patients (<12.0 g/dl). The assessment results for the GDS, MMSE, Braden Scale, MFS, motor and cognitive FIM scores are presented in Table 3.

Comparison of Body Composition and Rehabilitation Variables With Sociodemographic and Clinical Characteristics

With regard to body composition variables, group differences between the levels of the sociodemographic and clinical characteristics (Table 4) were nonsignificant with the exception of gender and number of household members.

For gender, female patients had a significantly higher fat mass than male patients, whereas male patients had significantly higher skeletal muscle mass, fat-free mass, lower limb with OA weight, and lower limb without OA weight. In the case of the number of household members variable, significant differences between patients that lived alone and those who lived with their families were found for the following variables: fat mass and lower limb with OA, respectively.

Predictions for the LOS and the Time Between the Surgery and Beginning of Rehabilitation Program

Patients were hospitalized (*n* = 37) for a mean of 191.0 hours (±63.9), started the rehabilitation program (*n* = 36) at a mean of 80.3 hours (±31.5) postsurgery, and were uncorrelated (*r* = .022). The sample size reduction is related

Table 3 Clinical characteristics of patients included in the study at admission (*n* = 40)

Clinical Characteristics	*n* (%)
Pain (*M* ± *SD*)	3.8 ± 2.2
Intensity	
No pain	4 (10.0)
Mild pain (1–2)	9 (22.5)
Moderate pain(3–7)	26 (65.0)
Severe pain (8–10)	1 (2.5)
Location (*n* = 36)	
Hip with osteoarthritis	35 (97.2)
Other place	1 (2.8)
Frequency (*n* = 36)	
Continuous	12 (33.3)
Discontinuous	24 (66.7)
Scales scores	
Geriatric Depression Scale (*M* ± *SD*)	8.8 ± 6.3
Absence of depression (<11)	27 (67.5)
Presence of depression (≥11)	13 (32.5)
Mini-Mental State Examination (*M* ± *SD*)	26.1 ± 2.9
Normal cognition	34 (85.0)
Cognitive impairment	6 (15.0)
Braden Scale (*M* ± *SD*)	18.9 ± 1.8
With risk (≤16)	3 (7.5)
With no risk (>16)	37 (92.5)
Morse Fall Scale (*M* ± *SD*)	43.1 ± 16.8
Mild risk (<24)	4 (10.0)
Moderate risk (25–50)	27 (67.5)
High risk (>50)	9 (22.5)
Functional Independence Measure	
Motor score (*M* ± *SD*)	83.4 ± 8.7
Cognitive score (*M* ± *SD*)	34.3 ± 2.0

Table 4 Comparison between body composition and relevant sociodemographic and clinical characteristics

	Body Mass Index (kg/m²)	Fat mass (%)	Skeletal muscle mass (kg)	Lower limb with OA weight (kg)	Lower limb without OA weight (kg)
Gender					
Male	29.1 ± 4.5	29.3 ± 6.5***	27.0 ± 4.7***	8.6 ± 1.5***	8.8 ± 1.6***
Female	28.5 ± 4.2	45.0 ± 8.0***	17.3 ± 2.8***	5.8 ± 1.1***	6.1 ± 0.9***
Statistical result	$t(37) = 0.6$	$t(33) = -6.4$	$t(29) = 6.9$	$t(29) = 5.8$	$t(29) = 5.5$
Age (years)					
≤65	29.6 ± 5.3	32.5 ± 10.0	25.6 ± 7.5	8.0 ± 2.3	8.4 ± 2.4
66-74	27.6 ± 4.5	38.8 ± 10.7	19.6 ± 4.7	6.5 ± 1.6	6.7 ± 1.2
≥75	29.3 ± 3.5	41.0 ± 10.4	21.3 ± 3.9	7.3 ± 1.4	7.3 ± 1.3
Statistical result	$F(2, 36) = 0.8$	$F(2, 32) = 2.0$	$F(2, 28) = 3.8$	$F(2, 28) = 2.1$	$F(2, 28) = 2.9$
Number of household members					
Lives alone	28.9 ± 2.8	45.8 ± 3.9*	16.8 ± 3.7	5.5 ± 1.0*	5.9 ± 1.3
Lives with the family	28.8 ± 4.9	35.8 ± 10.8*	23.1 ± 6.2	7.5 ± 1.9*	7.8 ± 1.9
Statistical result	$U = 81.0$	$U = 22.0$	$U = 21.0$	$U = 20.5$	$U = 23.0$
Residence area					
Rural	28.9 ± 4.8	36.8 ± 11.3	22.8 ± 6.0	7.4 ± 1.9	7.6 ± 1.8
Urban	28.7 ± 4.2	37.9 ± 8.5	20.2 ± 7.4	6.7 ± 2.3	7.0 ± 2.3
Statistical result	$t(37) = 0.1$	$t(33) = -0.2$	$t(29) = 0.9$	$t(29) = 0.7$	$t(29) = 0.7$
Pain frequency					
Continuous	28.8 ± 3.1	33.2 ± 7.8	24.7 ± 5.8	7.8 ± 1.8	8.3 ± 1.8
Discontinuous	29.3 ± 5.3	37.8 ± 12.1	21.7 ± 5.9	7.2 ± 1.9	7.3 ± 1.7
Statistical result	$t(37) = -0.2$	$t(29) = -1.3$	$t(29) = 1.3$	$t(25) = 0.8$	$t(25) = 1.4$
GDS					
Absence	28.9 ± 4.8	34.4 ± 8.9	23.1 ± 5.9	7.5 ± 1.8	7.7 ± 1.8
Presence	28.7 ± 4.5	41.3 ± 12.4	20.9 ± 7.0	6.8 ± 2.1	7.2 ± 2.0
Statistical result	$t(37) = 0.2$	$t(33) = -1.9$	$t(29) = 0.9$	$t(29) = 1.1$	$t(29) = 0.7$
MMSE					
Normal	28.7 ± 4.8	36.5 ± 11.3	22.1 ± 6.5	7.2 ± 1.9	7.4 ± 1.9
Impairment	29.8 ± 4.0	39.2 ± 7.9	23.7 ± 5.4	7.6 ± 1.7	8.0 ± 1.7
Statistical result	$U = 85.5$	$U = 66.0$	$U = 86.0$	$U = 56.5$	$U = 50.5$
Braden Scale[a]					
With Risk	30.0 ± 5.6	36.4 ± 10.8	19.6 ± 0.6	6.2 ± 0.0	6.6 ± 0.3
With no risk	28.7 ± 4.6	43.0 ± 8.8	22.5 ± 6.4	7.3 ± 1.9	7.6 ± 1.9
MFS					
Mild risk	31.0 ± 1.7	38.3 ± 6.8	26.5 ± 4.8	8.9 ± 0.9	8.9 ± 1.3
Moderate risk	29.0 ± 5.0	37.9 ± 11.9	21.5 ± 6.6	7.0 ± 2.0	7.3 ± 2.0
High risk	27.4 ± 4.1	34.2 ± 8.5	22.6 ± 5.9	7.4 ± 1.8	7.5 ± 1.8
Statistical result	$F(2, 36) = 0.9$	$F(2, 32) = 0.4$	$F(2, 28) = 0.8$	$F(2, 28) = 1.4$	$F(2, 28) = 1.1$

All values are presented in *M* ± *SD*. $t(df)$ = *t* test with degrees of freedom; *U* = Mann–Whitney test; $F(df1, df2)$ = ANOVA with degrees of freedom; OA = osteoarthritis; GDS = Geriatric Depression Scale; MMSE = Mini-Mental State Examination; MFS = Morse Fall Scale.
[a]No statistical results are presented due to small sample size of "with-risk" group ($n = 3$).
*p<0.05. **p<0.01. ***p<0.001.

to the closure of the study. At the end, three to four patients were still involved at different recovery stages, and therefore, no data were available for these two variables. Table 5 presents the model predictions for the LOS and the time period between surgery and the beginning of the rehabilitation program, respectively, adjusted for gender and age.

The LOS endpoint was only predicted by lower limb without OA weight (HR = 1.42, 95% CI [1.02, 1.97], $p < .05$). Also, overweighed patients (HR = 2.15, 95% CI [0.88, 5.24], $p < .1$) and pain intensity (HR = 1.16, 95% CI [0.99, 1.35], $p < .1$) were related to LOS. The other variables evaluated were not statistically significant.

For the time period between surgery and commencement of the rehabilitation program, only the MFS was significant (HR = 1.03, 95% CI [1.01, 1.05], $p < .05$), showing an increased risk of 3% for each additional unit in the MFS scale. Pain intensity (HR = 1.16; 95% CI [0.99, 1.40], $p < .1$) was also related to this endpoint, and the other variables evaluated were not statistically significant.

Discussion

The demographic shift toward an increasingly older population, coupled with a predicted increase in patients requiring THA for OA, will increase demands for access

Table 5 Multivariate Cox's regression models[a] for length of stay and for time between surgery and beginning of the rehabilitation

	Length of stay (n = 37)		Time period between surgery and beginning of rehabilitation program (n = 36)	
	HR	95% CI	HR	95% CI
BMI (kg/m^2)				
Normal (18.5–24.9)	1	-	1	-
Overweight (≥25)	2.15	[0.88, 5.24]	1.28	[0.44, 3.70]
Body composition				
Fat mass (%)	0.99	[0.94, 1.05]	1.02	[0.96, 1.08]
Fat-free mass (%)	1.01	[0.95, 1.06]	0.98	[0.92, 1.05]
Skeletal muscle mass (kg)	1.09	[0.98, 1.21]	1.06	[0.95, 1.18]
Lower limb with osteoarthritis weight (kg)	1.21	[0.87, 1.68]	1.08	[0.77, 1.51]
Lower limb without osteoarthritis weight (kg)	1.42	[1.02, 1.97]	1.30	[0.94, 1.81]
Pain intensity	1.16	[0.99, 1.35]	1.16	[0.99, 1.40]
Pain frequency				
Continuous	1.73	[0.73, 4.12]	2.01	[0.79, 5.15]
Discontinuous	1	-	1	-
No. of comorbidities	0.93	[0.74, 1.16]	1.13	[0.91, 1.40]
Previous hip surgery				
Yes	1.19	[0.57, 2.47]	0.83	[0.39, 1.73]
No	1	-	1	-
GDS	0.96	[0.90, 1.03]	1.04	[0.98, 1.11]
MMSE	1.01	[0.89, 1.15]	1.04	[0.90, 1.20]
Braden Scale	0.95	[0.76, 1.17]	0.90	[0.72, 1.12]
MFS	0.99	[0.97, 1.01]	1.03	[1.01, 1.05]
FIM				
Motor score	1.01	[0.96, 1.05]	0.98	[0.94, 1.02]
Cognitive score	1.02	[0.84, 1.24]	0.96	[0.80, 1.14]

Note. HR = hazard ratio; CI = confidence interval.
[a]Covariates: gender and age.

to effective inpatient rehabilitation (Sadr Azodi et al., 2006; Sonoda et al., 2016). Thus, identification of factors that might be used to predict readiness for rehabilitation, likelihood of rehabilitation success, and LOS would be useful to guide effective resource allocation and competing demands. On one hand, a too-long rehabilitation process might be associated with increased risk for infections and excessive costs (Justo et al., 2011; Sonoda et al., 2016). On the other hand, a too-short rehabilitation might be associated with preventable disability, avoidable pain and poor outcome, and greater costs in the long run (Justo et al., 2011). Although several studies have been performed addressing these questions, it is believed that this study is the first to be conducted in Portugal, aiming to identify the presurgical predictors of rehabilitation commencement and LOS specific to inpatients following hip replacement.

Previous studies suggest that the length of rehabilitation and final outcome in older adult patients are associated with a large number of presurgical factors, such as number of comorbidities, marital status, advanced age, admission albumin levels, and cognitive function. Average LOS following THA has been found to be higher in patients over 65 years old (Graf, 2006), those with depression (Fredman et al., 2006), those with a high risk of falling (Yamada et al., 2010), and those with referred pain at admission (Hoogeboom et al., 2009). On the basis of the literature, it was expected that the results of this study would be similar. In terms of comorbidities hypertension, Type 2 diabetes mellitus, dyslipidemia, and hypercholesterolemia were the most common, as might be expected in a cohort of older adult patients (Patrick et al., 2001). However, unlike previous studies only lower limb without OA weight was significant ($p < .05$), whereas pain intensity and high BMI ($p < .1$) were associated with an increase in LOS. For the time period between surgery and beginning of the rehabilitation program, only MFS was significant ($p < .05$), although pain intensity was also related ($p < .1$).

Previous studies have shown that older patients have significant alterations in muscle composition, especially in skeletal muscle mass and adipose tissue accumulation (Caracciolo & Giaquinto, 2005; Cavill et al., 2016). This muscle atrophy and increase in adipose tissue accumulation with aging (sarcopenia) is linked to the fact that older patients often have a longer overall LOS and delayed entry into rehabilitation than the younger ones following THA (Graf, 2006; Hoogeboom et al., 2009; Janssen, Heymsfield, & Ross, 2002). The maintenance of muscle volume, therefore, seems to be critical in maintaining the activities of daily living in the elderly. Several previous studies have indicated that muscle volume is a strong independent predictor of physical disability or mortality (Bonnefoy, Jauffret, & Jusot, 2007; Janssen, 2006; Volpato et al., 2004). Other studies have found significant decreases in muscle density with aging, estimated by computed tomography, related to lower extremity function (Sipilä et al., 2004; Visser et al., 2002). According to Janssen et al. (2002), sarcopenia can influence the LOS of patients on a rehabilitation unit. The loss of muscle mass can be caused by advanced age, as well as muscle disuse, because of certain diseases, including OA (Caracciolo & Giaquinto, 2005). In addition to muscle atrophy, alterations in muscle composition—such as increased adipose tissue accumulation and water contained within the muscle—are related to a decrease in muscle strength and functional limitations (Hoogeboom et al., 2009; Namba, Paxton, Fithian, & Stone, 2005).

In our study, this expected result was not observed possibly due to the relative "young" age of patients in the cohort. However, we did find significant results for gender. Fat mass was significantly higher in female than in male patients, and skeletal muscle mass in male patients was higher than in female patients. With respect to lower limb weight, we found that male patients had significantly higher values than female patients in both limbs (lower limb with OA and lower limb without OA). These results are in agreement with those suggested in the literature, where female patients have been shown to have higher values for adipose tissue accumulation and lower values for lower limb weight compared to male patients (Graf, 2006; Hoogeboom et al., 2009; Janssen et al., 2002). This suggests that male patients experience less sarcopenia than female patients, and therefore, this difference in body mass composition might influence LOS and rehabilitation outcome, although no difference was evident in this study. In general, previous studies (Rolland et al., 2004; Yeung et al., 2010) have also concluded that LOS is influenced by gender. In these studies, it was shown that there was a tendency for female patients to have a longer LOS when compared to male patients. Yeung et al. (2010) indicated that female patients stay in hospital 1–2 days longer than male patients following THA and suggest that reduced bed flow and higher rehabilitation costs might be expected in inpatient settings with more female patients.

Another significant result is related to the household variable. Our results show that fat mass and lower limb with OA weight were different in patients that lived alone from those who lived with their families. Participation in physical activity in older adults is influenced by a number of variables including demographic factors such as gender, education, and marital status (Park, Elavsky, & Koo, 2014). In addition, choices of older adults to be regularly physically active are influenced by social support from family members or friends, availability of facilities for exercise and/or recreational activities, personal determinants especially one's motivation, self-efficacy, and self-regulation skills (Park et al., 2014). On the basis of these factors, it is not surprising that this study shows that those who lived with family had a body mass composition suggesting better nutrition and a more active lifestyle than those living alone.

According to previous studies, it was expected that the preoperative functional status of the patient would be a significant predictor of rehabilitation outcome (Cavill et al., 2016; Kennedy et al., 2006; Mitchell et al., 2007; Moncada et al., 2006). Various studies indicated that the period between surgery and the beginning of rehabilitation was higher for patients older than 75 years old, who lived alone, and presented with pain at admission (Graf, 2006; Hoogeboom et al., 2009; Janssen et al., 2002; Min et al., 2016; Sadr Azodi et al., 2006). However, in our study, most variables related to dependence on mobility were not significant, except for the MFS scores and pain intensity.

According to Yeung et al. (2010), patients who scored low on the FIM on admission were more dependent in basic functional activities when compared to patients who had higher scores and may accordingly take longer to achieve safe and independent/supervised mobility needed to return home. In the same study, the authors conclude that the admission FIM score has been found to be associated with longer LOS in patients with hip fractures and stroke, but whether FIM can predict LOS has not been previously examined in people following joint replacement.

Limitations

This study had certain limitations. First, related to the total sample size and nonprobabilistic sampling methods used, which can limit the extrapolation of the results. Second, LOS is likely to be affected by many patient- and non-patient-related factors, but due to limitations of access to some data, we have studied only some factors. It is possible that other variables, such as surgical technique (anterior or posterior) or postsurgical variables, are also important determinants of rehabilitation outcome and LOS. Considering that many multidimensional factors can possibly affect LOS, the option of focusing on selected presurgical variables suggested by the literature

Key Practice Points

- OA is one of the most important causes of disability in older adults, affecting ability to perform daily activities, increasing the risk of depressive symptoms, and interfering with quality of life.
- Lengthy inpatient rehabilitation is associated with an increased risk of infection and excessive costs. Short inpatient rehabilitation may be associated with preventable disability, avoidable pain or discomfort, and greater costs in the long run.
- The implications for clinical practice of identifying the factors that can impact the rehabilitation program and LOS will allow better prediction of the discharge of the patients, will support resource allocation, and can contribute to the overall improvement in the health care of older adult patients requiring a THA.
- Nursing professionals should understand the factors that can influence the rehabilitation process, because they play a vital role in helping patients regain health, improve quality of life, and reduce the social costs incurred.

allowed a greater depth of analysis. Third, we did not control for the severity of OA, and a uniform measure of severity of disease, possibly from the surgeons' preoperative assessments, would have ideally been included in the patient characteristics. A final limitation of this study is that data were collected from only one inpatient setting, which limits the generalization of the results.

Further research is needed to examine if different intervention strategies (e.g., altering the intensity, frequency, and/or duration of functional training) in overweight patients will shorten the LOS of inpatients following THA and to analyze if different geographic location influenced the studied factors.

Also, it seems important that further studies should be systematically conducted about different types of social support in influencing physical activity behaviors and which resources are important elements in promoting physical activity for older adults with OA, and a variety of types of social support can be created or enhanced via social network and policy interventions to promote physical activity for seniors.

Knowing the factors that can influence postoperative recovery may facilitate faster functional recovery, but multicenter and well-designed prospective randomized studies with larger numbers of patients and with outcome measures are necessary to confirm its efficacy. Literature supports the influence of these factors on postoperative recovery; however, we need larger, well-designed prospective studies with outcome measures and cost–benefit analysis to include this in the rehabilitation protocol.

Conclusion

The purpose of this study was to bring attention to factors that may prolong hospitalization and delay the start of a rehabilitation program (and therefore influence patient recovery) following THA. The predictors found in this pilot study can facilitate our understanding of the potential LOS and rehabilitation outcomes of inpatients. The results showed that hypertension, Type 2 diabetes mellitus, dyslipidemia, and hypercholesterolemia were the most common diagnosed comorbidities in the study group. LOS was mainly influenced by the lower limb without OA, followed by pain intensity and overweight patients. The time period between surgery and the beginning of the rehabilitation program was influenced primarily by MFS scores and secondarily by pain intensity. Significant differences in body mass composition were evident between male and female patients and between those patients living with family and those living alone. This suggests that gender and social support may be important determinants in LOS and rehabilitation outcome following THA. The implications for clinical practice of identifying the factors that can impact on the rehabilitation program and LOS will allow better prediction of the discharge of the patients, will support resource allocation, and can contribute to the overall improvement in the health care of older adult patients requiring a THA.

We suggest that the importance of the standard patient-centered rehabilitation model of care should be stressed to resurfacing patients following surgery so that they can achieve maximal functional improvement and a healthier lifestyle.

Acknowledgments

We would like to thank all of the subjects who participated in the study and Centro Hospitalar do Baixo Vouga, E.P.E.

Pedro Sa-Couto's work was supported by Portuguese funds through the CIDMA–Center for Research and Development in Mathematics and Applications and the Portuguese Foundation for Science and Technology ("FCT–Fundação para a Ciência e a Tecnologia"), within project UID/MAT/04106/2013.

The authors declare no conflict of interest.

References

Adunsky, A., Fleissig, Y., Levenkrohn, S., Arad, M., & Noy, S. (2002). A comparative study of Mini-Mental Test, Clock Drawing task and Cognitive-FIM in evaluating functional outcome of elderly hip fracture patients. *Clinical Rehabilitation*, *16*(4), 414–419. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12061476

Altman, R. D., Hochberg, M. C., Moskowitz, R. W., & Schnitzer, T. J. (2000). Recommendations for the medical management of osteoarthritis of the hip and knee: 2000 update. American College of Rheumatology Subcommittee on Osteoarthritis Guidelines. *Arthritis and Rheumatism*, *43*(9), 1905–1915. doi:10.1002/1529-0131(200009)43:9<1905::AID-ANR1>3.0.CO;2-P

Arinzon, Z., Fidelman, Z., Zuta, A., Peisakh, A., & Berner, Y. N. (2005). Functional recovery after hip fracture in old-old elderly patients. *Archives of Gerontology and Geriatrics*, *40*(3), 327–336. doi:10.1016/j.archger.2004.10.003

Barrera-Cadenas, J. L., & Hernández-Vaquero, D. (2011). Influence of preoperative variables on total hip arthroplasty results. *Revista Española de Cirugía Ortopédica Y Traumatología (English Edition)*, *55*(2), 91–97. doi:10.1016/S1988-8856(11)70288-7

Baumgarten, M., Rich, S. E., Shardell, M. D., Hawkes, W. G., Margolis, D. J., Langenberg, P., … Magaziner, J. (2012). Care-related risk factors for hospital-acquired pressure ulcers in elderly adults with hip fracture. *Journal of the American Geriatrics Society*, *60*(2), 277–283. doi:10.1111/j.1532-5415.2011.03849.x

Beaupre, L. A., Cinats, J. G., Senthilselvan, A., Scharfenberger, A., Johnston, D. W., & Saunders, L. D. (2005). Does standardized rehabilitation and discharge planning improve functional recovery in elderly patients with hip fracture? *Archives of Physical Medicine and Rehabilitation*, *86*(12), 2231–2239. doi:10.1016/j.apmr.2005.06.019

Bitsch, M. S., Foss, N. B., Kristensen, B. B., & Kehlet, H. (2006). Acute cognitive dysfunction after hip fracture: frequency and risk factors in an optimized, multimodal, rehabilitation program. *Acta Anaesthesiologica Scandinavica*, *50*(4), 428–436. doi:10.1111/j.1399-6576.2005.00899.x

Bonnefoy, M., Jauffret, M., & Jusot, J. F. (2007). Muscle power of lower extremities in relation to functional ability and nutritional status in very elderly people. *The Journal of Nutrition, Health & Aging*, *11*(3), 223–228.

Botha-Scheepers, S., Riyazi, N., Kroon, H. M., Scharloo, M., Houwing-Duistermaat, J. J., Slagboom, E., … Kloppenburg, M. (2006). Activity limitations in the lower extremities in patients with osteoarthritis: the modifying effects of illness perceptions and mental health. *Osteoarthritis and Cartilage/OARS, Osteoarthritis Research Society*, *14*(11), 1104–1110. doi:10.1016/j.joca.2006.04.011

Caracciolo, B., & Giaquinto, S. (2005). Determinants of the subjective functional outcome of total joint arthroplasty. *Archives of Gerontology and Geriatrics*, *41*(2), 169–176. doi:10.1016/j.archger.2005.01.005

Cavill, S., McKenzie, K., Munro, A., McKeever, J., Whelan, L., Biggs, L., … Haines, T. P. (2016). The effect of prehabilitation on the range of motion and functional outcomes in patients following the total knee or hip arthroplasty: A pilot randomized trial. *Physiotherapy Theory and Practice*, *32*(4), 262–270. doi:10.3109/09593985.2016.1138174

Coulter, C. L., Scarvell, J. M., Neeman, T. M., & Smith, P. N. (2013). Physiotherapist-directed rehabilitation exercises in the outpatient or home setting improve strength, gait speed and cadence after elective total hip replacement: A systematic review. *Journal of Physiotherapy*, *59*(4), 219–226. doi:10.1016/S1836-9553(13)70198-X

Crawford, R. W., & Murray, D. W. (1997). Total hip replacement: indications for surgery and risk factors for failure. *Annals of the Rheumatic Diseases*, *56*(8), 455–457. doi:10.1136/ard.56.8.455

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-mental state." A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, *12*(3), 189–198. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/1202204

Foote, J., Panchoo, K., Blair, P., & Bannister, G. (2009). Length of stay following primary total hip replacement. *Annals of the Royal College of Surgeons of England*, *91*(6), 500–504. doi:10.1308/003588409X432356

Fortin, P. R., Clarke, A. E., Joseph, L., Liang, M. H., Tanzer, M., Ferland, D., … Katz, J. N. (1999). Outcomes of total hip and knee replacement: preoperative functional status predicts outcomes at six months after surgery. *Arthritis and Rheumatism*, *42*(8), 1722–1728. doi:10.1002/1529-0131(199908)42:8<1722::AID-ANR22>3.0.CO;2-R

Fredman, L., Hawkes, W. G., Black, S., Bertrand, R. M., & Magaziner, J. (2006). Elderly patients with hip fracture with positive affect have better functional recovery over 2 years. *Journal of the American Geriatrics Society*, *54*(7), 1074–1081. doi:10.1111/j.1532-5415.2006.00786.x

Graf, C. (2006). Functional decline in hospitalized older adults. *The American Journal of Nursing*, *106*(1), 58–67. quiz 67–68. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/16481783

Gross, A., & Muir, J. M. (2016). Identifying the procedural gap and improved methods for maintaining accuracy during total hip arthroplasty. *Medical Hypotheses*, *94*, 93–98. doi:10.1016/j.mehy.2016.07.004

Haentjens, P., Autier, P., Barette, M., & Boonen, S. (2005). Predictors of functional outcome following intracapsular hip fracture in elderly women. A one-year prospective cohort study. *Injury*, *36*(7), 842–850. doi:10.1016/j.injury.2005.02.002

Hamilton, B. B., Granger, C. V., Sherwin, F. S., Zielezny, M., & Tashman, J. S. (1987). A uniform national data system for medical rehabilitation. *Rehabilitation Outcomes: Analysis and Measurement*, 137–147. Retrieved from http://www.mendeley.com/research/uniform-national-data-system-medical-rehabilitation-3/?utm_source=desktop&utm_medium=1.13.3&utm_campaign=open_catalog&userDocumentId=%7B4df1b3f6-e664-4237-8e79-c739b141ced9%7D

Harada, N. D., Chun, A., Chiu, V., & Pakalniskis, A. (2000). Patterns of rehabilitation utilization after hip fracture in acute hospitals and skilled nursing facilities. *Medical Care*, *38*(11), 1119–1130.

Hickie, C., Snowdon, J. (1987). Depression scales for the elderly: GDS, Gilleard. Zung. *Clinical Gerontologist*, 51–53. Retrieved from http://www.researchgate.net/publication/232424786_Depression_scales_for_the_elderly_GDS_Gilleard_Zung

Hoogeboom, T. J., van den Ende, C. H., van der Sluis, G., Elings, J., Dronkers, J. J., Aiken, A. B., & van Meeteren, N. L. (2009). The impact of waiting for total joint replacement on pain and functional status: a systematic review. *Osteoarthritis and Cartilage/OARS, Osteoarthritis Research Society*, *17*(11), 1420–1427. doi:10.1016/j.joca.2009.05.008

Janssen, I. (2006). Influence of sarcopenia on the development of physical disability: the Cardiovascular Health Study. *Journal of the American Geriatrics Society*, *54*(1), 56–62. doi:10.1111/j.1532-5415.2005.00540.x

Janssen, I., Heymsfield, S. B., & Ross, R. (2002). Low relative skeletal muscle mass (sarcopenia) in older persons is associated with functional impairment and physical disability. *Journal of the American Geriatrics Society*, *50*(5), 889–896. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12028177

Justo, D., Vislapu, N., Shvedov, V., Fickte, M., Danylesko, A., Kimelman, P., … Lerman, Y. (2011). Admission Norton Scale scores (ANSS) correlate with rehabilitation outcome and length in elderly patients following hip arthroplasty. *Archives of Gerontology and Geriatrics*, *53*(1), e33–e36. doi:10.1016/j.archger.2010.10.008

Keisu, K. S., Orozco, F., Sharkey, P. F., Hozack, W. J., Rothman, R. H., & McGuigan, F. X. (2001). Primary cementless total hip arthroplasty in octogenarians. Two to eleven-year follow-up. *The Journal of Bone and Joint Surgery. American Volume*, *83-A*(3), 359–363.

Kennedy, D. M., Hanna, S. E., Stratford, P. W., Wessel, J., & Gollish, J. D. (2006). Preoperative function and gender predict pattern of functional recovery after hip and knee arthroplasty.

The Journal of Arthroplasty, *21*(4), 559–566. doi:10.1016/j.arth.2005.07.010.

Keswani, A., Weiser, M. C., Shin, J., Lovy, A. J., & Moucha, C. S. (2016). Discharge destination after revision total joint arthroplasty: An analysis of postdischarge outcomes and placement risk factors. *The Journal of Arthroplasty*, *31*(9), 1866–1872.e1. doi:10. 1016/j.arth.2016.02.053

Lieberman, D., Friger, M., & Lieberman, D. (2006). Inpatient rehabilitation outcome after hip fracture surgery in elderly patients: a prospective cohort study of 946 patients. *Archives of Physical Medicine and Rehabilitation*, *87*(2), 167–171. doi:10.1016/j.apmr.2005.10.002

Lin, J. J., & Kaplan, R. J. (2004). Multivariate analysis of the factors affecting duration of acute inpatient rehabilitation after hip and knee arthroplasty. *American Journal of Physical Medicine & Rehabilitation/Association of Academic Physiatrists*, *83*(5), 344–352. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/15100623

Lindholm, C., Sterner, E., Romanelli, M., Pina, E., Torra y Bou, J., Hietanen, H., … Dealey, C. (2008). Hip fracture and pressure ulcers—the Pan-European Pressure Ulcer Study—intrinsic and extrinsic risk factors. *International Wound Journal*, *5*(2), 315–328. doi:10.1111/j.1742-481X.2008.00452.x

Lopez, M. N., Charter, R. A., Mostafavi, B., Nibut, L. P., & Smith, W. E. (2005). Psychometric properties of the Folstein Mini-Mental State Examination. *Assessment*, *12*(2), 137–144. doi:10. 1177/1073191105275412

Macfarlane, A. J., Prasad, G. A., Chan, V. W., & Brull, R. (2009). Does regional anaesthesia improve outcome after total hip arthroplasty? A systematic review. *British Journal of Anaesthesia*, *103*(3), 335–345. doi:10.1093/bja/aep208

McGilton, K. S., Mahomed, N., Davis, A. M., Flannery, J., & Calabrese, S. (2009). Outcomes for older adults in an inpatient rehabilitation facility following hip fracture (HF) surgery. *Archives of Gerontology and Geriatrics*, *49*(1), e23–e31. doi:10. 1016/j.archger.2008.07.012

Min, B. W., Kim, Y., Cho, H. M., Park, K. S., Yoon, P. W., Nho, J. H., … Moon, K. H. (2016). Perioperative pain management in total hip arthroplasty: Korean Hip Society guidelines. *Hip & Pelvis*, *28*(1), 15–23. doi:10.5371/hp.2016.28.1.15

Mitchell, S., McCaskie, A., Francis, R., Peaston, R., Birrell, F., & Lingard, E. (2007). The need for a falls prevention programme for patients undergoing hip and knee replacement surgery. *Journal of Orthopaedic Nursing*, *11*(2), 98–103. doi:10.1016/j.joon.2007.02.011

Mizrahi, E. H., Fleissig, Y., Arad, M., Blumstein, T., & Adunsky, A. (2007). Admission albumin levels and functional outcome of elderly hip fracture patients: Is it that important? *Aging Clinical and Experimental Research*, *19*(4), 284–289. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/17726358

Moncada, L. V., Andersen, R. E., Franckowiak, S. C., & Christmas, C. (2006). The impact of cognitive impairment on short-term outcomes of hip fracture patients. *Archives of Gerontology and Geriatrics*, *43*(1), 45–52. doi:10.1016/j.archger.2005.09.003

Morse, J. M., Morse, R. M., & Tylko, S. J. (2010). Development of a scale to identify the fall-prone patient. *Canadian Journal on Aging/La Revue Canadienne Du Vieillissement*, *8*(4), 366–377. doi:10.1017/S0714980800008576

Namba, R. S., Paxton, L., Fithian, D. C., & Stone, M. L. (2005). Obesity and perioperative morbidity in total hip and total knee arthroplasty patients. *The Journal of Arthroplasty*, *20*(7 Suppl. 3), 46–50. doi:10.1016/j.arth.2005.04.023

Nilsdotter, A. K., & Lohmander, L. S. (2002). Age and waiting time as predictors of outcome after total hip replacement for osteoarthritis. *Rheumatology*, *41*(11), 1261–1267. doi:10.1093/rheumatology/41.11.1261

Palan, J., Beard, D. J., Murray, D. W., Andrew, J. G., & Nolan, J. (2009). Which approach for total hip arthroplasty: anterolateral or posterior? *Clinical Orthopaedics and Related Research*, *467*(2), 473–477. doi:10.1007/s11999-008-0560-5

Park, C.-H., Elavsky, S., & Koo, K.-M. (2014). Factors influencing physical activity in older adults. *Journal of Exercise Rehabilitation*, *10*(1), 45–52. doi:10.12965/jer.140089

Patrick, L., Knoefel, F., Gaskowski, P., & Rexroth, D. (2001). Medical comorbidity and rehabilitation efficiency in geriatric inpatients. *Journal of the American Geriatrics Society*, *49*(11), 1471–1477. doi:10.1046/j.1532-5415.2001.4911239.x

Peres, W. A., Lento, D. F., Baluz, K., & Ramalho, A. (2012). Phase angle as a nutritional evaluation tool in all stages of chronic liver disease. *Nutrición Hospitalaria*, *27*(6), 2072–2078. doi:10.3305/nh.2012.27.6.6015

Phruetthiphat, O. A., Gao, Y., Anthony, C. A., Pugely, A. J., Warth, L. C., & Callaghan, J. J. (2016). Incidence of and preoperative risk factors for surgical delay in primary total hip arthroplasty: Analysis from the American College of Surgeons National Surgical Quality Improvement Program. *The Journal of Arthroplasty*, *31*(11), 2432–2436. doi:10.1016/j.arth.2016.05.054

Putman, K., Munin, M., Hsieh, C.-H., Horn, S., DeJong, G., Smout, R., & Tian, W. (2010). Poster 115: Analysis of rehabilitation activities within skilled nursing and inpatient rehabilitation facilities following hip replacement for acute hip fracture. *Archives of Physical Medicine and Rehabilitation*, *91*(10), e39–e40. doi:10.1016/j.apmr.2010.07.144

Rolland, Y., Pillard, F., Lauwers-Cances, V., Busquère, F., Vellas, B., & Lafont, C. (2004). Rehabilitation outcome of elderly patients with hip fracture and cognitive impairment. *Disability and Rehabilitation*, *26*(7), 425–431. doi:10.1080/09638280410001663148

Sadr Azodi, O., Bellocco, R., Eriksson, K., & Adami, J. (2006). The impact of tobacco use and body mass index on the length of stay in hospital and the risk of post-operative complications among patients undergoing total hip replacement. *The Journal of Bone and Joint Surgery. British Volume*, *88*(10), 1316–1320. doi:10.1302/0301-620X.88B10.17957

Saleh, K. J., Kassim, R., Yoon, P., & Vorlicky, L. N. (2002). Complications of total hip arthroplasty. *American Journal of Orthopedics (Belle Mead, N.J.)*, *31*(8), 485–488.

Sandy, B., & Ganz, M. (2004). A historic look at functional outcome following total hip and knee art. *Topics in Geriatric Rehabilitation*, *20*(4), 236–252. Retrieved from http://www.nursingcenter.com/lnc/JournalArticle?Article_ID=531257

Shabat, S., Mann, G., Nyska, M., & Maffulli, N. (2005). Scoring systems to evaluate elderly patients with hip fractures. *Disability and Rehabilitation*, *27*(18–19), 1041–1044. doi:10.1080/09638280500056642

Sipilä, S., Koskinen, S. O. A., Taaffe, D. R., Takala, T. E. S., Cheng, S., Rantanen, T., … Suominen, H. (2004). Determinants of lower-body muscle power in early postmenopausal women. *Journal of the American Geriatrics Society*, *52*(6), 939–944. doi:10.1111/j.1532-5415.2004.52261.x

Smith, T. O., Jepson, P., Beswick, A., Sands, G., Drummond, A., Davis, E. T., & Sackley, C. M. (2016). Assistive devices, hip precautions, environmental modifications and training to prevent dislocation and improve function after hip arthroplasty. *The Cochrane Database of Systematic Reviews*, *7*, CD010815. doi:10.1002/14651858.CD010815.pub2

Sonoda, Y., Sawano, S., Kojima, Y., Kugo, M., Taniguchi, M., Maegawa, S., & Kawasaki, T. (2016). Comprehensive geriatric assessment of effects of hospitalization and long-term rehabilitation of patients following lower extremity arthroplasty. *Journal of Physical Therapy Science*, *28*(4), 1178–1187. doi:10.1589/jpts.28.1178

Turner-Stokes, L., Nyein, K., Turner-Stokes, T., & Gatehouse, C. (1999). The UK FIM+FAM: Development and evaluation.

Functional Assessment Measure. *Clinical Rehabilitation*, *13*(4), 277–287. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/10460115

Visser, M., Kritchevsky, S. B., Goodpaster, B. H., Newman, A. B., Nevitt, M., Stamm, E., & Harris, T. B. (2002). Leg muscle mass and composition in relation to lower extremity performance in men and women aged 70 to 79: The health, aging and body composition study. *Journal of the American Geriatrics Society*, *50*(5), 897–904.

Volpato, S., Romagnoni, F., Soattin, L., Blè, A., Leoci, V., Bollini, C., … Zuliani, G. (2004). Body mass index, body cell mass, and 4-year all-cause mortality risk in older nursing home residents. *Journal of the American Geriatrics Society*, *52*(6), 886–891. doi:10.1111/j.1532-5415.2004.52254.x

Williams, O., Fitzpatrick, R., Hajat, S., Reeves, B. C., Stimpson, A., Morris, R. W., … National Total Hip Replacement Outcome Study Steering Committee. (2002). Mortality, morbidity, and 1-year outcomes of primary elective total hip arthroplasty. *The Journal of Arthroplasty*, *17*(2), 165–171. doi:10.1054/arth.2002.29389

Yamada, Y., Schoeller, D. A., Nakamura, E., Morimoto, T., Kimura, M., & Oda, S. (2010). Extracellular water may mask actual muscle atrophy during aging. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*, *65*(5), 510–516. doi:10.1093/gerona/glq001

Yeh, M-L., Chen, H-H., & Liu, P-H. (2005). Effects of multimedia with printed nursing guide in education on self-efficacy and functional activity and hospitalization in patients with hip replacement. *Patient Education and Counseling*, *57*(2), 217–224. doi:10.1016/j.pec.2004.06.003

Yesavage, J. A., Brink, T. L., Rose, T. L., Lum, O., Huang, V., Adey, M., & Leirer, V. O. (1983). Development and validation of a geriatric depression screening scale: a preliminary report. *Journal of Psychiatric Research*, *17*(1), 37–49. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/7183759

Yeung, S. M., Davis, A. M., & Soric, R. (2010). Factors influencing inpatient rehabilitation length of stay following revision hip replacements: a retrospective study. *BMC Musculoskeletal Disorders*, *11*, 252. doi:10.1186/1471-2474-11-252

For 14 additional continuing education articles related to the topic of osteoarthritis, go to NursingCenter.com/CE.

Instructions:

- Read the article. The test for this CE activity can be taken online at www.NursingCenter.com/CE/RNJ. Tests can no longer be mailed or faxed.
- You will need to create a username and password and login to your personal CE Planner account before taking online tests. Your planner will keep track of all your Lippincott Professional Development online CE activities for you.
- There is only one correct answer for each question. A passing score for this test is 7 correct answers. If you pass, you can print your certificate of earned contact hours and access the answer key. If you fail, you have the option of taking the test again at no additional cost.
- For questions, contact Lippincott Professional Development: 1-800-787-8985.

Registration Deadline: June 4, 2021

Disclosure Statement:
The authors and planners have disclosed that they have no financial relationships related to this article.

Provider Accreditation:

Lippincott Professional Development will award 1.0 contact hour for this continuing nursing education activity.

Lippincott Professional Development is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

This activity is also provider approved by the California Board of Registered Nursing, Provider Number CEP 11749 for 1.0 contact hour. Lippincott Professional Development is also an approved provider of continuing nursing education by the District of Columbia, Georgia, and Florida, CE Broker #50-1223. Your certificate is valid in all states.

Payment:

- The registration fee for this test is FREE for members through September 30, 2019, and $10.00 after September 30, and $12.50 for nonmembers.
  1. ARN members can access the discount by logging into the secure "Members Only" area of http://www.rehabnurse.org.
  2. Select the Education tab on the navigation menu.
  3. Select Continuing Education.
  4. Select the Rehabilitation Nursing Journal article of your choice.
  5. You will appear at nursing.CEConnection.com.
  6. Log in using your Association of Rehabilitation Nursing username and password. The first time you log in, you will have to complete your user profile.
  7. Confirm the title of the CE activity you would like to purchase.
  8. Click start to view the article or select take test (if you have previously read the article.)
  9. After passing the posttest, select +Cart to add the CE activity to your cart.
  10. Select check out and pay for your CE activity. A copy of the receipt will be emailed.