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CLINICAL RESEARCH

The Impact of Prefracture and Hip Fracture Characteristics on Mortality in Older Persons in Brazil

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Abstract

Background Hip fractures in the elderly are common and associated with considerable mortality and disability. Although well known in industrialized countries, the factors associated with mortality after hip fractures are not reported frequently in developing countries and little is known regarding risk factors in Latin America.

Questions/Purpose We investigated the rate of 1-year mortality and prefracture and fracture characteristics associated with mortality after a hip fracture in elderly Brazilian patients in a large metropolitan area.

Methods Two hundred forty-six persons 60 years and older admitted to four hospitals in Rio de Janeiro were included after experiencing fractures and were followed for 1 year. Data were collected on sociodemographic, health, and functional status; type of surgery; length of stay; and complications after surgery. Cox regression analyses were conducted to investigate factors associated with 1-year mortality after hip fracture.

Results Of the 246 patients, 86 died (35%). Of those 86, 22 died in the hospital (25.6%) and 64 (74.4%) died after discharge. Functional status before fracture, older age, male gender, and higher surgical risk increased the risk of mortality, whereas the use of antibiotics and the use of physical therapy after surgery decreased the risk.

Conclusions Our mortality rate was higher than those reported from industrialized countries. The use of antibiotics and physical therapy are potentially modifiable factors to improve patients' survival after fracture in Brazil.

Level of Evidence Level II, prognostic study. See the Guidelines for Authors for a complete description of the levels of evidence.

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Each author certifies that his or her institution approved or waived approval for the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.
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Introduction

Hip fracture is one of the most feared consequences of osteoporosis. Hip fractures are associated with high postfracture disability, increased mortality, and high healthcare expenditures [8, 29]. It has been estimated the number of hip fractures will increase by 310% in men and 240% in women by 2025, owing to aging of the population

[30]. A large Danish study showed persons with a hip fracture had a hazard ratio of 3.84 of dying in the next year compared with age- and gender-matched control subjects [54]. One study estimated that in 1990 worldwide there were 1.31 million new hip fractures, which led to 736,000 deaths and 2.9 million disability adjusted life-years [29]. Between 1999 and 2002 in the United States, Medicare spent almost $3-billion (USD) per year for health care related to hip fractures [2], and another study showed the costs related to hip fracture were approximately $31,000 (USD) for health care up to 6 months after fracture [34].

Two retrospective chart studies examined mortality after hip fractures in elderly Brazilians. In the first (65 patients) study, the 1-year mortality rate was reported as 30% [15]. In the second study, 89 charts were reviewed and an in-hospital mortality of 14% but no 1-year mortality was reported [38]. In one small prospective study (56 patients), a mortality rate of 23% after 6 months was reported, but factors that predicted mortality were not evaluated [11].

The reasons for the increased mortality attributable to hip fracture have been investigated mostly in developed countries, but they are not reported frequently from developing countries [48]. The additional mortality may be attributable to complications after the fracture such as pulmonary embolism and infections or to comorbid conditions already present before the fracture [32]. Several studies document comorbid diseases and prefracture health status are associated with the 1-year postfracture mortality [28, 46, 52], whereas others show no influence of these factors [10, 55]. Studies from developed countries suggest preoperative factors increasing the risk of mortality are race (nonwhite) [27, 42], old age [10, 12, 28, 52], presence of dementia [24, 42], male gender [12, 24, 33, 42], serious concomitant illness [10, 12, 33, 52], low body mass index (BMI) [24], low handgrip strength [37], not walking outdoors before fracture [37], history of hip fracture [4], delirium at admission [9], postoperative complications [46], high preoperative risk score [24, 44], and postoperative mobility [25]. In developing countries, orthopaedic services are less available. One study suggests the cost of a hospital stay for a patient with a hip fracture in 2004 was 13% of the total expenditures for hospital care for adults in Brazil [41]. The population in Brazil, as in other Latin American countries and other developing countries, is aging rapidly, and the incidence of hip fractures is expected to increase the most in developing countries [19, 29]. Identifying the variables influencing mortality in these countries potentially would allow the development of interventions to improve recovery and reduce mortality [1].

We therefore (1) determined the rate of 1-year mortality and (2) identified prefracture and fracture characteristics associated with mortality after a hip fracture in elderly Brazilian patients.

Patients and Methods

In January 2001, we initiated a longitudinal prospective study at four municipal hospitals in Rio de Janeiro, Brazil. These hospitals accounted for 55% of hip fracture surgeries covered by the Brazilian Public Health System (SUS) in Rio de Janeiro in 2000. These four hospitals were chosen because they deal with the majority of the hip fractures in older patients, as they have an intensive care unit available. Not all hospitals in Rio de Janeiro have an orthopaedics department. Partly these four hospitals were chosen for practical reasons as the study physician (SRMP) coordinated the study, recruited, and interviewed all patients. From April to November 2001, 270 subjects 60 years and older admitted consecutively with a femoral neck or intertrochanteric fracture attributable to a fall were eligible for the study. Patients with a fracture attributable to a traffic trauma or who had a pathologic fracture attributable to cancer were not eligible for inclusion in the study. For patients who for cognitive reasons or physical reasons were unable to participate in the study by themselves, a family member was approached and gave proxy consent. Data were collected for these 270 patients during the first hospital admission attributable to a hip fracture from an interview and from medical charts. During the hospital stay, data on admission, type of fracture, anesthesia and surgery, comorbidities, and medication use were extracted from the medical chart. Eighteen patients were unable to participate in the interview during the hospital admission and a family member responded to questions. Patients needed to provide a valid address when admitted to the hospital to be contacted for the followup interview. In Rio de Janeiro, patients are required to go to the hospital nearest their home to receive treatment. Patients in Rio de Janeiro commonly provide incorrect address information so they can be treated in a certain hospital and 10 patients were excluded because they could not be contacted for followup. Twelve of the 270 patients could not be located in the hospital to conduct the interview. Two individuals refused to participate in the study. Thus, the final sample included 246 of the 270 subjects (91%) from four hospitals. Nonresponse analysis was conducted to compare the participants with the excluded patients and there were no differences regarding age, gender, and marital status. One year after the hip fracture, all living patients were interviewed at home by the study geriatrician (SRMP). The research ethics committees from all four hospitals approved the study and verbal informed consent was obtained from all participants.

After 1 year, 86 patients had died (35.0%). The date of death was reported by a family member when they were contacted for the followup interview. All remaining patients (n = 160) participated in the followup interview.

However, for 19 of those patients, a proxy helped to answer questions.

To measure functional status, the Brazil Old Age Schedule questionnaire [53] was used as it was validated in Portuguese in Brazil. The version used has 10 items: can you (1) use public transportation on your own (bus, van, taxi, train, subway, ferry, etc); (2) walk outdoors on your own; (3) feed yourself; (4) dress yourself; (5) walk inside the house on your own; (6) climb stairs on your own; (7) get out of bed on your own; (8) bathe yourself; (9) control your bladder; and (10) go to the toilet on your own. The answer categories are (0) yes or (1) no. Scores ranged from zero, for the patient who was not disabled, to 10, for an individual who was disabled in all these activities. The number of functional limitations was grouped for the analyses.

The following health and sociodemographic variables were obtained from the medical charts. Gender, age, and marital status were recorded. Marital status was classified as single, married, divorced, or widowed, and for analyses, it was grouped into married versus other. Ethnicity was classified as white, black, or not white/not black.

Site of fall, type of fracture, traction used before surgery, number of days between admission and surgery, number of days between fracture and hospital admission, total length of hospital stay, and surgical risk score (American Society of Anesthesiologists [ASA] score [40]) were obtained. Site of fall was classified into two categories: outside the house versus inside the house. Type of hip fracture was classified as neck of the femur versus intertrochanteric for the analyses. The ASA risk scores 1 and 2 were combined into low risk and 3 and 4 into high risk. Type of surgery, anesthesia used during the operation, perioperative or postoperative complications (only bleeding, infection of surgical site, and thrombosis [including cerebrovascular accident, venous thrombosis of legs, pulmonary embolism, and arterial embolism of legs] were available), and traction used before surgery (yes/no) were recorded. Furthermore, medication use before and after surgery (use of antihypertensive, sedatives/antipsychotics/anxiolytics, oral hypoglycemic medication, antiinflammatory medications, antidepressants, antiParkinson, antibiotics, antiarrhythmics, bronchodilators, hormones, anticoagulant/platelet aggregation inhibitors, inotropic medication; all yes/no variables) and comorbid diseases (diabetes mellitus, chronic obstructive pulmonary disease, stroke, cardiovascular disease, depression, cataract, glaucoma, hearing impairment, hypertension, and urinary incontinence; all yes/no variables) were assessed at admission and abstracted from the medical charts. Type of surgery was classified as arthroplasty or osteosynthesis. Anesthesia used during the surgery was classified as general or epidural anesthesia (including spinal anesthesia). Furthermore, from the medical chart, it was assessed where the patient was discharged to and classified as home or other (nursing home, to stay with a family member, or to stay with another person). Delirium after surgery was determined by using information from progress notes of the doctors and nurses in charge or determined during the interview by the study geriatrician (SRMP). No assessment instruments were used.

The following variables were asked of the patient. Education level was assessed by asking the number of years of school attended. Educational level was classified in five groups: illiterate, 1 to 4 years, 5 to 8 years, 9 to 11 years, and 12 years and more. Living arrangements were dichotomized as living alone or not. Patients were asked if they were still working before the fracture (yes/no). Weight was assessed using a calibrated scale. Height was assessed in the hospital for patients who were able to stand up straight. When patients were unable to stand up straight, he or she was asked to lie down on his or her back in the bed and height was estimated using a similar measurement. BMI was calculated and was classified as underweight (BMI < 22.0), normal (BMI $= 22$–27), and overweight/obesity (BMI > 27) [35]. Asking the patient whether he or she had experienced dizziness and balance problems assessed self-reported dizziness before fracture. Physical therapy (yes/no) was assessed by asking the patients if they had received physical therapy after the hospitalization.

Time until death after fracture was calculated using the date of death given by the family member and the date of fracture obtained from the medical chart. Descriptive t tests and chi square tests were performed to assess differences between patients who died (86) and patients who survived (160) 1 year after hip fracture.

We conducted Cox regression analyses to investigate the risk factors for mortality. The correlations between all factors were examined and were less than 0.6, so all the variables could be combined in a multivariable model. For all single risk factors, the association with mortality was examined using Cox's proportional-hazards models adjusted for age and gender. All variables associated with mortality with a p value less than 0.10 were entered in one model adjusting for age and gender. A final model was constructed using a manual backward selection method to delete nonsignificant variables from the final model using the -2 log likelihood test. For the variable ASA risk score, there were 35 patients with missing information, and these were classified as missing (separate dummy variable in the analyses). For the other variables, six patients were missing information on location of the fall, 15 were missing information for type of surgery, five were missing information for BMI, and three were missing information for level of education. The univariate analyses were performed on the complete cases for each of the variables. The multivariate model was performed using only the complete cases for all the variables retained from the univariate analyses (n = 240, 97.6% of total sample). All the analyses were performed using the statistical package SPSS® Version 15.0 (SPSS Inc, Chicago, IL).

Results

Eighty-six patients died, resulting in a 1-year mortality of 35.0% (Table 1). Of the 67 men, 29 men died (43.3%), and of the 179 women, 57 women died (31.8%) within the first year after fracture. Of the 86, 22 died in the hospital within 30 days (25.6% of those who died), therefore, the in-hospital mortality rate/30-day mortality rate was 8.9%. Sixty-four patients (74.4% of those who died) died after discharge. Of those who died in the hospital/within 30 days, 50% were women and 50% were men. Fifteen patients died before undergoing surgery.

Seven patients died of pneumonia, one died of pulmonary embolism, one died of cerebral hemorrhagic event, and one died of hypoglycemia. For the five others, no cause of death was noted in the medical chart. Those who died before surgery more often were male (53.8% versus 25.5% of those who had surgery, p = 0.019), slightly older (84.0 years versus 78.8 years, p = 0.036), and had more functional limitations (3.4 versus 1.2, p = 0.025). There were no differences in number of comorbid conditions, type of fracture, or location of the fall. There were no differences in marital status, level of education, or ethnicity.

In the univariate Cox regression analyses, the number of functional limitations, age, gender, having diabetes, having had a cardiovascular accident, and higher surgical risk all were associated with increased risk of mortality (Table 2). The use of antibiotics after surgery and physical therapy after surgery were associated with decreased risk of mortality in the univariate analyses (Table 2). In the multivariable analyses, the hazard ratio (HR) was 1.75 for patients with one to two functional limitations, 1.18 for patients with three to four limitations, and 4.35 for patients with five or more limitations compared with the reference group without limitations (Table 2). The HR was 3.07 for patients 70 to 79 years old and 6.48 for patients 80 years or older compared with the reference group (60–69 years). Men had a HR of 2.04 compared with women. Patients with ASA scores of 3 or 4 had a HR of 2.15 compared with patients with ASA scores of 1 or 2. The use of antibiotics after surgery and the use of physical therapy decreased the risk of mortality (HR for use of antibiotics, 0.51; HR for use of physical therapy, 0.32).

Table 1. Characteristics of the study sample

Characteristic	Died (n = 86)	Alive (n = 160)
Mean age (years)	83.22‡	77.26
Gender (number of women)	57 (66.3%)	122 (76.3%)
BOAS disability before fracture		
No limitations	36 (41.9%)	115 (71.9%)
1–2 limitations	19 (22.1%)	27 (16.9%)
3–4 limitations	17 (19.8%)	15 (9.4%)
≥ 5 limitations	14 (16.3%)*	17 (6.9%)
Marital status		
Married	22 (25.6%)	37 (23.1%)
Widowed	47 (54.7%)	86 (53.8%)
Divorced	1 (1.2%)	3 (1.9%)
Single	16 (18.6%)	34 (21.3%)
Level of education		
Illiterate–4 years	45 (53.6%)	90 (56.6%)
5–8 years	31 (36.9%)	52 (32.7%)
9+ years	8 (9.5%)	17 (10.7%)
Living alone	10 (11.6%)	23 (14.4%)
Site of fall		
Outside the home	22 (26.8%)	70 (44.3%)
In the bedroom	23 (28.0%)	38 (24.1%)
In the bathroom	11 (13.4%)	15 (9.5%)
In other room	26 (31.7%)	35 (22.2%)
Ethnicity		
White	65 (75.6%)	119 (74.4%)
Not black/not white	19 (22.1%)	28 (17.5%)
Black	2 (2.3%)	13 (8.1%)
Comorbid diseases at admission		
Diabetes mellitus	17 (19.8%)	25 (15.6%)
Hypertension	38 (44.2%)	58 (36.3%)
Chronic obstructive pulmonary disease	11 (12.8%)	18 (11.3%)
Stroke	12 (14.0%)†	8 (5.0%)
Cardiovascular disease	14 (16.3%)	18 (11.3%)
Depression	4 (4.7%)	6 (3.8%)
Cataracts	15 (17.4%)	35 (21.9%)
Glaucoma	2 (2.3%)	7 (4.4%)
Hearing impairment	5 (5.8%)	10 (6.3%)
Self-reported dizziness	24 (27.9%)*	26 (16.3%)
Urinary incontinence	10 (11.6%)	13 (8.1%)
Medication use before surgery		
Oral glucose-lowering agents and insulin	5 (5.8%)	15 (9.4%)
Sedatives, antipsychotics, and antianxiolytics	17 (19.8%)	32 (20%)
Antihypertensives	36 (41.9%)	54 (33.8%)
Antidepressants	3 (3.5%)	17 (10.7%)
AntiParkinson drugs	5 (5.8%)	2 (1.3%)
Antiinflammatory drugs	3 (3.5%)	1 (0.6%)

Table 1. continued

Characteristic	Died (n = 86)	Alive (n = 160)
Antiarrhythmic medication	7 (8.1%)	11 (6.9%)
Inotropics	6 (7.0%)	5 (3.1%)
Anticoagulants	12 (14.0%)	16 (10.0%)
Bronchodilators	1 (1.2%)	4 (2.5%)
Hormones	2 (2.3%)	4 (2.5%)
Weight		
Normal (BMI = 22–27)	40 (48.8%)	73 (45.9%)
Underweight (BMI < 22.0)	34 (39.5%)	73 (45.6%)
Overweight/obese (BMI > 27)	15 (17.4%)	31 (19.4%)
Femur fracture vs intertrochanteric	29 (33.7%)	46 (28.8%)
Traction used (yes/no)	29 (33.7%)	72 (45%)
General anesthesia (vs epidural and spinal anesthesia)	4 (4.7%)	15 (9.4%)
Arthroplasty (vs osteosynthesis)	21 (24.4%)	34 (21.3%)
ASA scores 3 and 4 (vs 1 and 2)	44 (51.2%)‡	40 (25.0%)
Delirium	32 (37.2%)*	37 (23.1%)
Complications during/after surgery	18 (20.9%)	20 (12.5%)
Use of physical therapy after surgery	16 (18.6%)	84 (52.5%)‡
Medication use after surgery		
Antihypertensives	17 (19.8%)	38 (23.8%)
Anticoagulants	32 (37.2%)	55 (34.4%)
Antibiotics	47 (54.7%)†	115 (71.9%)
Analgesics	18 (20.9%)	49 (30.6%)
Antiinflammatory drugs	22 (31.0%)	56 (37.8%)
Time between fracture and admission		
0 days	50 (58.1%)	90 (56.3%)
1–2 days	15 (17.4%)	39 (24.4%)
≥ 3 days	21 (24.4%)	31 (19.4%)
Total length of stay		
< 7 days	12 (14.0%)	26 (16.35)
8–30 days	57 (66.3%)	108 (67.5%)
30+ days	17 (19.8%)	26 (16.3%)

* $p < 0.05$; † $p < 0.01$; ‡ $p < 0.001$; BOAS = Brazil Old Age Schedule; BMI = body mass index; ASA = American Society of Anesthesiologists.

Discussion

Hip fractures in the elderly are common and associated with considerable mortality and disability. The factors associated with mortality after hip fractures have not been studied often in developing countries. In a prospective study, we therefore (1) determined the rate of 1-year mortality and (2) identified prefracture and fracture characteristics associated with mortality after a hip fracture in Brazilian elderly.

We acknowledge several limitations. First, we relied on the reported date of death by family members. We suspect this would not substantially affect the data as family members would not likely misreport the death of another family member. Second is our small sample size, which might lead to our findings being less generalizable to the population in Brazil. Owing to practical reasons, we did not recruit subjects in additional hospitals (particularly outside a metropolitan area) or for a longer time. However, in this study, patients were from the four major hospitals, representing 55% of the total population with hip fractures in Rio de Janeiro annually, and our loss to followup was low; patients died, but no participant refused to do the followup interview, thereby reducing selection bias. Third, some information obtained from the charts had missing data, eg, the ASA risk scores were missing for 35 patients; these patients were grouped as a separate category and kept in the analyses. For the other variables, the amount of missing data was very low. Fourth, use of the charts gave information without having to bother the patient, who usually is in considerable pain and discomfort before the surgery. In addition, we relied on proxy information for some patients unable to participate with interviews, although the number of proxy interviews was small (n = 18). The use of proxies allowed us to follow patients who otherwise would have been lost to followup. Finally, our findings from metropolitan hospitals in Brazil might be less generalizable to developed Western countries with different healthcare systems. However, as the other countries in Latin America have similar healthcare systems and the populations are aging as rapidly as the Brazilian population, our results might be generalizable to other Latin American countries. The strengths of our study are that we used a prospective design, had a 1-year followup, had consecutive recruitment of all patients with first hip fracture, had a high response rate, and examined a wide array of risk factors.

Our first aim was to determine the 1-year mortality rate. Our in-hospital mortality rate was 8.9%, whereas our 1-year mortality rate was 35.0%. The in-hospital mortality varies considerably among countries, which might reflect different inclusion and exclusion criteria. Previous studies in Canada [28] and Italy [12] have had in-hospital mortality rates of 6.3% versus 5.4%, respectively. Studies from the United States have shown low in-hospital mortality rates of 1.6% and 1.8% [7, 23]. In another study from a developing country, Thailand, an in-hospital mortality of only 2.1% and a 1-year mortality of only 17% were reported. Previous retrospective studies from Brazil have reported 6.5% in-hospital mortality [15]. The 1-year mortality of 35% in our study was high compared with the rates in previous studies from developed countries, in which mortality rates were reported between 15% and 25% [6, 16, 18, 20, 21, 31], but in agreement with previous reports from Brazil by Garcia et al. [15] who reported 30% and Fortes et al. [11] who reported 23% after 6 months. Our 1-year mortality rate is

Table 2. Univariate and multivariate Cox regression analyses

Variable	Univariate analysis		Multivariate model	
	HR value (95% CI)	p Value	HR value (95% CI)—final model	p Value
Age		0.000*		0.001*
60–69 years	Reference		Reference	
70–79 years	3.25 (0.97–10.91)	0.056	3.07 (0.90–10.51)	0.073
80 + years	7.03 (2.21–22.41)	0.001	6.48 (1.97–21.36)	0.002
Male gender	2.20 (1.39–3.48)	0.001	2.04 (1.26–3.30)	0.004
Level of education		0.927*		
Illiterate–4 years	0.91 (0.43–1.96)	0.818		
5–8 years	0.99 (0.45–2.19)	0.989		
9+ years	Reference			
Site of fall (in the home vs outside)	1.53 (0.93–2.52)	0.095		
Marital status (married vs not married)	0.89 (0.51–1.57)	0.689		
Ethnicity		0.204*		
White	0.90 (0.54–1.51)	0.693		
Not black/not white	Reference			
Black	0.26 (0.06–1.14)	0.075		
Weight		0.607*		
Normal (BMI = 22–27)	Reference			
Underweight (BMI < 22.0)	0.83 (0.52–1.31)	0.417		
Overweight/obese (BMI > 27)	1.14 (0.53–2.44)	0.745		
Femur vs intertrochanteric fracture	1.25 (0.80–1.96)	0.325		
Lived alone before fracture vs not	0.88 (0.46–1.70)	0.704		
BOAS score		0.001*		0.000*
No limitations	Reference			
1–2 limitations	1.62 (0.92–2.9)	0.098	1.75 (1.00–3.09)	0.052
3–4 limitations	1.85 (1.00–3.40)	0.048	1.18 (0.63–2.23)	0.605
5+ limitations	6.11 (3.21–11.65)	0.0001	4.35 (2.25–8.40)	0.000
Chronic diseases at admission				
Diabetes mellitus	1.85 (1.07–3.19)	0.028		
Hypertension	1.41 (0.92–2.17)	0.118		
Chronic obstructive pulmonary disease	1.04 (0.55–1.97)	0.909		
Stroke	2.20 (1.17–4.12)	0.014		
Cardiovascular disease	1.39 (0.78–2.47)	0.260		
Depression	1.69 (0.61–4.66)	0.311		
Cataracts	0.65 (0.37–1.15)	0.137		
Glaucoma	0.68 (0.17–2.75)	0.584		
Hearing impairment	0.85 (0.34–2.10)	0.723		
Postural instability	1.41 (0.87–2.29)	0.161		
Urinary incontinence	1.18 (0.60–2.30)	0.636		
Medication use at admission				
Anticoagulants	1.11 (0.60–2.06)	0.733		
Inotropics	1.73 (0.75–4.00)	0.201		
AntiParkinson drugs	1.83 (0.72–4.65)	0.206		
Sedatives, antipsychotics, and antianxiolytics	1.06 (0.62–1.80)	0.841		
Oral glucose-lowering agents and insulin	1.09 (0.43–2.76)	0.852		
Antidepressants	1.21 (0.38–3.90)	0.744		
Antiinflammatory drugs	Not possible			
Bronchodilators	0.64 (0.89–4.67)	0.664		

Table 2. continued

Variable	Univariate analysis		Multivariate model	
	HR value (95% CI)	p Value	HR value (95% CI)—final model	p Value
Antiarrhythmics	1.01 (0.47–2.20)	0.974		
Antihypertensives	1.32 (0.86–2.03)	0.208		
Hormones	1.07 (0.26–4.37)	0.929		
Hip arthroplasty vs osteosynthesis	0.99 (0.98–1.01)	0.566		
Use of traction	0.83 (0.53–1.31)	0.430		
Surgery risk		0.001*		0.018*
Low (ASA scores 1 and 2)	Reference		Reference	
High (ASA scores 3 and 4)	2.58 (1.56–4.27)	0.000	2.15 (1.25–3.69)	0.006
No information	1.34 (0.72–2.49)	0.359	1.33 (0.70–2.53)	0.378
General anesthesia vs other	0.54 (0.20–1.47)	0.229		
Delirium during hospital stay	1.40 (0.90–2.17)	0.142		
Complications during/after surgery	1.54 (0.91–2.59)	0.105		
Physical therapy received	0.25 (0.15–0.44)	0.000	0.32 (0.18–0.57)	0.000
Medication use after surgery				
Anticoagulants	0.90 (0.58–1.40)	0.637		
Antiinflammatory drugs	1.47 (0.46–4.75)	0.520		
Analgesics	0.62 (0.37–1.04)	0.710		
Antihypertensives	0.89 (0.52–1.51)	0.656		
Antibiotics	0.51 (0.33–0.78)	0.002	0.51 (0.32–0.80)	0.003
Total length of stay		0.627*		
≤ 7 days	Reference			
8–30 days	1.18 (0.63–2.19)	0.611		
> 30 days	1.43 (0.68–3.00)	0.345		
Time between fracture and admission		0.605*		
0 days	Reference			
1–2 days	0.77 (0.43–1.38)	0.383		
3+ days	1.07 (0.64–1.81)	0.788		

Variables associated with mortality in univariate analysis ($p < 0.10$) were selected as candidate determinants for the multivariate analysis; a final model (age and gender adjusted) was constructed using manual backward selection method to delete nonsignificant variables from the final model using the −2 log likelihood test; *p value for the group dummy variables; HR = hazard ratio; CI = confidence interval; BMI = body mass index; BOAS = Brazil Old Age Schedule; ASA = American Society of Anesthesiologists.

in disagreement with that of Vidal et al. [56] who reported a rate of 21.5%. But those analyses were restricted to patients who had undergone surgery, whereas in our prospective study, 15 patients (6.1%) died before the surgery.

The second aim of our study was to examine prefracture and fracture characteristics associated with mortality. Functional status before fracture, older age, male gender, and higher surgical risk increased the risk of mortality, whereas the use of antibiotics and physical therapy after surgery decreased the risk. Previous studies showed functional status before fracture [14, 42, 45, 52], male gender [12, 15, 28, 33, 36, 42, 47], older age [10, 15, 28, 36, 43, 47, 50, 52, 55], and higher ASA scores predicted mortality in older patients [24, 26, 33, 44, 49] (Table 3), which is in agreement with our findings. In our study, we did not see a difference in mortality between patients undergoing arthroplasty versus patients undergoing osteosynthesis, which is in agreement with mortality reported by Garcia et al. [15] and others [18, 33, 37]. However, others have reported an increased mortality rate for patients who had arthroplasties [39, 54]. It has been suggested the reason for this increased mortality after arthroplasty could be higher use of arthroplasty with older age, but so far the evidence is inconclusive [18, 54]. Finally, many authors have reported the impact of comorbid conditions on mortality [10, 12, 14, 28, 36, 37, 42, 46, 47, 50–52], whereas we did not observe this. This might be attributable to our measurement of comorbid conditions. We had to rely on the hospital charts in which the comorbid condition was recorded as yes/no and we did not have the level of severity. However, in our

Table 3. Overview of studies investigating mortality after hip fracture

Study	Description	Study years	Number of patients	Followup	Country	Mortality rate	Risk factors associated with mortality after hip fracture
Fortes et al. [11] (2008)	Prospective study	2004	56 (from 2 hospitals)	6 months	Brazil (São Paulo)	12.5% (in-hospital) 23.2% (6 months)	Causes: infections (46.1%), cardiovascular disease (46.1%), undetermined (7.8%)
Sakaki et al. [47] (2004)	Systematic review of mortality after proximal femoral fractures; publications from 1998 to 2002; 25 articles from Medline and Cochrane databases; 14 prospective trials, 8 retrospective, 3 systematic reviews		24,062 patients (> 60 years)		Brazil	4.7% (1 month) 11.9% (3 months) 10.8% (6 months) 19.2% (1 year)	Advanced age, comorbidity, male gender, cognitive impairment; small effect: walking ability, ASA score, hemoglobin level, albumin level, lymphocyte count, previous stroke; no effect: time to surgery, anesthetic techniques, type of osteosynthesis
Pinheiro et al. [43] (2006)	Prospective study using database of Hospital Information System of the Unified Health System and Mortality System	1995	606	1 year	Brazil (Rio de Janeiro)	21.5% (1 year)	Mortality higher among the elderly (> 80 years); type of surgery, gender not risk factors
Furlaneto and Garcez-Leme [13] (2006)	Prospective study	2001	103 (from one institute)	1 year	Brazil (São Paulo)		Mortality tended to higher levels in the group with delirium (not statistically significant)
Furlaneto and Garcez-Leme [14] (2007)	Prospective study	2001–2005	103 (from one institute)	4 years	Brazil (São Paulo)		30% presented with delirium; no impact on mortality 4 years later (42 survivors); 6 deaths during hospitalization: 5 with delirium, 1 without; risk factors: comorbidities, functional and cognitive impairment (at baseline)
Souza et al. [51] (2007)	Prospective study	1995	390 (from one hospital)	90 days	Brazil (Rio de Janeiro)	7.4% (90 days)	Age, number of comorbidities, time to surgery
Souza et al. [50] (2008)	Prospective study; mean age, 74.8 years (SD, 10.7 years)	1995–2000	390 (from one hospital)		Brazil (Rio de Janeiro)	7.4% (90 days)	Respiratory and cardiovascular systems, dementia; gender not a risk factor
Garcia et al. [15] (2006)	Retrospective descriptive chart review study	2000	56 (from one institute)		Brazil (São Paulo)	30.5% (1 year)	Age (> 80 years), male gender
Mesquita et al. [36] (2009)	Systematic review of mortality-morbidity after hip fracture; papers from 2003 to 2007; Medline, Lilacs and Scielo		4013		Brazil	21.8% (1 year)	Age, comorbidities, male gender
Rocha et al. [45] (2008)	Prospective study	2005	68 (from one hospital)	1 year	Brazil (Triângulo Mineiro)	36.8% (1 year)	Previous functional status

Table 3. continued

Study	Description	Study years	Number of patients	Followup	Country	Mortality rate	Risk factors associated with mortality after hip fracture
Tosteson et al. [52] (2007)	Prospective study; 730 patients with hip fractures from 25,178 participants in Medicare Current Beneficiary Survey	1996–2000	730	3.8 years (median)	USA		Prefracture health status, functional impairments, comorbidities, socioeconomic status (limited to the first 6 months after fracture); gender, race (black vs nonblack), age (< 80 vs 80+ years), facility-dwelling status (institutional vs community dweller), health status (limitations vs no limitations) not risk factors
Dolan et al. [9] (2000)	Prospective study of short- and long-term impact of delirium present on hospital admission in a sample of aged patients who were nondemented, and had hip fractures	1990	682 (from eight hospitals)	2 years	USA (Baltimore, MD)		13.5% of patients identified as confused or delirious at the time of hospital admission; risk factors: age, functional impairments, comorbidities; at 12 months, greater proportion of the no-delirium group regained mobility; MMSE scores lower for the delirium group; delirium associated with slowed recovery and increased likelihood of dependency in ADLs and IADLs; delirium is an independent predictor of poor outcomes in hospitalized elderly persons; delirium on hospital admission was not a predictor of mortality
Penrod et al. [42] (2008)	Prospective study of association of race, gender, comorbidities, and prefracture mobility and function with mortality; data pooled from three longitudinal studies	1997–1999 1990–1991 1987–2001	2692 (three cohorts)		USA	12% (6 months)	Mortality and mobility advantage for whites; dementia had a negative impact on survival; risk factors: male gender, COPD, congestive heart failure, cancer
Vestergaard et al. [55] (2007)	Historic cohort using administrative databases; all patients with a hip fracture between 1977 and 2001 from Danish National Health Service		169,145		Denmark		Largest contributors to excess mortality: infections, psychiatric conditions, age at the time of fracture; factors contributing the most to death after hip fracture besides the trauma-related deaths: infections psychiatric diseases, pulmonary diseases, dementia, neurologic diseases

Table 3. continued

Study	Description	Study years	Number of patients	Followup	Country	Mortality rate	Risk factors associated with mortality after hip fracture
Vestergaard et al. [54] (2007)	Historic cohort study; patients from 1981 to 2001 from the National Hospital Register		163,313		Denmark		Greater mortality in subjects undergoing arthroplasty than those undergoing osteosynthesis; infections, lung disease, and to a lesser degree psychiatric causes were more frequent causes of death in patients than in control subjects; higher mortality in men than in women
Rae et al. [44] (2007)	Observational study	2002–2004	222 (from one hospital)	30 days	Australia		Higher ASA, fracture treated with arthroplasty
Meyer et al. [37] (2000)	Prospective study	1992	248 (from two hospitals)	3.5 years	Norway		Reduced mental status (within the first 6 months), two or more chronic diseases, low physical ability (walking outdoors)
Karagiannis et al. [33] (2006)	Prospective study	1989	499	10 years	Greece		Age, gender, type of fracture (intertrochanteric), heart failure
Farahmand et al. [10] (2005)	Retrospective study of the Swedish National Inpatient and Cause-of-Death Registers to establish survival after hip fractures in women and assess the impact of comorbidity on mortality	1993–1995	1327 patients (women $\geq$ 50 years) 3170 control subjects (from 24 hospitals)		Sweden	4.3% (3 months) 10.6% (1 year) (fourfold over the controls)	Even patients with hip fractures without comorbidity have an increase in mortality soon after the fracture and longer term; the mechanisms by which hip fracture causes death are uncertain, although the injury seems to trigger a long-term deterioration in health; the relative excess mortality is independent of comorbidity and known hip fracture risk factors; in patients 76–81 years old, 13.6% of patients and 4.3% of control subjects died during the first year postfracture; in terms of absolute risk, age was a risk factor for early mortality; the relative risk of hip fracture for death appears to be higher at younger ages

Table 3. continued

Study	Description	Study years	Number of patients	Followup	Country	Mortality rate	Risk factors associated with mortality after hip fracture
Hommel et al. [26] (2008)	Prospective study	2003	420 (from one hospital)	1 year	Sweden (Lund)		Mortality higher among men; early surgery, within 24 hours, not associated with reduced mortality; anticoagulation therapy before fracture decreased mortality at 4 months (10%); patients with operative delay for medical reasons had a high mortality of 46%; mortality increased with ASA grade; living at home at the time of fracture protected against mortality when compared with institutional care; cognitive impairment was a risk factor for mortality; patients with subtrochanteric fractures had the lowest mortality; arthroplasty higher mortality
Roche et al. [46] (2005)	Prospective observational cohort study	1999–2003	2448 (from one hospital)	1 year	UK	9.6% (30 days) (men, 15%; women, 8.2%) 33% (1 year)	Most common postoperative complications: chest infection (9%), heart failure (5%); strongest risk factor: presence of three or more comorbidities; rehabilitation had no effect on early mortality
Franzo et al. [12] (2005)	Retrospective cohort study of effect of waiting time for surgery on mortality using an administrative database	1996–2000	6629 (from 13 hospitals)		Italy	5.4% (in-hospital) 20% (6 months) 25.3% (1 year)	Age, male gender, comorbidities; 1 day of waiting time for surgery had no effect on mortality
Hasegawa et al. [24] (2007)	Prospective study	2000	759 (from four hospitals)	120 days	Japan	37% (30 days) 9% (120 days)	Male gender, older age, high ASA grade, cognitive ability after FF (dementia), residence in an institution; earlier surgery had no effect on mortality
Smektala et al. [49] (2008)	Prospective observational study using hospital records of relationship between time to surgery with frequency of postoperative complications and 1-year mortality	2002	2916 (from 268 hospitals)	1 year	Germany	19.7% (1 year)	Age (HR = 1.05 per year of age), postoperative complications (cardiovascular, pressure sores, stroke), prior history of cancer, poorer ASA classification; time to surgery had no effect on mortality

Table 3. continued

Study	Description	Study years	Number of patients	Followup	Country	Mortality rate	Risk factors associated with mortality after hip fracture
Vidal et al. [57] (2009)	Review of MED-ECHO (administrative database) between 2003 and 2004 for delay from admission to surgery and the actual gap from fracture to surgery; all hospitals in Quebec; mean age, 81.2 years (60–107 years)		3754 patients (2994 women, 79.8%)		Canada	9% (in-hospital)	Mean length of hospital stay: 27 days (interquartile range, 8–41 days); admitted to the hospital on the same day of fracture: 44%; first or second day, 51.2%; third day or later, 5%; mean times from fracture to surgery, 1.84 days; from admission to surgery, 1.02 days; neither times were predictors of in-hospital mortality
Jiang et al. [28] (2005)	Retrospective study using hospital discharge records	1994–2000	3981 (from two hospitals)		Canada	6.3% (in-hospital) (men, 10.2%; women, 4.7%) 30.8% (1 year) (men, 37.5%; women, 28.2%)	Older age, male gender, long-term care residence, 10 different; their hip fracture-specific risk adjustment tool is pragmatic and reliable
Current study	Prospective study	2001	246 (from four hospitals)	1 year	Brazil (Rio De Janeiro)	8.9% (in-hospital) 35.0% (1 year)	Functional status before fracture, older age, male gender, higher surgical risk; use of antibiotics and use of physical therapy after surgery decreased the mortality risk

ASA = American Society of Anesthesiologists; MMSE = mini mental state examination; ADLs = activities of daily living; IADLs = instrumental activities of daily living; COPD = chronic obstructive pulmonary disease; FF = femur fracture; HR = hazard ratio.

study, functional limitations were a strong predictor of mortality, which might have captured some of the effect of the comorbid conditions.

The use of antibiotics perioperatively [3] and the use of physical therapy postoperatively improves recovery, although the best form of physical therapy has yet to be determined [3, 5, 22, 25]. Only 162 of the 246 patients (66%) received prophylactic antibiotics after surgery, although antibiotics reportedly prevent infections after hip surgery [17]. For our study patients, there was no antibiotic used preoperatively unless there was a clinical diagnosis such as urinary tract infection. The antibiotics were administered to patients within 60 minutes of the surgery in the operating room. The antibiotics were continued for 2 days unless there was an infection in which case they were continued for a longer period. Unfortunately, antibiotics after surgery are not always available. This unavailability of antibiotics in the public health system is not rare. On some days, there are no antibiotics, so none of the patients receive them, whereas on other days, it is available and all patients receive them. Making antibiotics more available in Brazil for older patients after surgery may increase their survival after hip fracture. Fortes et al. [11] reported 46% of the mortality was attributable to infections. In our study, 12 patients who died after surgery died of pneumonia and 14 patients had urinary tract infections after surgery. Furthermore, a previous Brazilian study also reported the use of physical therapy was associated with decreased mortality [38]. Not all the patients undergoing surgery for a hip fracture receive postoperative physical therapy. At the time of our study, in-hospital physical therapy programs were not available in any of the four hospitals. Therefore, this finding might be because only patients with good functional status after discharge and/or patients who lived in better socioeconomic circumstances who could afford physical therapy and the associated costs of transportation received physical therapy. However, these factors are modifiable and could improve survival of patients in Brazil after hip fracture surgery. With the expected increase in the older population in Brazil, these are relevant interventions to prevent morbidity and mortality after a hip fracture.

The 1-year mortality after hip fracture was high, 35%. Men and patients with more prefracture functional limitations and higher surgical risk had an increased risk of mortality. As the population of Brazil ages and orthopaedic services and osteoporosis treatment are not as widely available in Brazil, a large increase in the incidence of hip fractures can be expected. In developed countries, despite the increase in proportion of older persons, the mortality rate attributable to hip fractures has not changed during the last 40 years as a result of improvements in medical management of hip fractures (early surgery, better operative techniques, better nursing and community care for patients) [21]. It is less clear how aging of the population in Brazil and increase in hip fractures will develop with time. Patients who received physical therapy and antibiotics after surgery had a lower risk of mortality, showing potentially modifiable factors to improve survival after hip fracture surgery.

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