

Clinical characteristics and impact of treatment gap of fragility fractures in Colombia: experience of 10 Fracture Liaison Services (FLS)

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Background & aims. Fragility fractures are those caused by low-energy trauma or falls from standing height. The mortality after the first year of suffering a hip fracture ranges from 15 to 30%. This problem has been addressed through the creation of interdisciplinary programs for fragility fracture early diagnosis and prevention. Describing the clinical characteristics of a cohort of patients diagnosed with fragility fractures in 10 fracture liaison services in Colombia.

Methods. Led by the Asociación Colombiana de Osteoporosis y Metabolismo Mineral, this is a cross-sectional descriptive study, in patients with a diagnosis of fragility fracture in 10 fracture liaison services. Demographic and clinical variables were described for one year from the diagnosis of the fracture.

Results. were analyzed 1699 records of patient fractures between 50 and 101 years of age, 1334 were women (76.5%), 581/1484 (39.1%) had previous fragility fractures, 570/1599 (35.7%) had a previous diagnosis of osteoporosis. Of these, 70/1051 (7%) received anti-osteoporosis medication, and 311/733 (42.4%) received it post-fracture. Of the total records with information, 65/707 (9.2%) died the following year of the fracture.

Conclusions. Fracture prevention programs in institutions allow for de-

tecting patients with fragility fractures, clinical characteristics of these, in addition to strengthening the conditions of a centralized national registry, based on the parameters of the International Osteoporosis Foundation - Capture the Fracture program, through strategies with multidisciplinary personnel.

Key words: osteoporosis, fractures bone, hip fractures, mortality, registries, therapy

INTRODUCTION

Fragility fractures are those caused by low-energy trauma or falls from standing height, as a consequence of the deterioration of bone microarchitecture and quality caused by osteoporosis. These fractures occur more often in women than in men ¹, and their incidence increases after the fifth decade of life, the hip being the most frequent place, in relation to menopause, with a reported prevalence of 39 to 50% in women and 13 to 22% in men. Approximately 3.5 million new cases per year have been reported in Europe, a figure expected to double by 2050 ^{2,3}. The impact on post-fracture hip functionality, this being the most frequent, shows a permanent disability of 40% and an inability to perform daily activities of 80% ⁴. The mortality after the first year of suffering the hip fracture ranges from 15 to 30% ^{4,6}. Similarly, the direct cost of treating fragility fractures has been described at USD \$ 7000 per event, regardless of the location of the fracture, with an average of 10 days of hospitalization, and according to calculations made by direct care, the derived costs between 2016 and 2050 could reach USD \$ 228 billion ^{3,7}. This worrying situation adds to the change in the population pyramid, where the increase in the population over 50 years of age worldwide is evident, impacting the risk factors for osteoporosis, and therefore, fragility fractures. Colombia is no stranger to this reality, given that the prevalence of lumbar osteoporosis has been described in people over 50 years of age around 15.7%, with an annual fragility fracture rate of 8000 to 10,000 cases ⁸. Despite having several osteoporosis medications available to them, 8 out of 10 women do not receive treatment in the year following an osteoporosis-related fracture ⁹.

This problem has been addressed through the creation of interdisciplinary programs for the early diagnosis and prevention of fragility fractures, such as the Kaiser bone health program, which has shown a 40% reduction in the incidence of new fractures and 51% of hip fractures in 3 years ¹⁰. In other reports of studies of fracture patients, after a fracture prevention program was

established the number of treated patients increased between 2 and 3 times, compared to the baseline ¹¹.

These initiatives have been led by international organizations, as proposed by the International Osteoporosis Foundation (IOF). One of them, denominated "Capture the Fracture" has had a relevant impact on the prognosis of these patients ¹¹.

The implementation of these international strategies requires that there be local leaders in each country, in order to provide viability to these projects. These projects have shown reductions both in the incidence of fractures after the first fragility fracture and in post-fracture mortality, which has a direct impact on the costs of care and in the indirect ones that are related to the quality of life of the patients as well as their caregivers. For this reason, the creation of a population registry would give way to a closer knowledge of this critical reality. Additionally, this would turn into a space where the participation of referring institutions that offer comprehensive management of these patients could be socialized at the national level, in order to publicize the behavior of this pathology in our country.

In this context, the Asociación Colombiana de Osteoporosis y Metabolismo Mineral (ACOMM), with the support of the IOF, has joined the initiative of "Capture the Fracture", where it hopes to build a national database and institutionalize fracture liaison services (FLS). This study describes the clinical characteristics of a cohort of patients diagnosed with fragility fractures of 10 FLS in Colombia, constituted in a multidisciplinary manner during one year of follow-up.

PATIENTS AND METHODS

A descriptive cross-sectional study was conducted, which describes a group of patients diagnosed with fragility fractures, as a result of an initiative of the ACOMM, in order to build the first national registry of fragility fractures, for which 10 centers were invited and each one submitted their respective databases. The research group compiled and consolidated the data in order to determine the most relevant variables for the description of the first registry initiative.

Fragility fracture was defined as the fracture caused by minimal trauma and/or by a fall from standing height. This definition was taken into account by common agreement by the researchers, to determine the selection criteria for each of the records. Selection criteria: all patients with a previously defined fragility fracture diagnosis were included. Exclusion criteria: patients with malignancy or traumatic fractures. Consequently, the study obtained variables including sociodemographic factors, comorbidity, history of osteoporosis by

densitometry and its previous medical management, history of fragility fracture and location (hip, forearm, humerus proximal, reported by the patient and vertebral fractures diagnosed by radiography), surgical and medical treatment after the fracture, the time between diagnosis and surgical treatment, and mortality within the first year of the fracture. As stated above, 10 health care centers in four cities in Colombia participated in the project: Hospital de San José (Bogotá), Hospital Universitario de La Samaritana (Bogotá), Hospital San Blas (Bogotá), Hospital Universitario San Ignacio (Bogotá), Fundación Santa Fe (Bogotá), Hospital Universitario Clínica San Rafael (Bogotá), Hospital Santa Clara (Bogotá), Hospital Universitario del Valle (Cali), Hospital Universitario San Vicente Fundación (Medellín), and Hospital de Caldas (Manizales). From the matrices sent by the centers, information was consolidated in a database with the common variables that allowed describing the patients and the centers included.

Once the information was consolidated, despite its variability, it was validated against the coding that each center sent, and as a result, a large database was built which included the variables that the centers and the researchers homogeneously considered important for the analysis. For this, a descriptive analysis of the information was performed. The qualitative variables were presented with absolute and relative frequencies, and the quantitative variables were presented with measures of central tendency and dispersion, according to the distribution of the data. The data processing was done in Excel and the analysis in STATA¹⁴.

With regards to ethical considerations of research with human beings, this registry took into account national regulations (resolution 8430 of 1993) and was classified as a risk-free investigation, taking into account that it deals with information collected retrospectively. In the same way, it was endorsed by the ACOMM academic committee.

RESULTS

Information was collected from 10 fragility fracture care centers in 4 cities in Colombia, which responded to the call made by ACOMM. The information analysis led to identifying some variables in common, and others that are presented below, but that are not in all the centers, which will be part of the discussion, hoping in the future to homogenize the collection of information. The institutions that participated are reference hospitals that are characterized by attention to pathologies of high complexity, some of them are university, and multidisciplinary hospitals, with the participation of clinicians and orthopedists.

The databases were consolidated, and 1699 patient records were obtained, between 50 and 101 years old, with a female representation of 1334 patients (76.5%). With regards to weight and height ($n = 685$), a median weight of 60 kg was determined, with an interquartile range (IQR) of 52-66, while the median size was 1.52 (IQR: 1.48-1.6).

Weight and height were described according to sex, obtaining the following results: female: weight median 59 kg (IQR: 51-65), height median 1,5 mt (IQR: 1.47-1.56), and male: weight median 63 kg (IQR: 55-70), height median 1,64 mt. (IQR: 1.57-1.68).

Among the secondary causes of osteoporosis, the most frequent are: diabetes mellitus, insufficient vitamin D and corticosteroid therapy. The rest of the general characteristics of the population are presented in Table I.

Once patients were evaluated by each center and fragility fractures were diagnosed, different variables that allowed characterizing the population were analyzed.

Variables referring to the pathological history and toxicological history were included within which alcohol consumption and smoking were analyzed (Tab. I). Likewise, in the case of the toxicological history, information for alcohol consumption was reported in 872 patients, of which 74 (8.4%) consumed alcohol (3 or more units of alcohol daily),

Table I. General characteristics of the population.

| | n | % |
|---|----------|---------|
| Sex (n = 1699) | | |
| <i>Female</i> | 1334 | 76.5 |
| <i>Male</i> | 365 | 21.5 |
| Age - median (IQR †) | 79 | (70-84) |
| BMI ‡ - median (IQR †) | 25.3 | (22-28) |
| Secondary causes of osteoporosis | | |
| Pathologies | | |
| <i>Vit-D insufficiency </i> | 145/632 | 22.9 |
| <i>Diabetes</i> | 134/1064 | 12.6 |
| <i>Rheumatoid arthritis</i> | 48/980 | 4.9 |
| <i>Malabsorption syndrome</i> | 14/419 | 3.3 |
| <i>Hypogonadism</i> | 17/632 | 2.7 |
| Pharmacotherapy | | |
| <i>Corticosteroids **</i> | 61/788 | 7.7 |
| <i>Anticonvulsants</i> | 13/296 | 4.4 |
| <i>Antipsychotics</i> | 20/460 | 4.3 |
| <i>Antidepressants</i> | 7/184 | 3.8 |
| Toxicological history | | |
| <i>Smoking</i> | 251/1147 | 21.9 |
| <i>Alcohol consumption</i> | 73/872 | 8.4 |
| Mortality * | 63/673 | 9.3 |

† interquartile range; ‡body mass index; *after a year of fracture; **≥ 5 mg/day for 3 months or equivalent, || ≤ 30 ng/dl. For the variables: secondary causes of osteoporosis, pharmacotherapy, toxicological history and mortality, in the denominator was taken into account the total number of patients with reported records.

Table II. Prescription details of osteoporosis medications prior to the diagnosis of fragility fracture and after hospital treatment.

| Medication | Before † n (%) | After ‡ n (%) |
|--------------------|-------------------|------------------|
| Calcium | 75 (47.7) | 262 (62.9) |
| Vitamin D3 | 32 (20.3) | 72 (17.3) |
| Alendronate | 42 (26.7) | 37 (8.8) |
| Ibandronate | 2 (1.2) | 1 (0.2) |
| Risedronate | 2 (1.2) | 1 (0.2) |
| Zoledronic acid | 9 (0.9) | 83 (20) |
| Strontium ranelate | 0 (0) | 3 (0.7) |
| Raloxifene | 0 (0) | 0 (0) |
| Teriparatide | 9 (5.7) | 110 (26.4) |
| Denosumab | 6 (5.7) | 76 (18.2) |

Patients with prescription medication prior to fragility fracture † (n = 162), and with prescription after hospital discharge ‡ (n = 439).

and for smoking in 1147 cases of which 251 (21.9%) had this antecedent. When evaluating the history of previous fragility fractures, 1484 (87.3%) records were reported of which 581 (39.1%) reported having suffered a fracture. The antecedents related to the causes of secondary osteoporosis were described, which included pathologies and drug uses that have been shown to be a direct cause of loss of bone density, the detail is described in Table I. Regarding the antecedents of osteoporosis, it was determined that of 1599 (94.1%) patients who reported information, 570 (35.7%) had a previous diagnosis of osteoporosis, and of these, it was possible to identify that 180 (31.5%) were receiving pharmacological treatment (anti-osteoporosis, calcium and vitamin D drugs), this means that a previous pharmacological management was prescribed to 10.6% of the total of the registries. Of the 1051 records with a report of administration of osteoporosis medication prior to fragility fracture 162 (15.4%) received treatment. In the case of the post-hospital prescription, 733 patients were reported of which 439 (59.9%) received medical treatment. Of these patients, only 70 (7%) received anti-osteoporosis medication (antiresorptive or osteoforming therapy), and after the fracture, 311 (42.4%). The details of the medications used are presented in Table II.

In relation to sex and age, the median age in years for women was 79 (IQR: 70-85), minimum age of 50 and a maximum of 101, similar to that of men, 79 (IQR: 71-84), minimum age of 50 and a maximum of 99. Age was categorized in order to find out the frequencies of presentation, finding that 108 (6.3%) were under 60, 326 (19.2%) were between 60 and 70, and 1265 (74.4%) were older 70 years old age was also explored according to the location of the fracture, which is presented in Table III. When describing fragility fractures, an anatomical distribution was found, and it is presented in Figure 1.

When evaluating surgical management, information was reported on 677 (39.8%) cases, of which 541 (79.1%) were taken to surgery, and the time in days from the diagnosis of fragility fracture to the surgical procedure was presented as follows: between 1 and 2 days, 182 (40%), 3 to 5 days 162 (35.6%), 6 to 9 days 87 (19.1%) and more than 9 days 24 (5.2%).

The proportion of patients with a history of osteoporosis and previous treatment for this pathology was explored, according to the anatomical location of fracture due to current fragility (Tab. IV).

Of the patients with a history of osteoporosis, 379 (74.5%) reported having had a previous fragility fracture. With respect to mortality, clarifying that this study does aim to determine causality, it was determined that of the total information reported (n = 707), 65 (9.2%) died during the first year after the fracture. Similarly, mortality was calculated according to the fracture site, finding that of the total number of deceased patients (n = 63), 40 (61.6%) had hip fractures, 8 (12.4%) in the proximal humerus, 8 (12.4%) in wrist, 5 (8%) in vertebral, and 4 (6.1%) other fractures. Of the total number of patients with hip fracture, 40 died (8.1%).

DISCUSSION

Fragility fractures have become a public health problem worldwide, which is related to the increase in the population over 50, which is susceptible to osteoporosis. These changes are directly related to the increase in the elderly population and the decrease in perinatal

Table III. Age according to fracture site.

| Age | Fracture location | | | | | Total (n = 1678) |
|-------|-------------------|------------|------------------|------------|----------|---------------------|
| | Hip | Vertebral | Proximal humerus | Wrist | Others | |
| < 60 | 43 (39.8) | 18 (16.7) | 4 (4.6) | 35 (32.4) | 7 (6.5) | 108 (6.4) |
| 61-70 | 163 (51) | 87 (27.2) | 11 (3.4) | 44 (13.7) | 15 (4.7) | 320 (19) |
| > 70 | 770 (61.6) | 214 (17.1) | 53 (4.2) | 135 (10.8) | 78 (6.2) | 1142 (68) |

n (%)

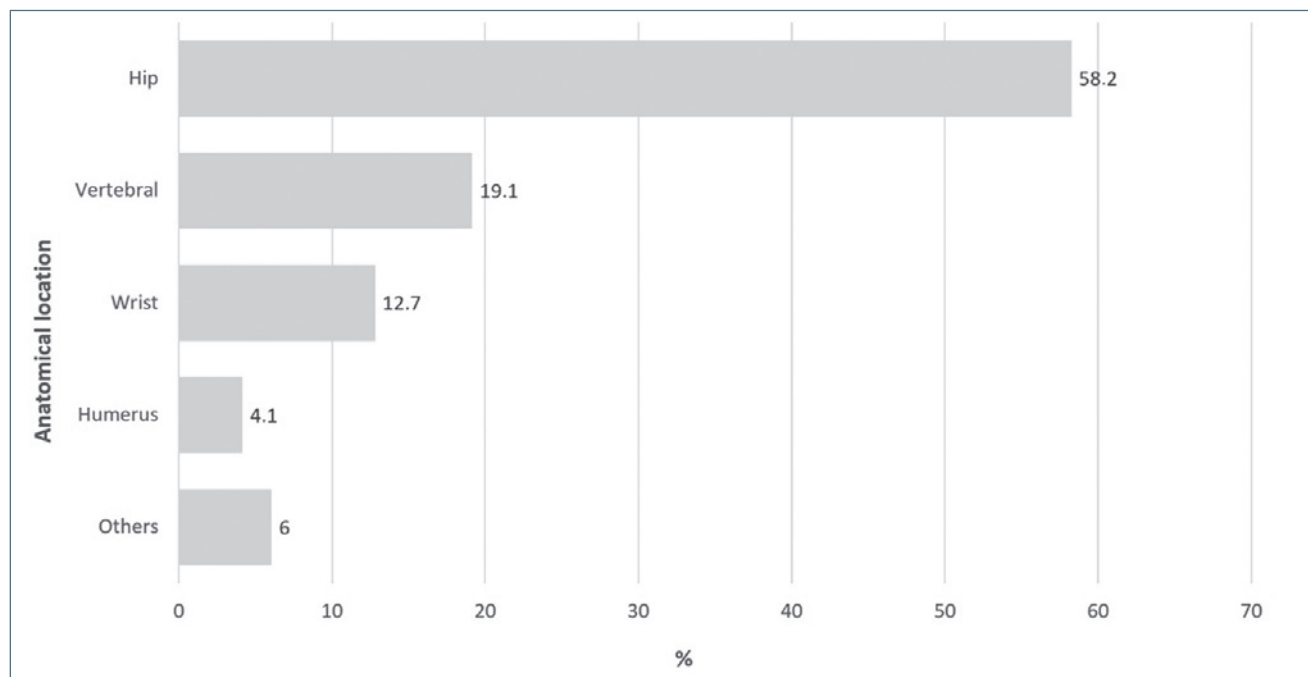


Figure 1. General anatomical description of fragility fractures.

Table IV. Anatomical location of the fractures according to the history of osteoporosis and previous medical treatment.

| Previous pharmacological treatment for osteoporosis | | | History of osteoporosis | | | |
|---|-----------|------------|-------------------------|------------|------------|-------|
| Anatomical location | YES | NO | Total | YES | NO | Total |
| Hip | 98 (14.7) | 557 (85.3) | 655 | 203 (22.3) | 686 (77.1) | 889 |
| Vertebral | 31 (24.4) | 96 (75.6) | 127 | 221 (69.4) | 95 (30.1) | 316 |
| Humerus | 6 (11.7) | 45 (88.3) | 51 | 23 (33.3) | 46 (66.6) | 69 |
| Wrist | 17 (10.1) | 152 (89.9) | 169 | 65 (31.5) | 141 (68.5) | 206 |
| Others | 10 (20.4) | 39 (79.6) | 49 | 40 (40.8) | 58 (59.2) | 98 |

n (%)

mortality, showing a transformation in the demographic pyramid ¹². It is estimated that by 2006 there were 200 million cases of osteoporosis, with projections of 20 million new cases by 2020, where the distribution by age range increases the prevalence as follows: 10% between 60-70 years, 20% between 71-80 years, 40% between 81-90 years and 66% in people over 90 years ¹². In the last decade, in Europe, Asia, and America, it has been identified that osteoporosis has not only increased its prevalence but has become one of the pathologies with more demand in health services, above cancer and arthritis rheumatoid, which historically had been diseases that characterized the elderly population ¹³.

According to the above, and analyzing the results of this study, only 35.6% of the population had a previous diagnosis of osteoporosis, and of these, 40% had been receiving treatment, which contrasts with a descriptive

cross-sectional study of a university hospital in Bogotá, Colombia, published in 2019, which included 111 patients diagnosed with fragility fractures, of which 33 patients (21%) had a history of osteoporosis ³. This evidences the great problem that a large part of the Colombian population probably faces, since 70% do not know their disease, and therefore, are not aware of the risk of a fracture. When contrasting our results with studies reported by Cohen and Terence, who report previous diagnoses of osteoporosis in patients with 45% fragility fractures, it is evident that there is a need to strengthen the conditions of a national and centralized registry, based on the parameters of the IOF program - Capture the Fracture, as well as the urgency of implementing in a homogeneous way the strategies of the same program, which could reach higher prevention percentages, hoping to reduce fracture, re-fracture and mortality fracture rates ¹⁴.

By the same token, the identification of risk factors that have proven to be predictors of mortality in patients with fragility fractures allows their intervention in a timely manner. Among these factors are advanced age, smoking, low bone mineral density and presence of comorbidities. These variables, which were mostly included in our study, could be the starting point to estimate the patient's risk of suffering an osteoporotic fracture, associated mortality and disability in our population and thus recognize its impact on the health system.

When analyzing the data obtained in all fragility fractures of different anatomical locations, it is observed that only 35.6% had a previous diagnosis of osteoporosis, even though the percentage of previous fragility fracture was 39.1%. It is striking that mainly in the hip fracture (58.6%), and in the majority of cases in which the diagnosis of osteoporosis was known, there was no prior antiresorptive or osteoforming treatment. This correlates with the study by Cuddihy M-T, in which 8 out of 10 women did not receive treatment in the year following an osteoporotic fracture⁹.

The establishment of medical treatment for osteoporosis, along with other measures is necessary to avoid subsequent fractures, because after the osteoporotic fracture occurs, there is an 86% risk of subsequent refractures¹⁵.

Regarding the time between the diagnosis and the surgical procedure, it is important to note that this period is directly related to the prognosis of the patient, specifically with morbidity and mortality, taking into account in-hospital infections, injuries due to long periods of immobility (thrombus embolisms, pressure sores, and psychiatric pathologies, among others), and the impact on quality of life^{16,17}. Thus, the recommendation according to the literature, about the ideal time, is that the surgical procedure is performed between 24 and 48 hours after diagnosis. This is argued in studies where medians between 1.8-3 days are reported, which contrasts with the results of this study where a median of 4 days was evidenced (IQR: 1-10), which implies a review of the processes, since 60% ($n = 455$) of the population was taken to surgery 72 hours after. This reflection obliges fragility fracture care centers to improve the opportunity for attention and reduce the time for surgery, once the indication for surgery is identified^{18,19}.

The post-fracture anti-osteoporosis treatment was 43.6% similar or greater than expected in the different programs for prevention of second fragility fracture, as observed in other studies of Gardner with an increase to 42% ($p = 0.036$), Davis, 68% ($p < 0.05$) and Majumdar 52% ($p < 0.001$)¹¹. In our study, before the fracture, only 7.4% received antiresorptive or osteoforming therapy, the majority received calcium and vitamin D; after the fracture, within each FLS and in the data that were

recorded, the percentage that received antiosteoporosis treatment rose to 43.6%, in contrast to a local study in which a post-fracture treatment rate of 10% was found in a population of 111 patients with fragility fractures³. An explanation for the change in the treatment gap before and after the fracture is the elaboration and dissemination of the second Colombian consensus of postmenopausal osteoporosis, in which management guidelines are given for patients at high risk of fracture, such as those have suffered a previous osteoporosis fracture, or are elderly; This is how medications such as zoledronic acid, denosumab and teriparatide increase markedly in their percentage of post-fracture use²⁰. Data on the reduction of the incidence of re-fracture could not be analyzed in our study, as a 40% reduction in the incidence of hip fracture is reported in the Kaiser bone health program (California-USA), or as reported by Marsh, D, of a re-fracture risk reduction of up to 51% after the implementation of a FLS in 3 years¹¹.

Notably, the most common type of fracture in our study at any age was the hip, contrary to what is observed in previous studies, in which the fracture of the distal forearm predominates in women under 60 years of age and the hip, in those older than 70²¹. This could be explained because, most patients are operated or hospitalized, unlike what happens with fractures of the distal and vertebral forearm. It is also noteworthy that our study, compared to the LAVOS study (Latin American Vertebral Osteoporosis Study), which included five countries: Argentina, Brazil, Colombia, Mexico and Puerto Rico, a very similar general prevalence for vertebral fracture was found: 14%⁸.

Hip fractures should be considered a relevant cause of mortality, since in men and women they cause 37 and 25% respectively, one year after the fracture occurred¹². There is also the impact of fragility fractures on quality of life such as the return of functionality, which is only achieved in 50% of cases, the presence of chronic pain in 80% and the probability of 60% of presenting new fragility fractures¹². In our study, mortality was 9.1%, within the year following the fracture, and when evaluating by anatomical location, the hip was the most frequent, being present in 63% of deceased patients. Mortality in hip fracture patients was lower than reported in the literature, with a percentage of 8.1 compared to 15 to 30% in the first year after the fracture occurred⁴⁻⁶. It is important to mention that less than half of the records reported all data. This mortality is lower than that reported in other studies, possibly due to lack of patient follow-up, since many of them are not seen again in the institution where they were operated or admitted, with the consequent under-recording, and due to positive factors such as impact of the increase in the number of patients with post-fracture treatment

and reduction in the time elapsed from admission to surgery that was 1-5 days, by 76%. The functionality variables of 2 ortho-geriatric centers were not included, because they were not the variables requested from all other SEFs, however, it is important, in the future, to consider including them.

Gittoes et al. not only mentioned the importance of these comprehensive care programs for fragility fractures, but they suggested some elements that should be part of both the registries and the programs ¹⁵: identifying patients with fragility fractures for care and treatment, building population records to analyze the behavior of the associated risk factors and the prognostic factors of our population, structuring pedagogical strategies for patients to work together to prevent fragility fractures, timely intervening in the pharmacological and non-pharmacological management for osteoporosis and the prevention of second fractures, and structuring interdisciplinary programs at all levels of care to ensure patient coverage.

It is important to mention that these strategies have proven effective since they reduce the incidence of fragility fractures by 51%, second fragility fractures by 80% and mortality by 33% ²².

Although the contribution in the national epidemiology of the characterization of fragility fractures, and the impact of SEFs on the therapeutic gap are the main strengths of our study, its weaknesses are based on the fact that the registration of the information was not homogeneous, as the variables included are not similar in all centers by collection characteristics. This heterogeneity did not allow for establishing the main comorbidities as well as, whether or not there was a risk of falls program, depending on its location, and the follow-up of treatment, re-fracture, and death.

All of the above, not only obliges our hospitals and the health system to consider the formal implementation of the programs but also to build a registry to monitor the behavior of fragility fractures since the contribution of consolidated statistical data would allow establish population parameters as possible explorations in the associations of variables that would be collected continuously and that would probably be representative of the Colombian population. Similarly, the analysis of this registry would give way to the ACOMM as leader of the registry to be able to elaborate statements for making homogeneous decisions and contribute elements to public policy as scientific unionization. This first description of patients with a diagnosis of FF would be the gateway to standardize the registry, constitute a follow-up strategy and use the information to improve the quality of life of patients, in addition to supporting aspects in public policy to reduce barriers to access in this disease ¹¹.

CONCLUSIONS

This is the first Colombian registry of fractures, which identifies demographic data, diagnosis of osteoporosis, fracture, and treatment, prior to the fracture, as well as post-treatment, mortality and comorbidity. Given the heterogeneity of the data, it is necessary to strengthen the conditions of a centralized national registry, based on the parameters of the IOF – Capture the Fracture program, as well as prioritize the homogeneous implementation of the strategies of the same program, which could reach percentages of higher prevention, hoping to reduce the rate of fractures due to fragility, re-fracture and mortality. In that order of ideas, it is imperative to propose strategies in each institution, and involve more multidisciplinary personnel for the excellent performance and achievement of goals in each FLS. It is important to clarify that the goals of this study was not to establish causality among variables, but to describe the patients' clinical characteristics, including the mortality of patients with FFs.

Limitations

This study was built upon the initial proposal for a national FF registry. However, the heterogeneity in the report of included variables did not allow for gathering the complete records of all 10 centers.

Ethical consideration

This manuscript was classified as a risk-free investigation because the information was collected retrospectively. The ethical considerations of research with human beings were based on national regulations (resolution 8430 of 1993) and were endorsed by the ACOMM academic committee.

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Author contributions

All the authors contributed in the development of this manuscript.

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