Objective: To evaluate the profile of patients with osteoporotic fractures treated at a tertiary orthopedic hospital. Methods: Using questionnaires, 70 patients with osteoporotic fractures (OF) were compared with 50 outpatients with multiple osteoarthritis (OA) followed through an outpatient clinic. Results: The OF group was older (p < 0.001), less heavy (p = 0.003), had lower BMI (p = 0.006), was more likely to be white (p = 0.011), was less likely to be married (p = 0.008), and had previous falls, previous fractures, old fractures (>1 year), falls in the last 12 months, fractures due to falls, and needed more assistance (p < 0.05). They also had lower Lawton & Brody Instrumental Activities of Daily Living scores (p < 0.05) and reported less lower limb disability, foot pathology, muscle weakness, hypothyroidism, and vitamin D intake than patients in the OA group. White race, previous falls, previous falls, and previous fractures increase the risk of osteoporotic fractures by 10.5, 11.4, and 4.1 times, respectively. The chance of fracture dropped 29% for each one-unit increase in Lawton & Brody & IDL score. Married participants had fewer fractures than participants with other marital status. Conclusion: Together, race, marital status, previous falls, foot pathologies, previous fractures, and IADL scores define the profile of patients with osteoporotic fractures.

Keywords: Osteoporotic fractures. Osteoporosis. Epidemiology. Diagnosis. Bone density. Prevalence.

INTRODUCTION

Osteoporosis is a chronic disease characterized by progressive reduction of bone mass, leading to decreased bone strength and greater risk of fractures. It is considered a public health problem worldwide. It has been estimated that 9 million osteoporotic fractures occur each year, the equivalent of one fracture every 3.5 seconds.

Although this is the most common bone disease, many patients are not treated until the first fracture occurs. The Brazilian population is in the process of aging, as can be seen in the epidemiologic pyramids for the years 2017 and 2050. This aging is accompanied by an increase in the prevalence of osteoporosis and the incidence of falls and fractures. These fractures are associated with increased...
mortality, decreased functional capacity and quality of life,6–9 and increased spending in the health system. It is estimated that approximately 50% of women and 20% of men 50 years of age or over will suffer an osteoporotic fracture during their lives. Even though osteoporosis and osteopenia are a growing problem in older people, attempts to analyze the characteristics of osteoporotic patients in Brazil are rare.

The objective of this study was to evaluate the epidemiological profile of the population affected by osteoporotic fractures (fractures of the proximal femur, the proximal humerus, the distal radius, and the thoraco-lumbar spine) treated in a tertiary orthopedic hospital over a three-month period, with or without a previous diagnosis of osteopenia or osteoporosis, in an attempt to correlate the clinical characteristics present in patients treated for osteoarthritis during the same period.

Primary objective: To explore the epidemiological profile of patients with osteoporotic fractures treated in a tertiary orthopedic hospital, identifying factors potentially related to this fracture in relation to patients treated for osteoarthritis during the same period. Secondary objective: To describe the types of osteoporotic fractures treated in a tertiary center, along with function and bone mineral density in these patients.

MATERIALS AND METHODS

This study was conducted at the Osteo-Metabolic Diseases Group at the Instituto de Ortopedia e Traumatologia do Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo (IOT-HC-FMUSP) with the approval of the institutional review board (number 76629217.3/0000.0068). All participants were patients with osteoporotic fractures treated over a three-month period in 2017 and patients with osteoarthritis of the knee (of this group, only those treated in the osteometabolic disease group at a tertiary orthopedic hospital).

Inclusion criteria: Study group (osteoporotic fractures, OF): Patients above 45 years of age presenting any one or a combination of the following fractures; proximal femur, proximal humerus, distal radius, and thoraco-lumbar spine, with a mechanism of low-energy trauma. Patients with high-energy fractures were not included.

Control group (patients with osteoarthritis, OA): Patients above 45 years of age presenting any one or a combination of the following fractures; hip fractures, isolated or not, with and without comorbidities.

Exclusion criteria: Age below 45 years; suspicion or confirmation of pathological fractures; patient unwilling to participate.

Interventions

The participants filled out a questionnaire (Table 1) collecting data on demographic profile, fracture type, race, patient level of education, habits, personal history, previous fractures, level of physical activity, aids for locomotion, place and time of the accident which caused the fracture, use of medications and behavioral measures to treat osteoporosis, and functional assessment (Katz and Lawton and Brody).11,12 Patients with proximal femur fracture completed the Harris Hip Score (HSS)13 and fragility score (SHARE) questionnaires.

Statistical analysis

Patient characteristics were described using absolute and relative frequencies according to groups for the qualitative variables, and association was verified using the chi-square or Fisher’s exact tests. Summary measures (mean and standard deviation or median, minimum, and maximum) were calculated according to groups for quantitative variables and the groups were compared using Student’s t-test or the Mann-Whitney test.

The unadjusted odds ratio was estimated for each variable to approximate the chance of osteoporosis with the respective intervals, with 95% confidence.

The multiple logistic regression model was used to explain the osteoporosis group, selecting the variables that showed statistical significance in the bivariate tests and using backward stepwise selection with a 5% criterion for entry and exit of the variables (p<0.05). IBM SPSS for Windows software version 20.0 was used for these analyses, and Microsoft Excel 2003 was used to tabulate the data. The tests were performed at a 5% significance level.

RESULTS

The results of the questionnaires applied to 70 patients with osteoporotic fractures (OF) and 50 patients with osteoarthritis (OA) of the knee (or osteoarthritis of multiple joints including the knee) are summarized in Tables 2–4. Table 2 shows that in isolation, patients with osteoporosis were statistically older on average (p<0.001), were less heavy and had lower BMI (p = 0.003 and p = 0.006, respectively), the frequency of white race was statistically higher in patients with osteoporosis (p = 0.011), patients with osteoporotic fractures were statistically less likely to be married (p = 0.008), and this group had more previous falls, previous fractures, old fractures (> 1 year), falls over the past 12 months, fractures from falls, and needed more assistance (p<0.05) than patients with OA. Patients with osteoporotic fractures reported less disability in the lower limbs, pathology in the feet, muscle weakness, hypothyroidism, and vitamin D consumption than patients with OA. Using the functional scale by Lawton and Brody,12 their scores for instrumental activities of daily living (IADL) were lower (p<0.05). Table 3 shows that together, race, marital status, previous falls, pathologies in the feet, muscle weakness, hypothyroidism, previous fractures, and Lawton and Brody IADL score explained the patients with osteoporosis independent of the other characteristics we assessed (p<0.05). White patients were 10.48 times more likely to present osteoporosis than nonwhite patients, single patients and those with other marital status had a statistically greater chance of osteoporosis than married patients, patients who had previous falls were 11.39 times more likely to have osteoporosis than patients without previous falls, and patients with previous fractures were 4.13 times more likely to have osteoporosis than patients without previous fractures. Pathologies of the feet, muscle weakness, and hypothyroidism presented similar protections for osteoporosis, with the chance of osteoporosis approximately 86% less for each of these characteristics, and each one-unit increase in the Katz and Lawton IADL score12 decreased the chance of osteoporosis by 29%. Table 4 shows the profile of patients with osteoporotic fractures treated in a tertiary trauma center, with an 81% incidence of patients with hip fractures, confirming that osteoporosis accompanies this fracture in mean bone densitometry values.

DISCUSSION

Osteoporosis is a chronic disease characterized by progressive decrease in bone mass, leading to decreased bone strength and greater risk of fractures.1 This disease can be characterized as primary or secondary. Primary osteoporosis can occur in both sexes at any age, but often occurs after menopause in women and later in men.1

In this study we observed that the patients with osteoporotic fractures were older, a greater number were women (similar to the group with OA), weighed less, had lower BMI, and whites were more prevalent (Table 2), consistent with findings in other studies.14,15 Perhaps because of the size and characteristics of the sample (older adults, Caucasians, and hip fractures were more prevalent) (Tables 2, 3 and 4),
Table 1. Evaluation of post-osteoporotic fracture patients and controls.

| Identification                                |       |
|-----------------------------------------------|-------|
| Age                                           |       |
| Sex                                           |       |
| Weight                                        |       |
| Height                                        |       |
| Race                                          |       |
| Marital status:                               |       |
| Lives with                                    |       |
| Kinship                                       |       |
| Education                                     |       |
| Number of years of school                     |       |
| Father or mother with hip fracture?           |       |
| Current smoker?                               |       |
| Glucocorticoids                               |       |
| Rheumatoid arthritis?                         |       |
| Secondary osteoporosis?                       |       |
| Alcohol: >3 drinks per day?                   |       |
| Sedatives?                                    |       |
| Previous falls?                               |       |
| Cognitive deficit?                            |       |
| Visual impairment?                            |       |
| Disability of lower limbs?                    |       |
| Foot pathology?                               |       |
| Change in balance?                            |       |
| Muscle weakness?                              |       |
| Changes in gait?                              |       |
| Postural hypotension?                         |       |
| Dizziness?                                    |       |
| Depression/Apathy/Confusion?                  |       |
| Diabetes?                                     |       |
| HBP?                                         |       |
| Hypothyroidism?                               |       |
| Previous fractures?                           |       |
| Old fracture (> 1 year)?                      |       |
| Current fracture?                             |       |
| Date of current fracture?                     |       |
| Fractured limb                                 |       |
| Physical activity before fracture?            |       |
| Physical activity after fracture?             |       |
| Type of activity                               |       |
| Frequency                                     |       |
| Fear of falling?                              |       |
| Fall in last 12 months?                       |       |
| Number of falls?                              |       |
| Where?                                        |       |
| Factors                                       |       |
| Fracture from fall?                           |       |
| Assistance                                    |       |
| Mechanism of trauma?                          |       |
| Time of Accident                              |       |
| Previous conduct related to current fracture? |       |
| Prior diagnosis of osteoporosis?              |       |
| Calcium supplementation?                      |       |
| Sun exposure 3x week?                         |       |
| Vitamin D supplementation?                    |       |
| If yes, how many IU?                          |       |
| Taking medication for osteoporosis?           |       |
| Katz ADL                                      |       |
| Lawton & Brody IADL                           |       |

Fractured limb:
- Spine: 0 / Lumbar Spine: 1 / R Hip: 2 / L Hip: 3 / R Wrist: 4 / L Wrist: 5 / R Shoulder: 6 / L Shoulder: 7

Date of current fracture:
- Physical activity before fracture:
  - No: 0 / Yes: 1
- Type of activity:
  - Weight training: 0 / Stretching 1 / Water or pool exercise: 2 / Walking: 3 / Cycling: 4
- Physical activity after fracture:
  - No: 0 / Yes: 1
- Type of activity:
  - Weight training: 0 / Stretching 1 / Water or pool exercise: 2 / Walking: 3 / Cycling: 4
- Frequency:
  - 1x month: 0 / 2X month: 1 / 3X month: 2 / 1X week: 3 / 2X week: 4 / 3X week: 5 / >4X week: 6 / Never: 7
- Fear of falling:
  - No: 0 / Yes: 1
- Fall in last 12 months:
  - No: 0 / Yes: 1

Where:
- At home: 0 / Outside the home: 1

Factors:
- Dizziness: 0 / Tripped: 1 / Slipped: 2 / Weakness or lower limb instability: 3 / Other: 4

Assistance:
- Cane: 0 / Crutches: 1 / Walker: 2 / Wheelchair: 3 / None: 4

Mechanism of trauma:
- Fall from height: 0 / Same-level fall: 1 / Direct trauma: 2 / Twisting: 3 / Carrying weight: 4

Time of Accident:
- 7:00 - 11:00: 0 / 11:01 - 15:00: 1 / 15:01 - 19:00: 2 / 19:01 - 22:00: 3 / 22:01 - 7:00: 4

Previous conduct related to current fracture:
- Analgesic medication: 0 / Cast or vest: 1 / Surgery: 2 / Physical therapy: 3

Prior diagnosis of osteoporosis:
- No: 0 / Yes: 1

Calcium supplementation:
- No: 0 / Yes: 1

Sun exposure 3x week:
- No: 0 / Yes: 1

Vitamin D supplementation:
- No: 0 / Yes: 1

If yes, how many IU?
- No: 0 / Yes: 1

Taking medication for osteoporosis:
- No: 0 / Yes: 1

Katz ADL
- No: 0 / Yes: 1 - (Maximum: 6)

Lawton & Brody IADL
- No: 0 / Yes: 1 - (Maximum: 8)
Table 2. Description of characteristics present in both groups and the results of unadjusted analyses.

| Variable | Control | Osteoporosis | Total | OR | IC (95%) | p  |
|----------|---------|--------------|-------|----|----------|----|
|          | (N = 50) | (N = 70)     | (N = 120) |    |          |    |
| Sex (female), n (%) | 39 (78) | 49 (70) | 88 (73.3) | 0.66 | 0.28 | 1.53 | 0.329 |
| Age (years), mean ± SD | 66.7 ± 9.6 | 75.1 ± 11.7 | 71.6 ± 11.6 | 1.07 | 1.03 | 1.12 | <0.001* |
| Weight (Kg), mean ± SD | 72.9 ± 11.2 | 66.1 ± 13.1 | 68.8 ± 12.8 | 0.96 | 0.92 | 0.99 | 0.003** |
| Height (cm), mean ± SD | 162.3 ± 7.3 | 161.4 ± 8.8 | 161.8 ± 8.2 | 0.99 | 0.94 | 1.04 | 0.601** |
| BMI (Kg/m²), mean ± SD | 27.9 ± 4.3 | 25.3 ± 5.1 | 26.3 ± 5.3 | 0.89 | 0.82 | 0.97 | 0.006** |
| Education (years of school), median (min.; max.) | 8 (0; 30) | 8 (0; 18) | 8 (0; 30) | 0.98 | 0.91 | 1.06 | 0.648£ |
| Race (White), n (%) | 35 (70) | 62 (88.6) | 97 (80.8) | 3.32 | 1.28 | 8.61 | 0.011 |
| Marital status, n (%) | 0.008 |
| Married | 33 (66) | 25 (35.7) | 58 (48.3) | 1.00 |
| Widowed | 7 (14) | 22 (31.4) | 29 (24.2) | 4.15 | 1.53 | 11.24 |
| Single | 3 (6) | 11 (15.7) | 14 (11.7) | 4.84 | 1.22 | 19.21 |
| Other | 7 (14) | 12 (17.1) | 19 (15.8) | 2.26 | 0.78 | 6.58 |
| Lives with, median (min.; max.) | 1 (0; 3) | 1 (0; 6) | 1 (0; 6) | 1.301 | 0.95 | 1.78 | 0.370£ |
| Father or mother with hip fracture, n (%) | 3 (6) | 4 (5.7) | 7 (5.8) | 0.95 | 0.20 | 4.44 | >0.999* |
| Current smoker, n (%) | 6 (12) | 8 (11.4) | 14 (11.7) | 0.95 | 0.31 | 2.92 | 0.923 |
| Glucocorticoids, n (%) | 3 (6) | 5 (7.1) | 8 (6.7) | 1.21 | 0.27 | 5.29 | >0.999* |
| Rheumatoid arthritis, n (%) | 0 (0) | 2 (2.9) | 9 (7.5) | 2.71 | 0.04 | 0.91 | 0.751 |
| Secondary osteoporosis, n (%) | 7 (14) | 4 (5.7) | 11 (9.2) | 0.37 | 0.10 | 1.35 | 0.198* |
| Alcohol: >3 drinks per day, n (%) | 3 (6) | 2 (2.9) | 5 (4.2) | 0.46 | 0.07 | 2.87 | 0.648* |
| Sedatives, n (%) | 7 (14) | 9 (12.9) | 16 (13.3) | 0.91 | 0.31 | 2.62 | 0.856 |
| Previous falls, n (%) | 13 (26) | 38 (54.3) | 51 (42.5) | 3.38 | 1.54 | 7.43 | 0.002 |
| Foot pathology, n (%) | 18 (36) | 6 (8.6) | 24 (20) | 0.17 | 0.06 | 0.46 | <0.001 |
| Changes in balance, n (%) | 19 (38) | 25 (35.7) | 44 (36.7) | 0.91 | 0.43 | 1.92 | 0.798 |
| Muscle weakness, n (%) | 24 (48) | 21 (30) | 45 (37.5) | 0.46 | 0.22 | 0.99 | 0.045 |
| Changes in gait, n (%) | 24 (48) | 24 (34.3) | 48 (40) | 0.57 | 0.27 | 1.19 | 0.131 |
| Postural hypotension, n (%) | 10 (20) | 13 (18.6) | 23 (19.2) | 0.91 | 0.36 | 2.29 | 0.845 |
| Dizziness, n (%) | 13 (26) | 18 (25.7) | 31 (25.8) | 0.99 | 0.43 | 2.26 | 0.972 |
| Depression/Apathy/Confusion, n (%) | 11 (22) | 17 (24.3) | 28 (23.3) | 1.14 | 0.48 | 2.70 | 0.770 |
| Diabetes, n (%) | 19 (38) | 22 (31.4) | 41 (34.2) | 0.75 | 0.35 | 1.60 | 0.454 |
| HBP, n (%) | 30 (60) | 35 (50) | 65 (54.2) | 0.67 | 0.32 | 1.39 | 0.278 |
| Hyperthyroidism, n (%) | 14 (28) | 9 (12.9) | 23 (19.2) | 0.91 | 0.43 | 1.92 | 0.798 |
| Osteoporosis (n), n (%) | 8 (16) | 35 (50) | 43 (35.8) | 5.25 | 2.16 | 12.78 | <0.001 |
| Old fracture (>1 year), n (%) | 8 (16) | 35 (50) | 43 (35.8) | 5.25 | 2.16 | 12.78 | <0.001 |
| Physical activity before fracture, n (%) | 19 (38) | 21 (30) | 40 (33.3) | 0.70 | 0.33 | 1.51 | 0.395 |
| Fear of falling, n (%) | 34 (68) | 44 (62.9) | 78 (65) | 0.80 | 0.37 | 1.72 | 0.560 |
| Fall in last 12 months, n (%) | 17 (34) | 41 (58.6) | 58 (48.3) | 2.74 | 1.29 | 5.83 | 0.008 |
| Fracture from fall, n (%) | 2 (4) | 67 (95.7) | 69 (57.5) | 536.00 | 86.23 | 3331.95 | <0.001 |
| Assistance, n (%) | 13 (26) | 35 (50) | 40 (33.3) | 9.00 | 3.19 | 25.36 | <0.001 |
| Prior diagnosis of osteoporosis, n (%) | 14 (28) | 26 (37.1) | 40 (33.3) | 1.52 | 0.69 | 3.33 | 0.295 |
| Calcium supplementation, n (%) | 14 (28) | 20 (28.6) | 34 (28.3) | 1.03 | 0.46 | 2.30 | 0.945 |
| Sun exposure 3x week, n (%) | 24 (48) | 36 (51.4) | 60 (50) | 1.15 | 0.56 | 2.37 | 0.711 |
| Taking medication for osteoporosis, n (%) | 4 (8) | 8 (11.4) | 12 (10) | 1.48 | 0.42 | 5.23 | 0.537 |
| Katz ADL, median (min.; max.) | 6 (2; 6) | 6 (1; 6) | 6 (1; 6) | 0.73 | 0.46 | 1.16 | 0.0902 |
| Lawton & Brody IADL, median (min.; max.) | 8 (1; 8) | 7.5 (0; 8) | 8 (0; 8) | 0.83 | 0.70 | 0.99 | 0.0152 |

Chi-square test; * Fisher's exact test; ** Student's t-test; £ Mann-Whitney test.
Although there were 70 patients with osteoporosis, some information was missing for all variables. Multiple logistic regression.

### Table 3. Result of the joint model describing the osteoporosis group according to evaluated variables.

| Variable          | OR | IC (95%) Below | IC (95%) Above | p     |
|-------------------|----|----------------|----------------|-------|
| Race (White)      | 10.48 | 1.61           | 68.20          | 0.014 |
| Marital status    |     |                |                |       |
| Married           | 1.00 |                |                |       |
| Widowed           | 4.93 | 0.94           | 25.99          | 0.060 |
| Single            | 57.15 | 2.61           | 1162.39        | 0.008 |
| Other             | 10.65 | 1.80           | 65.56          | 0.009 |
| Previous falls    | 11.39 | 2.18           | 59.45          | 0.004 |
| Foot pathologies  | 0.13 | 0.02           | 0.74           | 0.022 |
| Muscle weakness   | 0.15 | 0.03           | 0.77           | 0.024 |
| Hypothyroidism    | 0.14 | 0.03           | 0.75           | 0.022 |
| Previous fractures| 4.13 | 1.12           | 15.23          | 0.033 |
| Katz & Lawton IADL| 0.71 | 0.53           | 0.95           | 0.020 |

### Table 4. Description of characteristics that were evaluated only in patients with osteoporosis.

| Variable                              | Description |
|---------------------------------------|-------------|
| Fractured limb, n (%)                 |             |
| Lumbar Spine                          | 2 (2.9)     |
| Hip                                   | 57 (81.4)   |
| Wrist                                 | 4 (5.7)     |
| Shoulder                              | 7 (10)      |
| Physical activity after fracture, n (%)|             |
| No                                    | 47 (67.1)   |
| Yes                                   | 23 (32.9)   |
| Ca Supplementation, n (%)             |             |
| No                                    | 35 (71.4)   |
| Yes                                   | 14 (28.6)   |
| SHARE FI exhaustion, n (%)            |             |
| No                                    | 29 (58)     |
| Yes                                   | 21 (42)     |
| SHARE FI Appetite, n (%)              |             |
| Reduced                               | 8 (16)      |
| Maintained                            | 37 (74)     |
| Increased                             | 5 (10)      |
| HSS Pain                              |             |
| mean SD                               | 32.2 ± 12.6 |
| median (min.; max.)                   | 40 (8; 44)  |
| HSS Function                          |             |
| mean SD                               | 26.3 ± 12   |
| median (min.; max.)                   | 27.5 (0; 47) |
| HSS ADM                               |             |
| mean SD                               | 2.4 ± 0.8   |
| median (min.; max.)                   | 2.2 (0.9; 4) |
| HSS ADM Deformity                     |             |
| mean SD                               | 3.3 ± 1.3   |
| median (min.; max.)                   | 4 (1; 4)    |
| HSS Total                             |             |
| mean SD                               | 65.1 ± 19.6 |
| median (min.; max.)                   | 72 (20.9; 97) |
| DMO COL T-Score                       |             |
| mean SD                               | -2 ± 1.8    |
| median (min.; max.)                   | -2.1 (-4.8; 2.6) |
| DMO FN T-Score                        |             |
| mean SD                               | 2.7 ± 0.6   |
| median (min.; max.)                   | -2.6 (-3.7; -1.7) |
| DMO TH T-Score                        |             |
| mean SD                               | -2.5 ± 0.8  |
| median (min.; max.)                   | -2.8 (-3.8; -1.3) |
| DMO Troc T-Score                      |             |
| mean SD                               | 2.4 ± 0.7   |
| median (min.; max.)                   | -2.4 (-2.9; -1.9) |

Although there were 70 patients with osteoporosis, some information was missing for all variables.
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