

Trends in hip fracture rates in Ecuador and projections for the future

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ABSTRACT

Objective. To examine recent trends in hip fracture rates in Ecuador and predict the number of hip fractures over the next decades.

Methods. The *Anuario de Egresos Hospitalarios*, the national database of annual hospital discharges, was analyzed to determine the incidence of hip fractures among those 50 years of age and older in 1999–2008. Census estimates of the population were used as the denominator to calculate hip fracture rates per 100 000 persons. Hip fracture rates were then standardized by the direct method. The annual percentage change in hip fracture rates observed in the different age groups over the study period were used to predict the numbers of hip fractures among older adults by the years 2020, 2030, and 2050.

Results. The number of hip fractures increased from 703 in 1999 to 1 315 in 2008. After controlling for age, hip fracture rates increased by 3.9% annually (95% Confidence Interval, 1.4–6.5), from 46.4/100 000 in 1999 to 62.4/100 000 in 2008. This increase in age-adjusted rates was mainly attributed to an increase in hip fractures among those 80 years of age or older. If the annual percentage change in age-specific rates continues, the total number of hip fractures among older adults in Ecuador will be about 3 909, 8 980, and 47 275 by the years 2020, 2030, and 2050, respectively.

Conclusions. Hip fracture rates increased substantially among persons 50 years of age and older in Ecuador during the study period. As the population of Ecuador ages, the number of hip fractures is expected to increase considerably among those 80 years of age and older.

Key words

Hip fractures; aged, 80 and over; health of the elderly; Ecuador.

Hip fracture represents the most serious complication of osteoporosis and is associated with considerable morbidity, excess mortality, loss of independence, and health care costs (1–4). Although the proportion of persons 50 years of age and older in Latin America was 16.8% in 2005, it is expected to reach 28.6% by 2030 and 38.2% by 2050 (5). These demographic changes alone will result in marked increases in the number of hip fractures occurring among older adults

in the area. Moreover, a recent study (6) estimates that 75% of the burden from hip fractures among older adults will come from Asia and Latin America by the year 2050.

Recent studies on hip fracture in Canada and the United States of America reported a considerable decrease in hip fracture age-adjusted rates since the mid-1990s. This decrease was evident in both males and females, with an onset that precedes large-scale use of diagnostic testing and modern pharmacotherapy (7–9). However, it is uncertain whether hip fractures have also declined in Latin America countries. In fact, the most re-

cent population-based study in Chile, covering the 12-year period from 1982–1993, found a significant increase in hip fracture rates, predominantly among those 75 years of age and older (10). Despite these observations, little is known about recent hip fracture trends in Latin America.

In 2005, the incidence of hip fractures among those 50 years of age and older in Ecuador was reported to be 49.5 per 100 000 (34.8/100 000 males and 63.2/100 000 females). As expected, the number and incidence of hip fractures increased exponentially with age among both sexes and was one of the lowest in

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Latin America (11). Thus, the main objective of this study was to examine hip fracture incidence trends during 1999–2008 in Ecuador. A secondary objective was to predict the number of hip fractures among those 50 years of age and older over the coming decades.

MATERIALS AND METHODS

Ecuador has an area of 256 370 km² and an estimated 13.8 inhabitants, 16% of whom were 50 years of age or older in 2008 (12). Of the total population, 49% lives on the Pacific Coast; 45%, in the Andes Mountains; 5%, in the Amazon area; 0.2%, on the islands; and 0.6%, in areas not delimited (12).

As part of a national health surveillance system, the Instituto Nacional de Estadística y Censos de Ecuador (National Institute on Statistics and Census of Ecuador [INEC]) maintains database and produces an annual publication of all hospital discharges. Known as the *Anuario de Egresos Hospitalarios*, it covers discharges from all private and public hospitals in Ecuador.

In 2008, a total of 771 hospitals reported 983 286 patient discharges to INEC. Of these, 68.6% were discharged from private hospitals; 13.6%, short-stay hospitals; 9.2%, general hospitals, both public and private; and 8.5%, specialty hospitals. Most hospitalizations occurred in the Pacific Coast (49.0%), followed by the Andes Mountain (45.8%), the Amazon area (4.9%), and the islands and areas not delimited (0.1%).

Data extracted from hospital records included demographic and administrative information, discharge status, and a principal discharge diagnosis (13). Discharge diagnoses are coded according to the *International Classification of Diseases*, 10th revision (ICD-10) (14). The data selected for this study pertained to individuals 50 years of age or older who were hospitalized with a principal diagnosis of hip fracture (ICD-10 S72.0-72.2) in 1999–2008.

Population estimates, by age and sex, were used as the denominator to calculate incidence rates per 100 000 individuals. To account for changes in the age distribution of the population over time, hip fracture rates were standardized by the direct method to the 2001 population 50 years of age or older in Ecuador (12). Joinpoint software, version 3.4.0, (15) was used to examine the annual percent-

age change (APC) in rates and corresponding 95% Confidence Intervals (95% CI), assuming a Poisson distribution. The APC is one way to characterize trends over time in which the rates are assumed to change at a constant percentage of the rate of the previous year. For example, if the APC is 1%, and the rate is 50 per 100 000 in 1999, the rate is $50 \times 1.01 = 50.5$ in 2000 and $50.5 \times 1.01 = 51.005$ in 2001. Rates that change at a constant percentage every year change linearly on a log scale (15).

Hip fracture trends were analyzed by gender, by age group (50–59 years of age, 60–69 years, 70–79 years, and ≥ 80 years), and by areas of the country. The APC in hip fracture rates observed in the different age groups over the study period (1999–2008) were used to estimate the incidence of hip fractures in individuals 50 years of age and older in the years 2020, 2030, and 2050. The predicted absolute numbers of fractures were then obtained by multiplying the incidence rates by the estimated numbers of inhabitants (16), the latter being obtained from the Latin American and Caribbean Demographic Center (17). Statistical analysis was performed using SPSS Statistics software, version 17 (18).

RESULTS

In 1999–2008, a total of 8 936 hip fractures occurred among older adults in Ecuador. The mean age of patients was 78.6 years (Standard Deviation [SD]: 11.1) and females constituted 65.7% of the hospitalizations for this injury. Most

of the hip fractures were reported in the Andes Mountains area (61.9%), followed by the Pacific Coast (36.9%), and the Amazon (1.1%). The majority of patients (71.8%) were treated in public hospitals. The in-hospital case fatality rate was 3.5% for the 10-year period. The mean length of hospitalization stay decreased from 13.3 days (SD: 13.2) in 1999 to 10.8 days (SD: 10.4) in 2008.

From 1999–2008, the number of hip fractures increased by 87.0%, from 703 to 1 315 (Figure 1). Moreover, the crude incidence of hip fractures increased 32.1%, from 44.2/100 000 to 58.4/100 000 during the same time period; however, the number of inhabitants 50 years of age or older also increased, by 41.5%. Hip fracture rates increased predominantly among those 80 years of age and older at an annual rate of 5.4% (95%CI: 2.6–8.3), followed by those 50–59 years of age, at an annual rate of 4.0% (95%CI: 0.3–7.8). Conversely, the incidence of hip fractures among individuals in the 60–69 and 70–79 year age groups remained steady over the 10 years of observation (Figure 2). After controlling for age, hip fracture rates increased in 1999–2008 by 3.9% per year (95%CI: 1.4–6.5), from 46.4/100 000 to 62.4/100 000.

In 1999–2008, hip fracture age-adjusted rates among females increased by 4.2% (95%CI: 1.4–7.1) per year from 52.3/100 000 to 72.4/100 000. Similarly, during this period, fracture rates among males increased by 3.4% (95%CI: 0.8–6.0) per year, from 38.5/100 000 to 48.8/100 000. This increase in age-adjusted rates seen in both

FIGURE 1. Annual numbers and age-adjusted hip fracture rates in Ecuador, 1999–2008

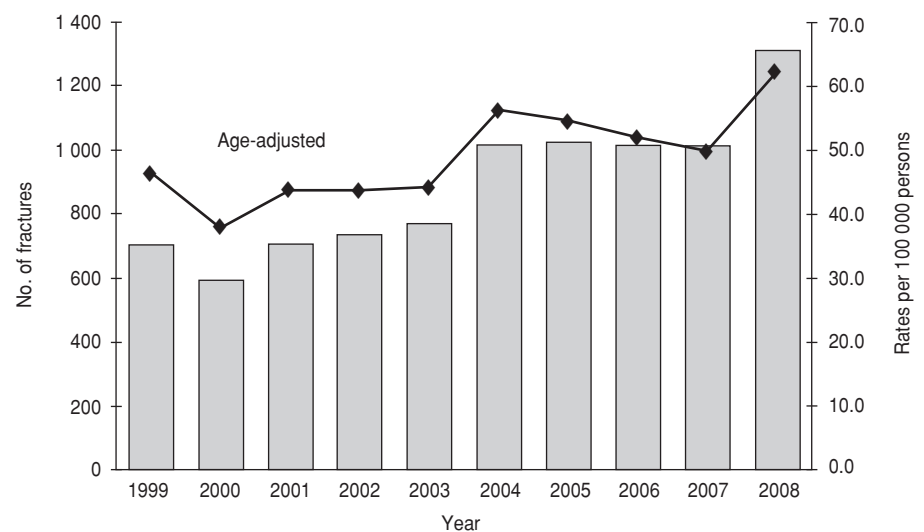
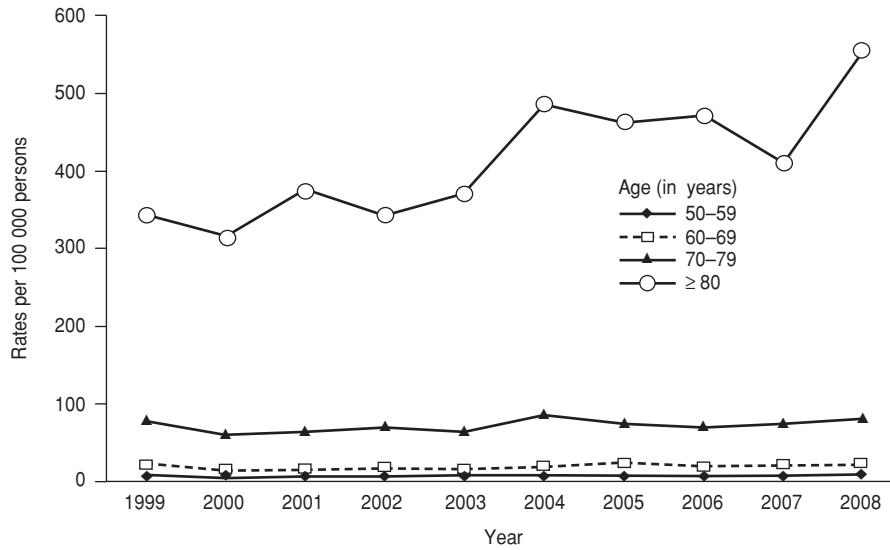


FIGURE 2. Age-specific hip fracture rates in Ecuador, 1999–2008



sexes was mainly attributed to an increase in hip fracture rates among those 80 years of age and older. In fact, hip fracture rates among individuals in this age group increased annually by 5.7% (95%CI: 2.5–9.0) in males, and by 5.2% (95%CI: 2.4 to 8.2) in females.

Although the majority of hip fractures in Ecuador occurred in the Andes Mountains area, the age-adjusted proportion of hospitalizations for hip fracture decreased by 3.3% (95%CI: –5.2 to –1.4) per year in this area, whereas the proportion of hip fractures in the Pacific Coast in-

creased substantially at an annual rate of 5.1% (95%CI: 2.9–7.3). The proportion of hip fractures in the Amazon area remained steady over time (Figure 3).

Assuming the APC in age-specific rates continues, the crude incidence of hip fractures (per 100 000 individuals 50 years of age and older) may be calculated to be 115.0, 198.5, and 677.4 by the years 2020, 2030, and 2050, respectively. Coupled with the increasing size of the elderly population, these figures mean that in the year 2020, the total number of hip fractures among older adults in Ecuador will be about 3 909; in 2030, about 8 980; and in 2050, about 47 275 (Table 1). Overall, the exponential increase in the numbers of hip fractures predicted over the next four decades will be attributed mainly to an increase in hip fractures among those 80 years of age and older.

DISCUSSION

The present study indicates that hip fracture rates among older adults increased substantially in Ecuador in 1999–2008. The increase in hip fractures was seen across age group, sex, and after controlling for age, suggesting that the number of hip fractures is increasing more rapidly than can be accounted for by demographic changes alone. Overall, the increase in hip fractures seen during the 10-year period was mainly attributed to a gradual increase in the incidence of hip fractures among those 80 years of age and older. These findings are consistent with recent studies of secular trends in hip fracture which report that incidence has increased among the oldest old, despite an overall decline in hip fracture rates (19, 20). This right-shift in hip fracture distribution towards the oldest old (> 75 years) is probably due to an increased number of octogenarians, a new population of particularly frail, old people (21).

In contrast with these results, in the United States hip fracture rates decreased during the period 1995–2005 among beneficiaries of Medicare, a government-administered social insurance program (8). The largest decrease, 24%, was observed in females more than 85 years of age, followed by an 18% decrease among females 65–74 years of age. In Canada, hip fracture rates were also reported to decrease by 2.4% per year in 1996–2005 (7). Published data on secular trends in the incidence of hip fractures

FIGURE 3. Age-adjusted proportion of hip fractures by geographic area in Ecuador, 1999–2008

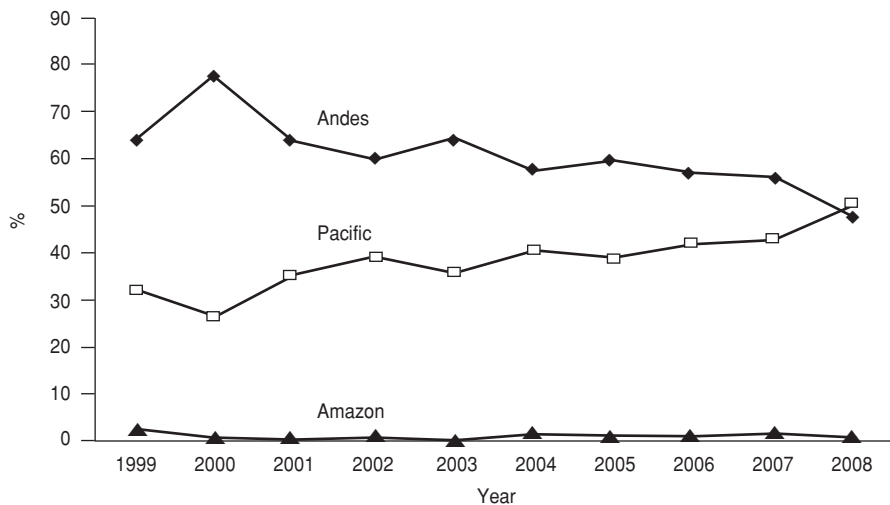


TABLE 1. Estimated population of Ecuador by age group and projected number of hip fractures for the years 2020, 2030, and 2050

Age group (in years)	2020		2030		2050	
	Estimated ^a population	Projected hip fractures	Estimated population	Projected hip fractures	Estimated population	Projected hip fractures
50–59	1 503 719	241	1 867 710	611	2 555 491	1 326
60–69	1 055 333	331	1 384 480	568	2 114 794	1 476
70–79	574 354	559	884 635	990	1 473 000	2 176
≥ 80	265 786	2 778	385 076	6 811	835 371	42 297
Total	3 399 192	3 909	4 521 901	8 980	6 978 656	47 275

^aLatin American and Caribbean Demographic Center, population projections 1970–2050 (17).

are variable, depending on time and location. Some of the studies of hip fracture incidence, in particular those that evaluated earlier data from Northern and Eastern Europe found upward trends in fracture rates (20, 22, 23). More recent studies have found a leveling off or downward trend in fracture rates during the past decade (9, 24, 25).

The precise reasons for increased hip fracture incidence in Ecuador are unknown; however, there are some possible explanations for the present findings. Life expectancy in Ecuador increased from 58.9 years in 1970 to 71.8 years in 2005 and is expected to increase to 78.3 years by 2050 (26). As a result, the proportion of frail elderly at increased risk of hip fracture may be greatest in the youngest birth cohort and account for the reported positive relationship between the birth cohort and hip fracture incidence (27). The increase in hip fracture rates among older adults in Ecuador may also reflect the effect of known risk factors of hip fracture, including decreased physical activity, nutrition (calcium and vitamin D intake), use of psychotropic drugs, lower body mass, frailty, decreased femoral bone mineral density, and increased risk of falling (1, 28).

Moreover, the upward trend in hip fracture rates seen in Ecuador in 1999–2008 may be partially explained by the lack of a structured nationwide osteoporosis and fall prevention program. To demonstrate the impact of osteoporosis prevention on hip fractures, a recently published prospective observational study (29) conducted with members of a Health Maintenance Organization (HMO) in California (United States) was conducted to evaluate the effectiveness of the Healthy Bone Program in managing osteoporotic disease in 650 000 patients in

2002–2007. After the implementation of the program, the dual x-ray absorptiometry scan utilization rate and the number of patients receiving antiosteoporotic medications increased by 263% and 153%, respectively. Moreover, hip fracture rates were reduced from 31%–54% at each of the 11 participating medical centers during the study period, which meant 970 hip fractures prevented in 2007 alone among 3.2 million HMO members (29).

Although the validity of hip fracture projections is dependent upon reliable and stable incidence rates and accurate population projections, assuming the APC in age-specific rates continues, the number of hip fractures in Ecuador is expected to increase exponentially over the next decades predominantly among those 80 years of age and older. In fact, it is projected that 89% of hip fractures will occur in this age group by the year 2050.

One of the interesting findings of this study was the marked geographic variation of hip fractures in Ecuador. Overall, the majority of hip fractures occurred in the Andes Mountains area during the study period. However, there was a significant increase in the incidence of hip fractures in the Pacific Coast area. This geographic variation of fracture rates suggests that some risk factors that contribute to fracture of the hip may vary throughout Ecuador. Such factors could increase the number of falls in the elderly or increase the rate of bone loss at an earlier age. Previous studies have suggested that nutritional, socioeconomic, or environmental factors may explain the differences in fracture rates seen between geographic areas (30). Moreover, the internal migration of inhabitants from several provinces of the Andes Mountains area to the Coastal area over the past two decades may have accounted for the up-

ward trend in hip fractures seen in this area (31). The effect of internal migration on hip fracture risk has been reported in a previous study showing that the relation between geographic location and hip fracture risk is stronger for area of residence early in life than for area of residence at the time of fracture (32).

The limitations of this study must be mentioned in interpreting the results. First, hip fracture hospitalization rates may be overestimated, as it was not possible to identify patients who were transferred from another study hospital. Second, the number of hip fractures may have been under- or overestimated by misclassification of the disease. However, hip fractures are clearly categorized in the ICD-10 and hip fracture coding has been proven for accuracy (33). Third, the number of cases would be underestimated if patients were treated outside of a hospital, although approximately 85%–100% of all patients with hip fracture are hospitalized (34). Finally, the *Anuario de Egresos Hospitalarios* database used in this study has not been validated for use in collecting data on hip fracture patients. Despite these limitations, this study is the first to report population-based trends in hip fractures among older adults in Ecuador.

In conclusion, hip fracture rates increased substantially among adults 50 years of age and older in Ecuador during the study period. As the population of Ecuador ages, the number of hip fractures is expected to increase considerably among the oldest old over the next decades. These findings should urge public health authorities in Ecuador, and other countries with similar demographics, to promote effective programs of osteoporosis and fall prevention among older adults.

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RESUMEN

Tendencias recientes y proyecciones futuras de las tasas de fractura de cadera en el Ecuador

Objetivo. Examinar las tendencias recientes de las tasas de fractura de cadera en el Ecuador y predecir el número de casos que se presentará en los próximos decenios.

Métodos. Se analizó el Anuario de Egresos Hospitalarios para determinar la incidencia de fractura de cadera en las personas a partir de los 50 años de edad entre 1999 y el 2008. Con el fin de obtener las tasas de fractura de cadera por 100 000 habitantes se utilizaron en el denominador los cálculos del censo de población. Las tasas de fractura de cadera se ajustaron luego mediante el método directo. La variación porcentual por año de las tasas de fractura de cadera observada en los diferentes grupos de edad en el período del estudio permitió la predicción del número de casos que se presentará en los adultos mayores para los años 2020, 2030 y 2050.

Resultados. El número de fracturas de cadera aumentó de 703 en 1999 a 1 315 en el 2008. Después de controlar la variable edad, se encontró que las tasas de fractura de cadera aumentaron en 3,9% anualmente (intervalo de confianza de 95%: 1,4-6,5), de 46,4 casos por 100 000 habitantes en 1999 a 62,4 casos por 100 000 habitantes en el 2008. Este aumento de las tasas ajustadas por edad se atribuyó principalmente a una mayor frecuencia de las fracturas a partir de los 80 años de edad. En caso de que el porcentaje de variación anual de las tasas específicas en función de la edad permanezca estable, el número total de fracturas de cadera en los ancianos en el Ecuador será cercano a 3 909 en el año 2020, a 8 980 en el 2030 y a 47 275 en el 2050.

Conclusiones. Durante el período de estudio las tasas de fractura de cadera aumentaron sustancialmente en las personas de 50 años de edad y mayores en el Ecuador. Se prevé que a medida que la población del país envejezca, el número de fracturas de cadera aumentará en forma considerable en las personas a partir de los 80 años de edad.

Palabras clave

Fracturas de cadera; anciano de 80 o más años; salud del anciano; Ecuador.