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Application of the National Osteoporosis Foundation Guidelines to Postmenopausal Women and Men: The Framingham Osteoporosis Study

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Abstract

Purpose—Little is known about the public health impact of the National Osteoporosis Foundation (NOF) Guidelines. Therefore, we determined the proportion of U.S. Caucasians recommended for treatment of osteoporosis according to NOF Guidelines (2003 & 2008).

Methods—1,946 postmenopausal women and 1,681 men ≥ age 50 years from the Framingham Study with information on BMD (1987-2001). Information on clinical predictors was used to estimate the 10-year probability of hip and major osteoporotic fracture by FRAX® (version 3.0).

Results—Overall proportion of women meeting treatment criterion was less when the 2008 NOF Guidelines were applied (41.1%) compared with 2003 Guidelines (47.8%). The proportion of women < age 65 years meeting treatment criterion was much less when applying 2008 Guidelines (23.1% in 2003, 8.3% in 2008), whereas the proportion of women > age 75 years increased slightly (78.3% in 2003, 86.0% in 2008). 17.0% of men ≥ age 50 years met treatment criterion (2.5% aged 50-64 years, 49.8% > age 75 years).

Conclusions—Nearly one-half of Caucasian post-menopausal women and one-sixth of men aged 50 years and older would be recommended for osteoporosis treatment according to 2008 NOF Guidelines. Given the high proportion of persons recommended for treatment, NOF Guidelines may need to be re-evaluated with respect to budget impact.

Keywords

osteoporosis; treatment; FRAX®; NOF guidelines

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Introduction

Osteoporotic fractures are common in older adults and are associated with high morbidity, mortality, and loss of independence [1]. Furthermore, osteoporotic fractures were responsible for an estimated $19 billion in costs to the U.S. health care system in 2005 alone [2]. Existing medications reduce fracture risk in both men and women [3-5]. Clinical guidelines help physicians identify persons who are likely to benefit from screening and treatment for osteoporosis [6,7]; however, the impact of adherence to these guidelines has not been fully evaluated.

In 2003, the U.S. National Osteoporosis Foundation (NOF) released guidelines for the treatment of osteoporosis in post-menopausal women based on bone mineral density (BMD), history of fracture, and other clinical risk factors for fracture [8]. Whereas these guidelines were evidence based [9], they did not fully account for age or the combined effect of multiple, clinical risk factors, which are important determinants of an individual's absolute risk of future fracture. In an effort to shift treatment recommendations towards consideration of an individual's absolute risk of fracture, the NOF released the revised, Clinician's Guide to Prevention and Treatment of Osteoporosis, in 2008 [10]. These new guidelines incorporated the use of a fracture risk assessment tool called FRAX®. FRAX® calculates the 10-year probability of hip and major osteoporotic fracture in women and men using information on ten, clinically available risk factors for fracture [11,12]. Derived and validated using several population-based, international cohorts [13], the FRAX® algorithm can be used either with or without information on BMD [11].

The 2008 NOF Guidelines provided clinicians with specific, pharmacologic treatment thresholds determined from application of the FRAX® tool [10]. In applying the 2008 NOF Guidelines to participants in the Study of Osteoporotic Fractures, investigators found a very high proportion (73%) of U.S. post-menopausal women age 65 years and greater would be recommended for treatment [14]. Since completion of the current study, Dawson-Hughes et al.[15] found that in the NHANES III population, 41% of U.S. Caucasian post-menopausal women and 22% of men aged 50 years and greater, satisfied criteria for treatment of osteoporosis. Our study extends the findings from these studies by estimating the proportion of U.S. women and men who fulfill the 2008 NOF Guidelines criteria for pharmacologic treatment of osteoporosis in a well-described, population-based cohort. Moreover, we determined the impact of the revision of the NOF Guidelines by comparing the proportion of postmenopausal women who would be recommended for treatment based on the 2003 and 2008 Guidelines.

Methods

Study Population

The Framingham Osteoporosis Study is comprised of participants from two cohorts of the Framingham Heart Study: the Original and Offspring Cohorts. The Original Cohort began in 1948, and it is comprised of 5,209 Caucasians who were systematically recruited as a two-thirds sample of the population of Framingham, MA, for the purpose of determining risk factors for cardiovascular disease [16]. The Offspring Cohort began in 1971 to examine familial clustering of cardiovascular disease [17], and it includes 5,124 adult children and their spouses of members of the Original Cohort. Members of both cohorts undergo regular comprehensive physical examinations by trained physicians, along with clinical risk factor assessments (every two years for Original Cohort members, every four years for Offspring Cohort members).

5,381 Framingham Osteoporosis participants were alive during examinations conducted between 1987-2001 with the opportunity for BMD testing. Because full application of the NOF

Guidelines requires measurement of BMD [10], we excluded participants who did not undergo BMD testing of the femoral neck (n=1,123: Original Cohort, n=331, Offspring Cohort, n=792). In accordance with the 2008 NOF Guidelines [10], we also excluded pre-menopausal women of any age (n=256) and males less than age 50 years (n=135). Finally, we excluded women who underwent premature menopause (n=240), defined as cessation of menses for at least one year before the age of 40 years. Thus, the current study included 1,160 participants of the Original Cohort (677 women, 483 men) and 2,467 participants of the Offspring Cohort (1,269 women, 1,198 men).

BMD Assessment

BMD of the femoral neck was measured in grams per square centimeter (g/cm^2), using a Lunar dual photon absorptiometer (DP3) between 1987-1991 and a Lunar dual x-ray absorptiometry (DPX-L) densitometer (Lunar Radiation Corp., Madison, WI) between 1992-2001. The right femur was scanned unless there was a history of fracture and/or hip joint replacement, in which case, the left side was scanned. BMD measurements from the dual photon absorptiometer were adjusted using published corrections, based on the cross-calibration of the two instruments [18], and the converted values are presented. The coefficients of variation ranged from 1.7% to 2.6% at the femoral neck.

Clinical Risk Factor Assessment—Weight, measured to the nearest pound without shoes, and height, measured to the nearest quarter-inch, were used to calculate body mass index, or BMI (kg/m^2). Rheumatoid arthritis was determined by a trained physician following a history and physical examination.

Current smoking status, consumption of ≥ 3 alcoholic beverages/day, and glucocorticoid use were ascertained by self-report (yes/no). Of note, FRAX® considers glucocorticoid use to be a risk factor if a lifetime minimum of 5mg of oral prednisolone or equivalent was used for greater than three months. We did not have information on the dose or duration of glucocorticoid use, and thus, participants reporting any glucocorticoid use since their last examination were classified as a user. Parental history of hip fracture was determined by self-report among Offspring participants only, and Original Cohort members were considered to have had no parental history of hip fracture. Secondary causes of osteoporosis other than rheumatoid arthritis, do not contribute to the probability of fracture as calculated by FRAX® when information on BMD is present; therefore, we did not include information on secondary causes of osteoporosis in our analyses.

Hip fractures were confirmed by comprehensive review of medical records [19]. History of adult fracture at any skeletal site (i.e. wrist, ankle, vertebrae, finger) was determined by self-report. We were unable to confirm the location of fracture for all self-reported non-hip fractures, and thus, any self-reported fracture was included in the FRAX® calculation. Because specific history of clinical vertebral fracture was not ascertained among all participants and spine radiographs were performed only among a small subset of participants [20], we did not consider history of vertebral fracture when determining the proportion of individuals recommended for pharmacologic treatment.

T-score Calculation—Information on femoral neck BMD (gm/cm^2) was provided to Dr. Kanis of the World Health Organization Collaborating Centre at Sheffield, in order to compute T-scores using a standard conversion to Hologic technology and based on the NHANES III reference population. We did not evaluate the effect of spine BMD in our analyses.

FRAX® Calculation—We used clinical cut-points as specified by FRAX® to categorize smoking status, alcohol use, history of rheumatoid arthritis, self-reported history of fracture,

and parental history of hip fracture. These variables, along with age, sex, BMI, and glucocorticoid use were provided to Dr. Kanis in order to calculate the probability of hip and major osteoporotic fracture (clinical vertebral, hip, forearm, proximal humerus) using FRAX® (version 3.0). Because clinical application of the FRAX® tool instructs users to answer "no" if information is not available [12], we assumed that all missing values were null (missing values for smoking, n=3; alcohol use, n=1; parental history of hip fracture, n=1,189; self-reported fracture, n=138).

FRAX® version 3.0, released in September 2009, differs from the previous version (2.0) in that the epidemiological data on vertebral and hip fracture rates used to construct the algorithm were updated at the request of the NOF [21]. There is a very strong correlation between the two versions although the probabilities of major osteoporotic fracture are somewhat lower in version 3.0 [22].

NOF Guidelines—The 2003 NOF Guidelines called for pharmacologic treatment for osteoporosis among postmenopausal women with any one of the following criteria: (1) history of hip or vertebral fracture, (2) T-score by central DXA < −2.0, or (3) T-score < −1.5 and one or more major risk factors for fracture (i.e. history of adult-fracture at any skeletal site, history of fragility fracture in a first degree relative, weight < 127 lbs. (57.6 kg), current smoking, or glucocorticoid use for > 3 months; Figure 1) [8]. We did not consider additional "non-major" risk factors for osteoporosis in our application of the 2003 Guidelines.

In addition to postmenopausal women, the target population in the 2008 NOF Guidelines was expanded to include men ages 50 years and older. According to the 2008 Guidelines, treatment is recommended for individuals with any one of the following criteria: (1) history of hip or vertebral fracture, (2) T-score ≤ −2.5 at the femoral neck or spine, or (3) T-score between −1.0 and −2.5 *and* 10-year probability of hip fracture ≥ 3% (as determined by FRAX®), or (4) T-score between −1.0 and −2.5 *and* 10-year probability of major fracture ≥ 20% (as determined by FRAX®) (Figure 1) [10].

Statistical Analysis

We applied the 2003 and 2008 NOF Guidelines in order to determine the proportion of participants meeting criteria for treatment of osteoporosis. We stratified our analysis according to three age groups, <65, 65-75, and >75 years, in order to examine possible differences according to age. We used SAS (version 9.1) to create all datasets and for descriptive analyses.

Results

The current study included 3,627 participants (1,946 women, 1,681 men; Table 1). The mean age of participants was 67 years and ranged from 42 to 96 years. Nearly twenty percent of participants were > 75 years, and the remaining eighty percent were equally distributed between age groups < 65 years and 65 to 75 years. Mean BMI in women was 27.1 kg/m^2 and 28.3 kg/m^2 in men. Eleven percent of participants were current smokers. Less than 1% of women and 3% of men consumed ≥ 3 alcoholic beverages/day. Frequency of glucocorticoid use (2.4%) and rheumatoid arthritis (0.9%) was low.

Parental history of hip fracture was reported among 9.6% of Offspring participants. Thirty percent of participants reported a history of an adult fracture at any skeletal site, and 1.4% of participants (39 women and 11 men) had a history of confirmed hip fracture. Fifty-three percent of women and 37.3% of men had a femoral neck T-score between −1 and −2.49, and 22.4% of women and 3.5% of men had a femoral neck T-score ≤ −2.5.

According to the 2003 and 2008 NOF guidelines for postmenopausal women, the most frequent criterion warranting a recommendation for pharmacologic treatment was low BMD (Table 2). Application of the 2003 Guidelines resulted in a recommendation for treatment of 38.7% of women based on BMD alone (T-score of < -2.0), whereas 22.4% of women met the criterion of low BMD (T-score ≤ -2.5) based on the 2008 Guidelines. The proportion of women meeting the criterion of low BMD increased with advancing age (2008 Guidelines: 5.8% of women < age 65, 50.2% of women > age 75 years).

Nearly half the women in our study met one or more criterion for pharmacologic treatment of osteoporosis when applying either the 2003 or 2008 NOF Guidelines (47.8% in 2003, 41.1% in 2008; Table 2). The proportion of younger postmenopausal women (< 65 years) recommended for pharmacological treatment was lower according to the 2008 Guidelines compared with the 2003 Guidelines (8.3% in 2008, 23.1% in 2003); however, the proportion of women > age 75 years recommended for treatment was slightly greater when the 2008 Guidelines were applied (86.0% in 2008, 78.3% in 2003).

In men, the most frequent criterion of the 2008 NOF Guidelines warranting a recommendation for treatment was a T-score between −1 and −2.49 *and* a 10-year probability of hip fracture of $\geq 3\%$ as calculated by FRAX® (13.1%; Table 3). The proportion of men meeting this criterion increased with advancing age (1.7% of men aged 50-65, 37.9% of men > age 75 years). In total, 17.0% of men age 50 years and older met one or more criterion for pharmacologic treatment, and the proportion of men recommended for treatment increased with advancing age (2.5% of men aged 50-64, 17.9% of men aged 65-75, 49.8% of men > age 75 years).

Discussion

We found that nearly half of Caucasian post-menopausal women and one-sixth of Caucasian men 50 years and older would be recommended for pharmacologic treatment of osteoporosis based on the 2008 NOF Guidelines. The proportion was greatest among women older than age 75 years (86.0%), yet a substantial proportion of older men (49.8%) would also be recommended for pharmacologic treatment according to the 2008 Guidelines.

Our finding that a high proportion of older women meet criteria for treatment is consistent with results from the Study of Osteoporotic Fractures (SOF), who reported that 73% of women age 65 years and greater and 93% of women age 75 years and greater would be recommended for pharmacologic treatment based on the 2008 NOF Guidelines [14]. We found a smaller proportion of women age 65 years and greater who would be recommended for treatment (61.4%, results not shown), compared to SOF. The differences may be due to a revision in the FRAX® tool, which occurred between the SOF analysis (version 1.0) and our study (version 3.0) because the original FRAX® tool was found to overestimate the 10-year probability of major osteoporotic fracture.

We found the overall proportion (41%) of postmenopausal women who met treatment criteria in our study was identical to that in a recent study of NHANES III [14], and the proportion of men who met treatment criteria (17%) was only slightly smaller compared to NHANES (22%). However, the proportion of younger postmenopausal women and men who met treatment criteria was smaller in our study. In applying the NOF Guidelines, we used information on BMD from the femoral neck site only, whereas the NHANES Study included simulated T-scores from the lumbar spine. In the NHANES Study, lumbar spine BMD was lower than femoral neck BMD in both younger postmenopausal women and men, which likely explains differences in our results. Furthermore, the prevalence of other clinical risk factors including self-reported fracture and lifetime history of glucocorticoid use, was somewhat greater in the NHANES Study compared with the Framingham Study, likely due to differences in the

ascertainment of predictors. For example, we estimated prevalence of glucocorticoid use as 2.7% in postmenopausal women based on self-report of any glucocorticoid use within the past two years, compared with a simulated lifetime estimate of glucocorticoid use of 7.9% in the NHANES Study.

We found the revision in 2008 of the 2003 Guidelines resulted in a smaller overall proportion of women who would be recommended for pharmacologic treatment (41.1% versus 47.8%). Particularly, this revision resulted in a reduced frequency of post-menopausal women younger than age 65 years satisfying treatment criteria (8.3% versus 23.1%), whereas frequency increased for post-menopausal women older than age 75 years (78.3% versus 86.0%). Given the large proportion of the elderly population who would be recommended for treatment based on the 2008 NOF Guidelines, it is important that future studies fully evaluate the efficacy of pharmacologic treatment among men and women over the age of 80.

There are several limitations to our study. First, because full application of the 2008 NOF guidelines requires BMD measurement, we excluded 1,123 individuals without this information. Participants without BMD were older, had lower BMI, and were more likely to smoke compared to participants with BMD. The average 10 year probability of *major fracture* as estimated by FRAX® in the absence of BMD was identical between the two groups (11.1%), whereas the average 10 year probability of *hip fracture* was slightly greater in the group without information on BMD (4.3% versus 3.1%). Thus, it is likely that our estimates of the proportion of individuals satisfying treatment criteria would have been slightly higher if we had had BMD measurements for all participants.

Second, we assumed that participants with missing data had no additional risk factors for fracture. Missing data were infrequent, with the exception of family history of hip fracture (33%) because this information was not collected in Original Cohort participants. Similarly, information on history of clinical or radiographic vertebral fractures was not collected for all participants and was assumed to be negative. It is likely that many participants with vertebral fracture would have met criteria for treatment on the basis of his or her T-score and clinical risk factors [23].

This conservative approach of assuming missing data as null is consistent with a clinical application of the FRAX® tool, which instructs users to answer “no” if information is not available [12]. Nonetheless, our results may underestimate the true proportion of individuals meeting treatment criteria. We believe this underestimation to be small given the NHANES III Study, which used simulation for missing data including paternal history of hip fracture and self-reported fracture, yet found the proportion of elderly persons meeting treatment criteria was similar.

Third, we were unable to confirm self-reported, non-hip fractures which are less commonly associated with osteoporosis (i.e. facial, toe). We found a high proportion of participants had a self-reported history of fracture at any skeletal site (29.5%). This estimate seems consistent with other studies demonstrating that nearly 40% of women and 13% of U.S. Caucasian men over the age of 50 will experience a major osteoporotic fracture within their lifetime [1], and it is just slightly less than estimates of self-reported fracture at any skeletal site as simulated by NHANES III (35%) [14]. We recognize that self-reported history of fracture may have led to misclassification which could partially explain the high proportion of persons recommended for treatment in our study; however, this same misclassification would be present in the community setting where the FRAX® tool would be applied.

Finally, our study was performed among U.S. Caucasians from Framingham, MA; therefore, we are unable to apply our results to other races and ethnic groups. Participants in this study represent a well-characterized population-based cohort, and disease rates for several

conditions, including hip fracture [19,24], approximate national rates. Furthermore, prevalence of current smoking and excess alcohol use, clinical predictors used to calculate FRAX® score, is similar in participants in this study compared with nationwide surveys of U.S. Caucasian populations [25,26].

In an effort to demonstrate the important clinical implications of our findings, we estimated the absolute number of U.S. Caucasian postmenopausal women and men who would be recommended for pharmacologic treatment of osteoporosis. Using the 2005 U.S. Census [27], we multiplied the absolute number of persons in each age and sex specific strata in the Census data by the probability of meeting treatment criteria, and we determined that application of the 2008 NOF Guidelines would have potentially resulted in 19.5 million U.S. Caucasians receiving prescription treatment for osteoporosis. As the number of U.S. men and women greater than age 65 years is expected to double by the year 2030 [28], the absolute number of persons recommended for treatment is likely to exceed 40 million within the next 20 years.

Clearly adherence with the NOF Guidelines would result in a substantial increase in treatment costs for osteoporosis within the U.S. Cost-effective analyses have determined that pharmacologic treatment costs may offset the physical and economic burden of osteoporotic fractures [29,30]. However, it is important to note that these cost-effective analyses may underestimate the cost of quality adjusted life years gained by treatment as they assume a 35 to 50% reduction in the risk of hip fracture among persons treated with a bisphosphonate [29,30]. Although this effect of bisphosphonates on the reduction of hip fracture has been seen in clinical trials, it has not been found in all observational studies. Additionally, cost-effective analyses have been performed by varying the drug costs to include generic alendronate [29], as well as proprietary treatments, such that the cost would be higher for more expensive treatments and those that have lesser effects on risk of non-vertebral and hip fractures.

Alternative guidelines for treatment of osteoporosis exist, including a recent European management strategy based on age and clinical risk factors [31]. The authors suggest that age-specific thresholds for treatment are likely to result in a lower proportion of persons recommended for treatment compared with absolute thresholds. For example, using age-specific thresholds, the proportion of women recommended for treatment of osteoporosis ranged from 23.4% in women ages 50 to 54 years to 46.5% in women age 80 years and greater. While introducing age-specific thresholds for treatment may improve cost-effectiveness, it may be more difficult for clinicians to implement in practice because of the increased complexity of incorporating age-specific thresholds into guidelines.

Our study is important as it confirms a high proportion of postmenopausal women [14,15] and men [15] aged 50 years and older who would be recommended for treatment of osteoporosis based on the 2008 NOF Guidelines. While we found that the overall proportion of post-menopausal women recommended for treatment decreased slightly when applying the 2008 versus the 2003 Guidelines, the 2008 Guidelines call for treatment among a very high proportion of older women and men. Thus, the NOF Guidelines may need to be re-evaluated with respect to budget impact given the untested efficacy of screening and its impact on acquisition and treatment costs.

Mini-abstract

We applied 2008 NOF Guidelines to Framingham Osteoporosis Study participants and found nearly one-half of Caucasian post-menopausal women and one-sixth of men aged 50 years and older would be recommended for osteoporosis treatment. Given the high proportion of persons recommended for treatment, NOF Guidelines may need to be re-evaluated with respect to budget impact.

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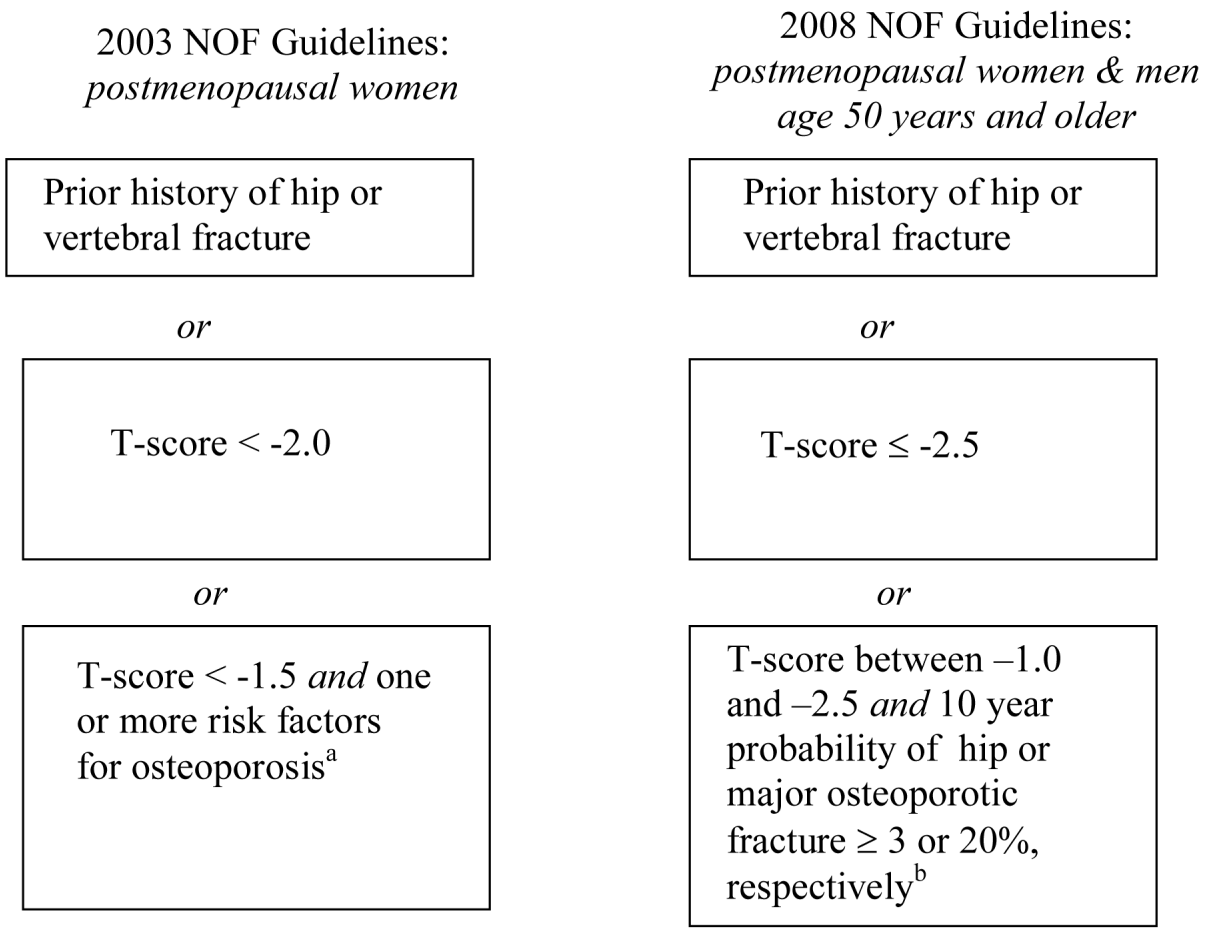

a We considered major risk factors (history of adult fracture, history of fragility fracture in first degree relative, weight < 127 lbs., current smoking, or oral corticosteroid use for > 3 months) in our application of the 2003 Guidelines. We did not consider additional risk factors (impaired vision, early estrogen deficiency, dementia, frailty, recent falls, low calcium intake, low physical activity, excess alcohol use) in our application of the 2003 Guidelines.

b Calculated by the FRAX® tool..

Figure 1.
Comparison of the criteria for pharmacologic treatment of osteoporosis according to the 2003 and 2008 National Osteoporosis Foundation (NOF) Guidelines [8,10]

Table 1

Description of clinical predictors used in the 2008 National Osteoporosis Foundation Guidelines, Framingham Osteoporosis Study (1987-2001)

	Post-menopausal Women (N=1946)	Men (N=1681)	Total (N=3627)
Clinical Predictor	**N (%) unless otherwise noted**		
Age			
< 65 years	745 (38.3)	692 (41.2)	1437 (39.6)
65-75 years	781 (40.1)	704 (41.9)	1435 (40.9)
>75 years	420 (21.6)	285 (17.0)	705 (19.4)
BMI (kg/m^2)[a]	27.1 ± 5.3	164 (9.8)	27.6 ± 4.9
Current smokers	231 (11.9)	28.3 ± 4.4	395 (10.9)
≥ 3 alcoholic beverages/day	8 (0.4)	56 (3.3)	64 (1.8)
Glucocorticoid use	53 (2.7)	33 (2.0)	86 (2.4)
Rheumatoid arthritis	25 (1.3)	7 (0.4)	32 (0.9)
Parental history of hip fracture [b]	127 (10.1)	107 (9.0)	234 (9.6)
History of fracture [c]	559 (30.1)	481 (29.5)	1040 (29.8)
History of confirmed hip fracture	39 (2.0)	11 (0.7)	50 (1.4)
Femoral Neck BMD (g/cm^2) [a]	0.81 ± 0.15)	0.94 ± 0.15	0.87 ± 0.16
Femoral Neck, T-score			
>−1.0	479 (24.6)	995 (59.2)	1474 (40.6)
−1.0 - −2.49	1031 (53.0)	627 (37.3)	1658 (45.7)
≤ −2.5	436 (22.4)	59 (3.5)	495 (13.7)

[a] mean ± standard deviation.

[b] Information reported for 2,438 Offspring participants.

[c] Information reported for 3,489 participants with information on self-reported fracture at any skeletal site.

Table 2

Proportion of postmenopausal women in the Framingham Osteoporosis Study meeting criteria for pharmacologic treatment of osteoporosis based on the 2003 and 2008 National Osteoporosis Foundation (NOF) Guidelines [8, 10], stratified by age

	Age (years)			
	< 65 (N=745)	**65-75 (N=781)**	**>75 (N=420)**	**Total (N=1946)**
	N (%)			
2003 NOF Guidelines, criteria for treatment [a]				
History of hip fracture[b]	1 (0.1)	13 (1.7)	25 (6.0)	39 (2.0)
T-score < −2.0	96 (12.9)	357 (45.7)	300 (71.4)	753 (38.7)
T-score < −1.5 and presence of any one of following:				
History of fracture at any skeletal site	107 (14.7)	201 (26.9)	137 (35.7)	445 (23.9)
Paternal history of hip fracture	35 (4.7)	47 (11.0)	6 (7.0)	88 (7.0)
Weight <127 pounds (<57.6 kilograms)	91 (12.2)	165 (21.1)	129 (30.8)	385 (19.8)
Current smoking	72 (9.7)	88 (11.3)	18 (4.3)	178 (9.1)
Recent oral glucocorticoid use	8 (1.1)	21 (2.7)	14 (3.3)	43 (2.2)
Total recommended for treatment	172 (23.1)	429 (54.9)	329 (78.3)	930 (47.8)
2008 NOF Guidelines, criteria for treatment [a]				
History of hip fracture[b]	1 (0.1)	13 (1.7)	25 (6.0)	39 (2.0)
T-score ≤ −2.5	43 (5.8)	182 (23.3)	211 (50.2)	436 (22.4)
T-score between −1 and −2.5, *and:*				
10-year probability of hip fracture ≥ 3%[c]	10 (1.3)	188 (24.1)	150 (35.7)	348 (17.9)
10-year probability of major fracture ≥ 20%[c]	12 (1.6)	52 (6.7)	34 (8.1)	98 (5.0)
Total recommended for treatment	62 (8.3)	377 (48.3)	361 (86.0)	800 (41.1)

[a] Categories are not exclusive.

[b] Guidelines call for history of hip or vertebral fracture.

[c] Calculated by the FRAX® tool.

Table 3

Proportion of men in the Framingham Osteoporosis Study meeting criteria for pharmacologic treatment of osteoporosis based on the 2008 National Osteoporosis Foundation (NOF) Guidelines [10], stratified by age.

	Age (years)			
	50-64 (N=692)	**65-75 (N=704)**	**>75 (N=285)**	**Total (N=1681)**
	N (%)			
2008 NOF Guidelines, criteria for treatment [a]				
History of hip fracture[b]	3 (0.4)	8 (1.1)	0	11 (0.7)
T-score ≤ −2.5	2 (0.3)	23 (3.3)	34 (11.9)	59 (3.5)
T-score between −1 and −2.5, *and:*				
10-year probability of hip fracture ≥ 3%[c]	12 (1.7)	101 (14.3)	108 (37.9)	221 (13.1)
10-year probability of major fracture ≥ 20%[c]	3 (0.4)	4 (0.6)	2 (0.7)	9 (0.5)
Total recommended for treatment	17 (2.5)	126 (17.9)	142 (49.8)	285 (17.0)

[a] Categories are not exclusive.

[b] Guidelines call for history of hip or vertebral fracture.

[c] Calculated by the FRAX® tool.