Article

Journal of Aging and Health
1–15

DOI: 10.1177/0898264316636839
jah.sagepub.com

Impact on Hip Fracture Mortality After the Establishment of an Orthogeriatric Care Program in a Colombian Hospital

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Abstract

Objective: The aim of this study is to evaluate mortality and survival rates of patients aged 65 years or older who sustained a hip fracture and were treated at a hospital in Bogotá, Colombia, after the establishment of an Orthogeriatric Program. **Method:** In total, 298 patients were treated according to the program's protocol. The primary outcome was 1-year mortality. Mortality predictors were estimated using Cox proportional hazards model, and survival was measured with Kaplan–Meier analysis. **Results:** The annual survival rate increased from 80% to 89% (p = .039) 4 years after its implementation. There was a significant decrease in mortality

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risk (Hazard Ratio = 0.54, p = .049). Arrhythmia, valvular heart disease, history of myocardial infarction, and age greater than 85 years were predictors of mortality. **Discussion:** This is the first study in Latin America to show decreased mortality rates 1 year after the implementation of an Orthogeriatric Program. Our rates were lower than developed countries, suggesting the existence of additional factors that influence long-term outcomes.

Keywords
hip fractures, orthopedic trauma, geriatrics, orthogeriatric care program, Latin America

Introduction

Hip fracture and its sequelae have been shown to lead an increased incidence of morbidity and mortality in the elderly population (Dy, McCollister, Lubarsky, & Lane, 2011). The annual mortality rate increases 2 to 3 times in patients 80 years or older with hip fracture when compared with an equivalent population without a hip fracture (Haentjens et al., 2010). The geriatric population tends to have multiple medical comorbidities and underlying bone fragility due to a lower bone mineral density and less muscular mass. Consequently, there is a higher risk for perioperative (Behan et al., 2009; Dawson-Bowling et al., 2008; Singh Mangat, Mehra, Yunas, Nightingale, & Porter, 2008) and postoperative complications that have a high impact on functional outcomes, independence, and quality of life (Bass, French, Bradham, & Rubenstein, 2007; Robertson & Robertson, 2006). Pioli et al. reported that an extended time between arrival to the hospital and surgical treatment of hip fractures increased the risk for short and long-term mortality (OR 1,56 p=0,01) (Pioli et al., 2012). At least 30% of patients with a hip fracture do not return home after being discharged from the hospital, and at least 50% of them require permanent gait assistance devices (Sernbo & Johnell, 1993).

These observations have drifted the management of elderly patients with hip fractures from solely an all-inclusive orthopedic care to a combined orthogeriatric management, where an orthopedic surgeon and a geriatrician both assess patients together during the perioperative period. Not surprisingly, Orthogeriatric Programs were developed across the globe, aiming to improve patient care (Blacklock & Woodhouse, 1988; Gonzalez-Montalvo et al., 2010; Harrington, Brennan, & Hodkinson, 1988; Singler et al., 2011; Tarazona-Santabalbina et al., 2012) and to decrease mortality, complications, and costs (Friedman, Mendelson, Bingham, & Kates, 2009; Kates, Mendelson, & Friedman, 2010). However, their effectiveness in Latin America remains vague on whether they decrease morbidity and mortality.

The Orthogeriatric Program at the *Hospital Infantil Universitario de San José*, in Bogotá, Colombia, was created 6 years ago to address the increased incidence of hip fractures in the elderly and, to our knowledge, it is the first of its kind in our country. In this study, we wished to evaluate whether the implementation of the in-house orthogeriatric program over a 5-year period led to reduced mortality rate and improved outcomes for patients aged 65 years or older treated for fragility hip fractures.

Patients and Methods

In June 2008, the *Hospital Infantil Universitario de San José* in Bogotá, Colombia, created an Orthogeriatric Fracture Care Program to improve hip fracture management in the elderly population. Prior to implementation of the care program, there was no dedicated approach toward the treatment of elderly injured patients at our institution. After its implementation, between June 2008 and July 2012, a prospective cohort study was carried out, after which a survival analysis was done to compare mortality rates in two different time periods. After institutional review board approval, data from the patient's hospitalization and follow-up visits at the Orthopaedic clinic were collected.

The patients eligible to the Orthogeriatric Program were all patients aged 65 years or older who sustained a hip fracture after a low-energy fall. Exclusion criteria included all patients who sustained high-energy trauma or a pathologic fracture. The orthopedic surgeon and the anesthesiologist assessed patients after their arrival to the emergency department, and both followed standardized in-house protocols to prevent common complications in this population such as delirium, thrombotic events, and nosocomial infections. The protocols used in our hospital were adapted from the orthogeriatric experience obtained at the Highland Hospital at the University of Rochester in upstate New York (Friedman et al., 2008).

298 patients were treated at our institution accordingly with the co-manageable standards, and data were collected by physicians, residents, surgeons, and anesthesiologists (Table 1). All eligible patients were included in the program, with no exceptions. Medical records were reviewed to assess comorbidities and complications occurring during hospital stay. Patients underwent fracture reduction and fixation or total hip replacement, depending on fracture type and capsular involvement. Postoperative care was co-managed with the Internal Medicine Department, who were also in charge of promoting early and appropriate discharge from the hospital. Patients started physical therapy the day

Table 1. Patient Baseline Characteristics.

	2008-2010	2010-2012	
	M (*SD*)	*M* (*SD*)	*p*
Age	83.31 (8.43)	83.29 (8.01)	.979
Height (cm)	159.73 (5.57)	154.75 (8.28)	<.001
Weight (kg)	61.75 (8.85)	56.85 (11.04)	<.001
BMI (kg/cm^2)	24.17 (3.05)	23.66 (3.72)	.197
	% (*n*)	% (*n*)	
Fracture type			
Intracapsular	18.7 (52)	10.4 (29)	.97
Extracapsular	45.3 (126)	25.5 (71)	
Comorbidities			
Arrhythmia	37.8 (14)	62.2 (23)	.035
CHF	21.1 (8)	78.9 (30)	<.001
Valvular heart disease	71.4 (10)	28.6 (4)	.272
CAD	50.0 (32)	50.0 (32)	.466
Hypertension	49.5 (103)	50.5 (105)	.018
Peripheral artery disease	50.5 (108)	49.5 (106)	.049
COPD	48.6 (53)	51.4 (56)	.155
Diabetes	61.1 (44)	38.9 (28)	.166
Renal disease	47.1 (8)	52.4 (9)	.553
Cancer	65.2 (15)	34.8 (8)	.262
Gastrointestinal disease	0.0 (0)	100.0 (8)	.002
Rheumatoid arthritis	36.0 (9)	64.0 (16)	.059
Age ≥ 85	51.2 (65)	48.8 (62)	.396

Note. Patients were classified into two cohorts according to their admission date. BMI = body mass index; CHF = congestive heart failure; CAD = coronary artery disease; COPD = chronic obstructive pulmonary disease.

after surgery, which was focused in gait training with weight-bearing as tolerable; they were also given orders to continue home-based physical therapy for a period determined by the treating orthopaedic surgeon. After hospital discharge, patients were seen in follow-up consults at our institution by both an orthopedic surgeon and a geriatrician for a period of up to 1 year or until death, if it occurred before the end of the first postoperative year. The geriatrician evaluated patient comorbidities and assessed the environmental risk at the patient's home to prevent future fractures. Follow-up appointments in the outpatient clinics were scheduled at 15 days, 1 month, 3 months, 6 months, and 12 months after surgery if no additional complications were observed.

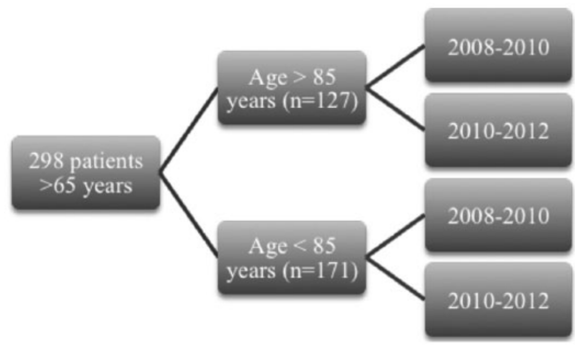

Figure 1. Stratification of patients.

Patients were stratified by age and by year of admittance to the hospital, making a total of four cohorts (Figure 1). Patients were initially stratified according to age as it acts as a confounder for hip fracture outcomes. In addition, patients were also stratified according to year of admission because the program's protocol was more strictly applied as time passed since its implementation. This was due to the fact that during the first two years the health professionals were still in the process of learning how to adequately implement the guidelines. Patients in each of the cohorts (2008-2010 and 2010-2012) were followed, and 1-year survival was measured. The primary outcome was 1-year mortality (death within the first 365 days after surgery) caused by any associated condition to the fracture or its treatment. Secondary outcomes included surgical delay, measured by time in days between hospital admission and start of surgery, and hospital length of stay after surgery. Comorbidities that were included for analysis were coronary artery disease, congestive heart failure, hypertension, cerebrovascular disease, pulmonary disease, neurologic disease, diabetes, rheumatologic disease, and neoplasms.

The current study had an increased risk of sample bias, due to patient dropout during the follow-up period. Therefore, to control possible dropouts, we encouraged patients to schedule their next appointment after each visit. In addition, if patients did not come to an appointment, we contacted them via telephone to reprogram their appointment and increase follow-up adherence.

First, the relative and absolute frequencies of demographic characteristics and comorbidities were calculated between the cohorts. Then, we used the χ^2 test for the categorical variables, and a Student's t test for the continuous variables to see whether there was a difference in the distribution between these two groups. Their analogous non-parametric tests were also considered if a normality assumption was not met. Next, a Cox proportional hazards model was used for two reasons: first, to determine the relationship between comorbidities and mortality, and second, to determine the association between the year of admittance and mortality. Finally, Kaplan–Meier analysis was applied to obtain a survival curve for the primary outcome. All statistical analyses were performed with SPSS Version 18.0.

Results

Four years after the program's implementation, we were able to recruit 298 patients aged 65 years or older with a diagnosis of fragility hip fracture. Laterality had no predilection on our patients, as half of them (n = 149) sustained a right hip fracture and the other half sustained a left hip fracture. None of them had a bilateral hip fracture. We did find, however, that 78% of our patients were female and 43% were 85 years or older.

The highest mortality rate was noted in patients who were recruited during the immediate year after the program's implementation (23% mortality). However, this rate decreased noticeably in the upcoming years to 16.2% in 2009 and 9.1% in 2010. Even though mortality rate increased to 12.7% in the year 2011, it was still lower than the first 2 years after the program's implementation (Figure 2). After patients were stratified by age, there was a statistical significance in the difference between mortality rates between patients aged above 85 years and those aged between 65 and 84 years (28% vs. 19%, p = .01). In addition, after stratifying by year of admittance to the hospital, we found a significant increase in survival between the two cohorts (80.1% vs. 89.1%, p = .038; Figure 3). Furthermore, the risk of dying after sustaining a hip fracture was lower in patients who had been treated between 2010 and 2012 (HR = 0.54, 95% confidence interval [CI] = [0.292, 0.997], p = .049). According to a Kaplan–Meier analysis, the survival rate for patients belonging to the cohort between the years of 2010 and 2012 was significantly greater than survival rate for patients in the first cohort, between the years of 2008 and 2010 (Figure 4). Moreover, mortality rates decreased considerably 3 months after surgery, which is evidenced by a flattening of the Kaplan–Meier curves.

However, surgical delay, which was measured in number of days, was not different between the two cohorts (Table 2). However, length of stay after surgery was significantly lower in the second cohort (3.42 days vs. 5.30 days), 2 years after the program's implementation. After performing a Cox proportional hazards model analysis, we found that the presence of arrhythmias, valvular heart disease, previous history of myocardial infarction, coronary artery disease, and age greater than 85 years were predictors of mortality (Table 3). However, there was a difference in the frequencies of coronary artery disease

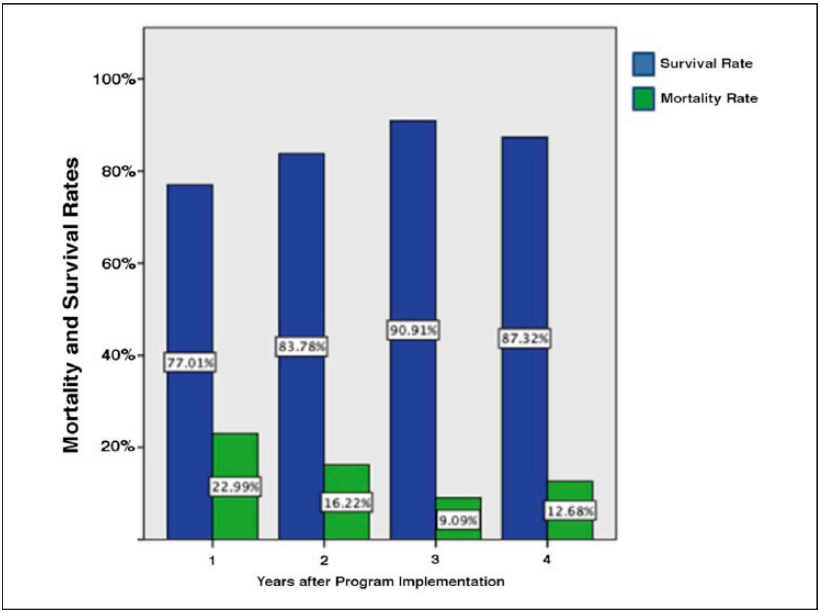

Figure 2. Survival and mortality rates per year.

(p = .031) and arrhythmias (p = .035) between the patients who survived 1 year after their fall versus the ones who died.

Discussion

The increase in life expectancy and the decrease in fertility rates in Latin America and Caribbean countries have now become of primary concern for the United Nations. This concern extends to the fact that there will be an important increase in the population aged 60 years or older; a population having higher comorbidities and complications related to age, such as hip fractures (Kannus et al., 1996), which are expected to increase to 6.26 million by 2050. In addition, hip fracture treatment costs are also expected to increase; today, annual costs fluctuate between 10.3 and US$15.3 billion (Dy et al., 2011). These led us to implement an orthogeriatric program in Colombia.

After the program's implementation, there was a progressive increase in patient survival, especially after its second and third year. As stated before, survival rates of patients belonging to the last cohort (fourth year) was greater than survival for the previous year. Nevertheless, survival rates for this year were lower than the ones found during the first 2 years. There is no clear

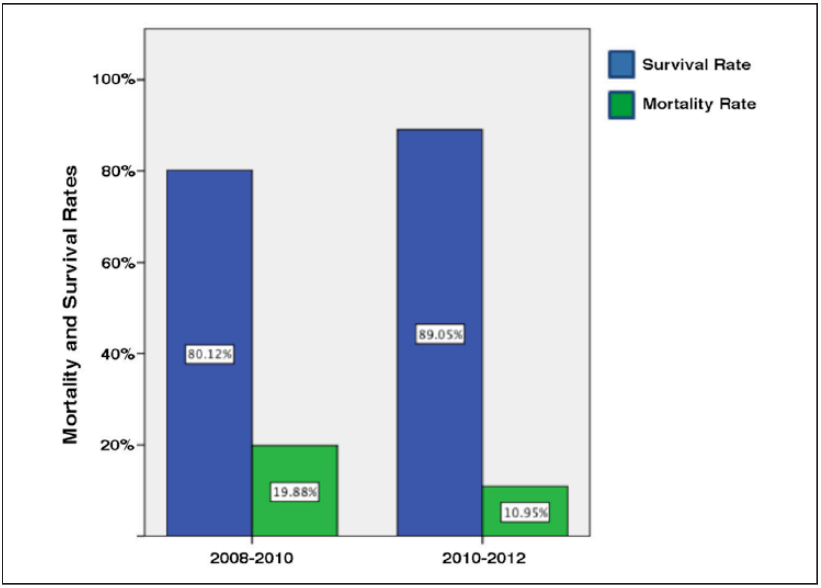

Figure 3. Survival and mortality rates after stratifying for year of admittance.

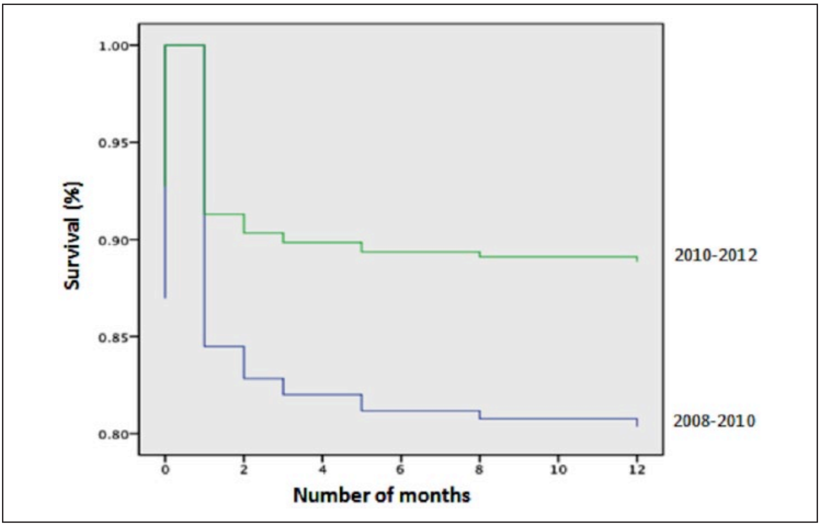

Figure 4. Survival analysis/Kaplan–Meir analysis for patients in the 2-year cohorts.

Table 2. Surgical Delay and Hospital Stay After Surgery.

	2008-2010	2010-2012	*p* Value
Surgical delay (mean in days)	3.91	3.66	.113
Hospital stay after surgery (mean in days)	5.30	3.42	.020

Table 3. Mortality Predictors After a 1-Year Follow-Up.

	% (*n*)	HR [95% CI]	*p* Value
(Reference) 2008-2010			
2010-2012		0.54 [0.292, 0.997]	.049
Comorbidities			
Age ≥85 years	42.6 (127)	2.06 [1.15, 3.70]	.015
Arrhythmia	12.4 (37)	2.64 [1.37, 5.08]	.004
CHF	12.8 (38)	1.66 [0.80, 3.43]	.172
Valvular heart disease	4.7 (14)	2.56 [1.01, 6.47]	.047
CAD	4.7 (14)	2.62 [1.04, 6.62]	.042
History of myocardial infarction	21.5 (64)	2.94 [1.65, 5.25]	<.001
Heart disease	27.5 (82)	2.46 [1.39, 4.37]	.002
Hypertension	69.8 (208)	1.43 [0.73, 2.82]	.297
Peripheral artery disease	71.8 (214)	1.29 [0.66, 2.54]	.454
COPD	36.6 (109)	1.58 [0.89, 2.80]	.120
Cerebrovascular disease	34.2 (102)	1.45 [0.82, 2.59]	.206
Diabetes	24.2 (72)	0.63 [0.29, 1.35]	.233
Renal disease	5.7 (17)	2.10 [0.83, 5.30]	.118
Cancer	7.7 (23)	0.79 [0.25, 2.54]	.693
Gastrointestinal disease	2.7 (8)	0.77 [0.11, 5.61]	.800
Rheumatoid arthritis	8.4 (25)	0.74 [0.23, 2.39]	.619

Note. CI = confidence interval; CHF = congestive heart failure; CAD = coronary artery disease; COPD = chronic obstructive pulmonary disease.

explanation for the increase in mortality rate during 2012, but it can probably be related to the fact that there was also an increase in the time from hospital admittance to surgery. As noted before, Pioli et al. (2012) found a statistical association between mortality rate and time from hospital admittance to surgery in patients with hip fracture.

After performing a Kaplan–Meier survival analysis, we observed a decrease in annual mortality rates during the second period (2010-2012) when compared with the first period (2008-2010) after the program's implementation. It also corroborated expected results, where mortality rates were greater during the first

3 months after surgery. Subsequently, after the first 3 months there was a decrease in number of deaths per unit of time. This has led us to believe that the first 3 postoperative months are the most critical in the management of elderly patients with hip fractures. Therefore, any modifications in treatment or habits will have the most impact in the first 3 months; after this period, changes in mortality will not have as much impact on patient survival. This further supports the benefits of creating orthogeriatric programs where patients are thoroughly and permanently assessed during the first 3 months after surgery. If physicians find any additional risks during postoperative consults they will be able to modify them toward decreasing mortality rates.

The demographic features and comorbidities of our patients did not differ from those in other studied populations around the world (Friedman et al., 2009; Wagner et al., 2012). Moreover, a Cox proportional hazards model was made to determine the possible mortality predictors and, as expected, we found that the risk of dying during the first 365 days after surgery was greater for patients with cardiovascular disease and for patients 85 years or older, which shows consistency with other studies (Harstedt, Rogmark, Sutton, Melander, & Fedorowski, 2015; Pugely et al., 2014). Age is a known risk factor, probably because of increased comorbidities, fragility and polypharmacy. It should also be noted that there was a statistically significant difference between the distribution of frequencies for arrhythmias and heart disease between both periods. Even though the patients in the second time period had significantly higher frequencies of cardiovascular disease, mortality rates were lower. We believe this can be attributed to the fact that the program was adequately standardized after its second year. Nonetheless, we cannot guarantee that improvement in patient survival was because of treatment per se, but instead a combination of management techniques.

To our knowledge, only one other study in Latin America (Wagner et al., 2012) has addressed the impact of an orthogeriatric program on morbidity, mortality, and length of stay, and ours is the first comparison in Colombia between the traditional and the orthogeriatric care model. However, this is the first study in Latin America to show a decrease in mortality rates 1 year after the implementation of an orthogeriatric care program. In addition, 1-year mortality rates for our population were lower than other studies conducted in the United States, Europe, Africa, and Asia (Table 4). Even tough patient demographics and orthogeriatric interventions are comparable across the studies shown in **Table 4**, mortality rates are lower in less developed countries (Singapore, Israel, China, Colombia). This not only reflects the effectiveness of an orthogeriatric intervention in these populations, but it also raises awareness of additional factors that might cause these lower mortality rates in less developed countries. We believe that one of the possible explanations relies on the fact that the culture in countries like Singapore,

Table 4. Mortality Rate Comparison Between Different Studies After the Implementation of an Orthogeriatric Model of Care for Fragility Hip Fractures.

Study	Year of publication	Geographical area	30-day mortality	1-year mortality
Asia				
Doshi, Ramason, Azellarasi, Naidu, and Chan	2014	Singapore/Singapore	2.3%	5.9%
Leung et al.	2011	Hong Kong/China	1.8%	11.5%
Shyu et al.	2008	Taiwan/China	1.2%	16.2%
North America				
Koval, Chen, Aharonoff, Egol, and Zuckerman	2004	New York/USA	—	8.8%
Della Rocca et al.	2013	Missouri/USA	—	31.0%
Kates, Mendelson, and Friedman	2010	Rochester/USA	—	21.2%
Europe				
Tarazona-Santabalbina et al.	2012	Valencia/Spain	8.7	25.9%
Vidán, Serra, Moreno, Riquelme, and Ortiz	2005	Madrid/Spain	—	18.9%
Holvik, Ranhoff, Martinsen, and Solheim	2010	Oslo/Norway	7.2%	23.5%
Stenvall, Olofsson, Nyberg, Lundstrom, and Gustafson	2007	Lulea/Sweden	—	16.0%
Suhm et al.	2014	Basilea/Switzerland	6.0%	29.0%
Cogan et al.	2010	Dublin/Ireland	—	34.0%
Barone et al.	2006	Geneva/Italy	—	25.0%
Africa				
Ginsberg, Adunsky, and Rasooly	2013	Tel-Aviv/Israel	1.9%	14.8%
Adunsky et al.	2011	Ramat Gan/Israel	1.9%	14.8%
Oceania				
Thwaites, Mann, Gilchrist, McKie, and Sainsbury	2006	Christchurch/New Zealand	—	18.8%
South America				
Wagner et al.	2012	Santiago/Chile	—	13.0%
Our study (2010-2012 cohort)		Bogotá/Colombia	—	10.9%

China, and Colombia is more family-oriented. Therefore, at discharge, rather than being admitted to rehabilitation centers, most patients return to their family core and postoperative care is performed by their children, siblings or significant others. We believe this could have a positive impact in long-term morbidity and mortality, as the patient remains in a familiar environment and is reintegrated quicker within the community and daily life activities. However, additional studies must be conducted in order to confirm this theory and to find additional factors that might explain such occurrence.

Even though surgical delay was not different between the two cohorts, length of stay after surgery was significantly reduced once the program had been established for 2 years. Efforts must be pursued to decrease time to surgery, as it is one of the mainstays of orthogeriatric programs. Shorter hospital stay decreases iatrogenic complications and promotes faster rehabilitation by allowing early mobilization to a physically active environment (Friedman et al., 2008). A shorter hospital stay is also associated with cost reductions while maintaining the same benefits of treatment, without increasing complication or mortality rates (Dy et al., 2011). Therefore, we plan to conduct a cost–benefit analysis after the implementation of an orthogeriatric program in a Latin American country.

This study has a number of limitations. We must mention the lack of data and follow-up information from patients who were treated at our institution before the Orthogeriatric Program's implementation. Therefore, performing any comparisons between our patients and those treated before them is of extreme difficulty, which was one of the reasons we stratified according to year of admittance. Likewise, any analysis on the impact of this program in terms of survival or mortality rates at our institution cannot be completed. It is worth mentioning that there are multiple covariates associated with mortality and outcome that were not assessed, such as costs and health care system limitations, which can also influence results. Thus, any conclusions made on our population must be carefully weighed when comparing other populations, especially in developed countries, as this model was based on the particular needs of our population and the institution. Finally, because these programs imply different interventions on patients, we cannot directly assess the impact of any specific interventions on mortality.

Conclusion

Geriatric patients with hip fractures usually have multiple comorbidities that increase morbidity and mortality risk, especially 1 year after sustaining the fracture. Our Orthogeriatric Program decreased annual mortality rates, and also revealed the necessity of continuous evaluation during the first 3 months after surgery. This is the first study in Latin America to show a decrease in mortality 1 year after the implementation of such a program. Because our mortality rates were lower than most developed countries, it also suggests the existence of additional influences, such as social factors, that might affect long-term outcomes. Further studies are necessary to confirm such findings.

We firmly believe in the advantages of co-management for hip fracture treatment, and therefore promote the implementation of orthogeriatric programs in Latin America and other Caribbean countries, which will help us deal with complications that arise from the aging population.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

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