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Research Article
Trends in Mortality Rates Due to Osteoporotic Hip Fractures in Ecuador from 1997 to 2016

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Abstract

Background and Objective: Hip fracture (HF) is a major public health concern because of its association with high mortality, particularly in older adults. National trends of in-hospital HF mortality in Ecuador have not yet been assessed. This study analyzed the trends of in-hospital mortality due to HF in the Ecuadorian population and compared with those of other populations. **Materials and Methods:** A time trend analysis based on the Ecuador population from 1997 to 2016 was conducted. Data from The Hospital Discharges Yearbook of Ecuador was used to determine the number of male and female patients aged ≥60 years who were hospitalized with HF. Crude and age-adjusted mortality rates were calculated. Mortality rates were age-standardized with the direct method, using the world population (WHO) as standard. Trends in the mortality rates standardized by age were estimated using Joinpoint regression analysis and expressed as annual percentage change (APC) and average annual percentage change (AAPC). **Results:** There were 895 deaths due to HF (564 women, 331 men). Mortality in men between 1997 and 2016 significantly increased with an estimated AAPC of 2.5%. In women, mortality showed a statistically significant increase with an estimated AAPC of 8.6%. **Conclusion:** Incidence of in-hospital mortality due to HF during the study reference period in Ecuador showed a statistically significant increase in both sexes. Trends observed in Ecuador were not similar to those observed in other countries and required an additional analysis to identify the determinants of this trend.

Key words: Hip fracture, osteoporosis, mortality, trends, epidemiology

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Hip fracture (HF) is a major public health problem because of its association with high morbidity and mortality, particularly in older adults[1]. Although HFs account for <20% of all osteoporotic fractures worldwide, these account for most of fracture-related mortality after the age of 50 years[1,2]. Approximately 80% of all women and 50% of all men with HF are aged >70 years. Ninety percent of cases of HF in the elderly are due to a fall from their own height and only 50% of those who survive their hospitalization recover their previous level of mobility and functional status[3]. In addition, approximately 25% of patients who lived independently prior to HF require long-term nursing care[3].

Patients with HF experience a marked increase in mortality during the months and years following the event as compared with the rest of the population. This excess risk tends to decrease over time; however, it is never completely resolved[1,4]. One-year mortality after HF ranges[3] from 10-35 and 7% of deaths occur during hospitalization[4-8].

Few studies have analyzed temporal trends in mortality rates after HF and the results have been inconsistent[6,8-13]. In Ecuador, no studies have yet examined trends in HF mortality. The objective of the present study was to characterize the national trends of in-hospital mortality rates due to HF in older adults between 1997 and 2016 and to contrast these in-hospital mortality rates with those of other populations.

MATERIALS AND METHODS

A time trend study based on the population of Ecuador from January 1, 1997 to December 31, 2016 was conducted. Data pertaining to the number of male and female patients hospitalized with hip fracture aged $\geq$60 years was sourced from The Hospital Discharges Yearbook of Ecuador.

The Hospital Discharges Yearbook of Ecuador is part of the National Health Surveillance System prepared annually by the National Institute of Statistics and Census of Ecuador. It records the discharge-related data from all public and private hospitals in Ecuador. The data extracted from the hospital records contains demographic and administrative data, hospital discharge status and primary diagnosis at discharge[14]. The following codes of the International Classification of Diseases 10th revision (ICD-10) for diagnosis of HF were included in the analysis: from 1997 to 2016, codes S720, S721 and S722. The variables included the year of death, total population per year, the number of deaths, sex, age, state or province of residence and the code of the basic cause of death. Crude and adjusted mortality rates were calculated by age and sex and are expressed as deaths per 100,000 individuals per year. The age groups included five-year ranges: 60-64, 65-69, 70-74, 75-79, 80-84 and $\geq$85 years. To appraise temporal changes in mortality from HF, mortality rates were estimated annually from the years 1997 to 2016. Mortality rates adjusted for age were standardized by the direct method using the world population (WHO) as a standard. Trends were expressed as annual percentage change (APC) and average annual percentage change (AAPC). Trends in mortality rates were modelled by regression analysis of inflection points (Joinpoint). A final model of best fit was selected with the estimated APC based on a trend within each segment. The trends were presented with their corresponding 95% confidence intervals (CIs). The $p<0.05$ was considered statistically significant.

The AAPC estimate involved the use of the underlying Joinpoint model to calculate a summary measure over a pre-specified fixed interval. This allowed the use of a single number to describe the average of APCs over several years. It is valid even if the Joinpoint model indicates that there were changes in trends of APCs during those years. It was computed as a weighted average of the APCs of the Joinpoint model with weights equal to the length of the APC interval. Joinpoint[15] regression® version 4.5.0.1 was used for data processing.

The design and the study protocol was approved by the Ethics Committee and Research from Teaching Hospital of the National Police, Guayaquil No. 2. Since this is a publicly accessible data base study, it is not necessary to informed consent from each patient according to Ecuadorian legislation. The dataset of medical statistics from INEC (National Institute of Statistics and Census of Ecuador)[14] contains fully anonymized patient data.

RESULTS

A total of 895 deaths due to HF (564 women and 331 men) were recorded during the reference period for this analysis. Hospital mortality due to HF by sex and age group was presented in Table 1.

Most deaths occurred at the age of $\geq$75 years for both sexes. About 88.6% of deaths occurred between those of $\geq$75 years and 11.4% among those of $\leq$75 years. The maximum number of deaths occurred in those aged $\geq$85 years and the number of deaths in women was higher than that of men (Fig. 1).

In the age group of 60-69 years, there was no difference in the absolute number of deaths among men and women.

Table 1: In-hospital mortality due to hip fractures in ecuador by sex and age group

	By gender				Age group												
Years	All females	%	All males	%	60-64	%	65-69	%	70-74	%	75-79	%	80-84	%	≥85	%	Overall
1997-2001	66	58.0	47	42.0	5	4.4	5	4.4	8	7.1	14	12.4	25	22.1	56	49.6	113
2002-2006	71	51.0	67	49.0	5	3.6	2	1.4	10	7.2	16	11.6	33	23.9	72	52.2	138
2007-2011	189	66.0	97	34.0	3	1.0	6	2.1	19	6.6	30	10.5	49	17.1	179	62.6	286
2012-2016	238	66.0	120	34.0	5	1.4	14	3.9	20	5.6	32	8.9	64	17.9	223	62.3	358
Total	564	60.2	331	39.8	18	2.0	27	3.0	57	6.4	92	10.3	171	19.1	530	59.2	895

Data presented as frequency and percentage

Table 2: Mortality attributable to hip fracture: Number of deaths and crude and standardized mortality rates from 1997 to 2016

	Women			Men		
		Ecuadorian population	World standard population		Ecuadorian population	World standard population
Year	Number of deaths	Crude rates	Age-standardized rates	Number of deaths	Crude rates	Age-standardized rates
1997	9	1.15	1.30	8	2.08	2.19
2002	10	1.07	1.96	7	1.48	2.48
2007	24	3.05	2.96	9	0.49	2.81
2012	35	3.73	4.46	19	2.69	3.17
2016	56	5.17	6.19	30	3.75	3.50

Table 3: Joinpoint analysis of hip fracture mortality rates in Ecuadorian males and females

Cohort	Period	APC* (95% CI)	AAPC** (95% CI)	p-value
Men	1997-2016	2.5 (0.3-4.7)	2.5 (0.3-4.7)	p<0.05
Women	1997-2016	8.6 (5.2-12)	8.6 (5.2-12)	p<0.05

*Annual percent change and **Average annual percent change

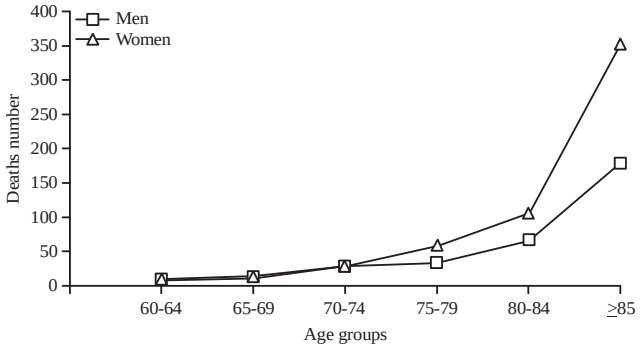

Fig. 1: Mortality due to hip fracture by age and sex from 1997-2016

The mortality curve began to diverge after the age of 70 years, with a predominance of females during the rest of the study period (Fig. 1).

The crude mortality rate in the Ecuadorian population and the standardized rates were presented in Table 2. The absolute number of male deaths due to HF increased from 8 in 1997 to 30 in 2016 (3.8 times) and that of female deaths increased from 9 in 1997 to 56 in 2016 (6.2 times) (Table 2).

At the beginning of the study period (1997), the standardized rates of HF in men were higher than standardized rates of HF in women (Fig. 2); subsequently, an increase in the rates can be observed in both genders up to 2006. After 2006, the increase in rates of HF among women can be observed as being higher than that among men, until the end of the study reference period (Fig. 2). In women, the rates increased from 1.3 per 100,000 in 1997 to 6.19 per 100,000 in 2016 (four-fold increase); in men, the rates increased from 2.19 per 100,000 in 1997 to 3.5 per 100,000 in 2016 (1.6-fold increase).

Mortality among men showed a statistically significant increase during the study period. The estimated AAPC was 2.5% (95% CI: 0.3-4.7, p<0.05), without any identified Joinpoint. Mortality among women showed a statistically significant increase between 1997 and 2016, with the AAPC estimated at 8.6% (95% CI: 5.2-12, p< 0.05), with no identified Joinpoint (Table 3).

DISCUSSION

In this study, the standardized mortality rates from HF showed a statistically significant increase in both genders; however, the increase was more pronounced in women. These results were different from those described in the international literature wherein a tendency for decrease or stabilization of mortality over time has been described[6,16].

Older adults face a higher risk of death after HF; approximately 20-30% die within a year, 13.5% die within 6 months and 7% die during hospitalization[4-6]. In Latin America, 17-37% of patients with HF die in the year following the fracture[7].

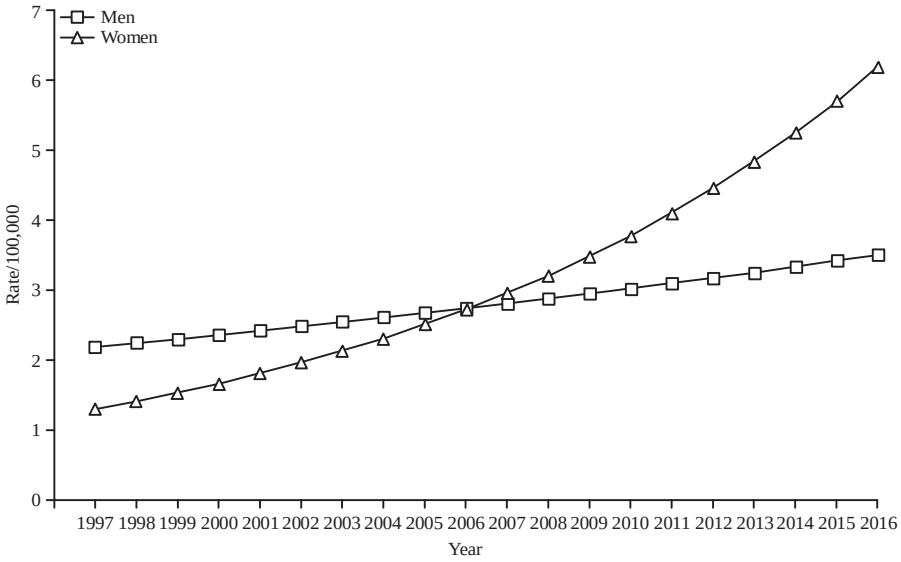

Fig. 2: Trends in hip fracture mortality in ecuador between 1997 and 2016 using a joinpoint regression model for men (squares) and women (triangle)

Post-fracture mortality is higher among men (32-62% per year) than women (17-29% per year)[8]. This gender disparity in mortality was confirmed by a systematic review of excess mortality at one year after HF[17]. Mortality rates also vary with age; patients older than 85 years (33%) experience higher rates than those patients under the age of 75 years (7%)[7]; this is consistent with the results of this study, wherein the majority of deaths (88.6%) occurred at $\geq$75 years of age for both genders and the maximum number of deaths occurred in the age group of $\geq$85 years.

Studies conducted in the 1990s revealed hospital mortality rates between[9,10] 1.6 and 10%. More recently, Mehra *et al.*[18] in their study reported a rate of 3.8%, which increased to 1.5% among Medicare patients aged >65 years[19]. In the US, the hospital case fatality rate is 4.9% among men and 2.6% among women[20].

Previous studies conducted in Latin America had revealed a wide variability in rates of hospital mortality due to HF in different countries (range, 1.02-10%)[21]. In Ecuador, two studies reported post-HF hospital mortality rates of 4.4-5.1% in men and 2.9-3.8% in women[18,19].

Few studies had analyzed the trends in mortality rates after HF and some of these study results had been contradictory[6,8,11-13]. Studies in Europe have described unchanged trends[16] and decreasing[12] of HF mortality rates in periods ranging from 20-40 years. Several studies conducted in the United States indicate a trend of decreasing or stable mortality in recent years[6,9,13,17,21,22]. Orces CH reported that mortality related to HF decreased significantly among older adults between[22] 1999 and 2013. A study in Texas showed that in-hospital mortality from HF decreased 1.8% per year (from 75.4% in 1990 to 60.1% in 2007)[23]. However, the same study found an increase (0.3%) in mortality among women, although the increase was not statistically significant[23].

In 3 studies conducted in Asia in adults 50 or 65 years and older, no changes in crude mortality per year[24] or trends in the standardized rate of mortality by HF[25,26] at 8 or 10 years.

These findings are in contrast to the results of the current study in which there is an increase in standardized mortality rates for HF in both genders. The divergence may be attributable to differences with respect to study design, study populations, data sources and in the choice and duration of the study period. In addition, in the developed countries, the integral treatment of HF has continuously improved during the past 2 decades, unlike integral treatment of HF in developing countries that typically has poor coverage of health systems[27].

The association between male gender and higher mortality was evidenced in previous studies. In-hospital mortality rates are generally higher in men than inwomen[13,17,23,28]. A recent study by Jantzen found a higher mortality rate among men at 30 days and 1 year[29]. A meta-analysis conducted by Haentjens corroborated this finding, showing greater mortality at all ages in men as compared with women[4]. Although the reasons for this gender disparity are unclear, pre-existing comorbidity has been proposed as a possible explanation[29]. These findings were in contrast to the results of the current study in which there is a

temporary trend of higher standardized mortality rates and higher absolute number of deaths in women than in men. This phenomenon is more evident after the age of 70 years when the mortality curve of men and women begins to diverge and such a divergence is predominantly driven by the female sex.

Several limitations of this study need to be considered while interpreting the results.

First, this was a retrospective, observational study and, therefore, not designed to establish causal. Second, The Hospital Discharges Yearbook of Ecuador does not include data pertaining to other risk factors related to in-hospital mortality after HF. Third, it is estimated that HF itself contributes to as a direct cause to death only in 10-24% of all deaths[15] and then other factors such as comorbidity are determinants of mortality. The Hospital Discharges Yearbook of Ecuador does not provide information about comorbidities; therefore, this analysis could not be conducted. Fourth, almost half of the patients over 50 years admitted with an HF previously suffered a fragility fracture[30]. The information contained in The Hospital Discharges Yearbook of Ecuador does not allow for the distinction between first and recurrent HF. Fifth, data pertaining to mortality statistics outside of hospitals were not available, and, therefore, hospital mortality data may have underestimated the actual mortality rates of patients. However, because practically all HF require hospitalization[2] and care is free in hospitals of the public health network, the gap between hospital mortality and actual mortality may not be significant.

One of the main strengths of this study, is its exhaustive coverage of all HF deaths, which is supported by the high "range of completeness" 79-93% of Ecuador's vital statistics registers[31]. Other strengths include the long period of data collection, the national scope of the hospital discharge registry that increases the generalizability of the results and the use of AAPC as an average measure of the temporal trend.

SIGNIFICANCE STATEMENTS

The results of this work should lead to studies in other countries of the region to identify similarities or differences with this trend that have not yet been explored by other researchers. The results of these investigations could lead to establish whether unexplored factors (dermographic, ethnic, quality of vital statistics registers, environmental, climate, or geographical) in each country explain or not this possible contradiction of mortality trends by HF with the trend of other developed countries of the world.

CONCLUSION

In this study the trend of the mortality rate from HF in Ecuador increased significantly in both sexes, being the main increase in women. The analysis of other mortality risk factors that were not included due to the design and origin of the data from this study, could explain the different trends found in developed countries.

REFERENCES

1. Katsoulis, M., V. Benetou, T. Karapetyan, D. Feskanich and F. Grodstein *et al*., 2017. Excess mortality after hip fracture in elderly persons from Europe and the USA: The CHANCES project. J. Internal Med., 281: 300-310.
2. Kanis, J.A., A. Oden, E.V. McCloskey, H. Johansson, D.A. Wahl and C. Cooper, 2012. A systematic review of hip fracture incidence and probability of fracture worldwide. Osteoporos. Int., 23: 2239-2256.
3. Hughson, J., J. Newman and R.C. Pendleton, 2011. Hip fracture management for the hospital-based clinician: A review of the evidence and best practices. Hosp. Pract., 39: 52-61.
4. Haentjens, P., J.S. Magaziner, C.S. Colon-Emeric, D. Vanderschueren, K. Milisen, B. Velkeniers and S. Boonen, 2010. Meta-analysis: Excess mortality after hip fracture among older women and men. Ann. Internal Med., 152: 380-390.
5. Sobolev, B., P. Guy, K.J. Sheehan, L. Kuramoto and E. Bohm, 2016. Time trends in hospital stay after hip fracture in Canada, 2004-2012: Database study. Arch. Osteoporos., Vo. 11. 10.1007/s11657-016-0264-5.
6. Brauer, C.A., M. Coca-Perraillon, D.M. Cutler and A.B. Rosen, 2009. Incidence and mortality of hip fractures in the United States. J. Am. Med. Assoc., 302: 1573-1579.
7. Gonzalez-Montalvo, J.I., T. Alarcon and A.I.H. Sanchez, 2011. Why do hip fracture patients die? Med. Clin., 137: 355-360.
8. Von Friesendorf, M., J. Besjakov and K. Akesson, 2008. Long-term survival and fracture risk after hip fracture: A 22-year follow-up in women. J. Bone Miner. Res., 23: 1832-1841.
9. Maravic, M., P. Taupin, P. Landais and C. Roux, 2011. Decrease of inpatient mortality for hip fracture in France. Joint Bone Spine, 78: 506-509.
10. Hannan, E.L., J. Magaziner, J.J. Wang, E.A. Eastwood and S.B. Silberzweig *et al*., 2001. Mortality and locomotion 6 months after hospitalization for hip fracture: Risk factors and risk-adjusted hospital outcomes. J. Am. Med. Assoc., 285: 2736-2742.
11. Mundi, S., B. Pindiprolu, N. Simunovic and M. Bhandari, 2014. Similar mortality rates in hip fracture patients over the past 31 years: A systematic review of RCTs. Acta Orthop., 85: 54-59.

12. Pedersen, A.B., V. Ehrenstein, S.K. Szépligeti, A. Lunde and Y.T. Lagerros *et al*., 2017. Thirty-five-year trends in first-time hospitalization for hip fracture, 1-year mortality, and the prognostic impact of comorbidity: A danish nationwide cohort study, 1980-2014. Epidemiology., 28: 898-905.
13. Sullivan, K.J., L.E. Husak, M. Altebarmakian and W.T. Brox, 2016. Demographic factors in hip fracture incidence and mortality rates in California, 2000-2011. J. Orthop. Surg. Res., Vol. 11. 10.1186/s13018-015-0332-3.
14. INEC., 2017. Camas y egresos hospitalarios. http://www.ecuadorencifras.gob.ec/camas-y-egresos-hospitalarios/
15. Joinpoint Regression Program, 2017. Joinpoint help manual 4.5.0.1. Statistical Methodology and Applications Branch, Surveillance Research Program, National Cancer Institute.
16. Haleem, S., L. Lutchman, R. Mayahi, J.E. Grice and M.J. Parker, 2008. Mortality following hip fracture: Trends and geographical variations over the last 40 years. Injury, 39: 1157-1163.
17. Abrahamsen, B., T. van Staa, R. Ariely, M. Olson and C. Cooper, 2009. Excess mortality following hip fracture: A systematic epidemiological review. Osteoporosis Int., 20: 1633-1650.
18. Mehra, T., R.M. Moos, B. Seifert, M. Bopp and O. Senn *et al*., 2017. Impact of structural and economic factors on hospitalization costs, inpatient mortality, and treatment type of traumatic hip fractures in Switzerland. Arch. Osteoporos. 10.1007/s11657-016-0302-3.
19. Erickson, B.J., B.U. Nwachukwu, E. Kiriakopoulos, R.M. Frank, B. Levine, L. Villarroel and F.M. McCormick, 2015. In-hospital mortality risk for femoral neck fractures among patients receiving Medicare. Orthopedics, 38: e593-e596.
20. Orces, C.H., 2013. In-hospital hip fracture mortality trends in older adults: The national hospital discharge survey, 1988-2007. J. Am. Geriatr. Soc., 61: 2248-2249.
21. Morales-Torres, J., S. Gutierrez-Urena and Osteoporosis Committee of Pan-American League of Associations for Rheumatology, 2004. The burden of osteoporosis in Latin America. Osteoporos. Int., 15: 625-632.
22. Orces, C.H., 2016. Hip fracture-related mortality among older adults in the United States: Analysis of the CDC WONDER multiple cause of death data, 1999–2013. Epidemiol. Res. Int., Vol. 2016. 10.1155/2016/8970259.
23. Orces, C.H. and A.H. Alamgir, 2011. Trends in hip fracture-related mortality in Texas, 1990-2007. South Med. J., 104: 482-487.
24. Yoon, H.K., C. Park, S. Jang, S. Jang, Y.K. Lee and Y.C. Ha, 2011. Incidence and mortality following hip fracture in Korea. J. Korean Med. Sci., 26: 1087-1092.
25. Chau, P.H., M. Wong, A. Lee, M. Ling and J. Woo, 2013. Trends in hip fracture incidence and mortality in Chinese population from Hong Kong 2001-09. Age Ageing, 42: 229-233.
26. Ha, Y.C., Y.G. Park, K.W. Nam and S.R. Kim, 2015. Trend in hip fracture incidence and mortality in Korea: a prospective cohort study from 2002 to 2011. J. Korean Med. Sci., 30: 483-488.
27. Tandon, A., C.J.L. Murray, J.A. Lauer and D.B. Evans, 2000. Measuring overall health system performance for 191 countries. World Health Organization, Geneva.
28. Wu, T.Y., M.H. Jen, A. Bottle, C.K. Liaw, P. Aylin and A. Majeed, 2011. Admission rates and in-hospital mortality for hip fractures in England 1998 to 2009: Time trends study. J. Publ. Health, 33: 284-291.
29. Jantzen, C., C.M. Madsen, J.B. Lauritzen and H.L. Jorgensen, 2018. Temporal trends in hip fracture incidence, mortality, and morbidity in Denmark from 1999 to 2012. Acta Orthop., 89: 170-176.
30. Braatvedt, G., S. Wilkinson, M. Scott, P. Mitchell and R. Harris, 2017. Fragility fractures at Auckland city hospital: We can do better. Arch. Osteoporos. 10.1007/s11657-017-0353-0.
31. WHO., 2017. WHO Methods and Data Sources for Country-Level Causes of Death 2000-2015. World Health Organization, Geneva, Swizerland, pp: 85.