# Osteoporosis in Veterans With Chronic Alcohol Use: An Early Recognition and Treatment Program

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Osteoporosis is often thought of as a disease of elderly, white women. However, as fracture rates continue to increase in men, this study examined whether certain medications or unhealthy lifestyles contributed to this surprising increase.

Approximately 10 million Americans have osteoporosis, and 34 million have been diagnosed with low bone mass, placing them at risk for developing the disease.[1] If this trend continues, the prevalence of osteoporosis is anticipated to increase to > 61 million people by 2020.[1] Historically, osteoporosis was a disease associated with elderly, white women.[2] Although fracture rates in women have improved, fracture rates in men continue to increase and with fractures occurring at an earlier age.[3] One of every 4 men will have an osteoporosis-related fracture in his lifetime.[2] Each year, 80,000 men sustain a hip fracture and one-third will die within 1 year with the risk of death remaining elevated for more than 10 years.[4,5] Male veterans have an even higher mortality rate within 1 year of acquiring a hip fracture, demonstrating the need for identifying and treating at-risk veterans for osteoporosis.[6]

Osteoporosis may be a primary or secondary condition. Primary osteoporosis is loss of bone mass not caused by illness and is caused by the aging process in men or by the loss of gonadal function in women.[7] Secondary osteoporosis occurs as a consequence of chronic diseases; regular use of certain medications; and unhealthy lifestyles such as smoking, alcohol use, and lack of exercise. Secondary osteoporosis accounts for 40% to 60% of the cases in men.[7]

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## OSTEOPOROSIS AND THE VETERANS HEALTH ADMINISTRATION (VHA)

Osteoporosis in men is a major health issue that concerns the VHA. In 2009, the VHA conducted a review of screening, diagnosis, evaluation, and treatment options of osteoporosis in men. As a result, it was recommended that men aged > 50 years be evaluated for osteoporosis risk factors and be considered for bone density testing.[8] Recommendations for patient evaluation by history and physical and laboratory tests, as well as methods of education and treatment were identified for men at risk for osteoporosis or low bone mass. Despite these recommendations, osteoporosis in men is still underrecognized and undertreated.[9,10] Veterans in the Midwest also have an increased risk of osteoporosis due to decreased exposure to ultraviolet-B radiation resulting in insufficient vitamin D production from November to March.[11] In response to VHA findings, an osteoporosis early recognition and screening program was initiated at the Cincinnati VAMC for veterans aged > 48 years with chronic alcohol use, and treatment was provided to those identified as having low bone mass. For this study, chronic alcohol use was defined as 5 years of daily alcohol use with the inability to maintain sobriety.

The VA osteoporosis early recognition and treatment program began with the hypothesis that men with chronic alcohol use are at high risk for osteoporosis at a younger age due to lifestyle indicators and medical comorbidities. The program consisted of an osteoporosis education class, alcohol-use assessment, osteoporosis risk assessment, bone mineral density (BMD) testing, diagnostic laboratory testing, and treatment. To determine the best method to identify and screen this at-risk patient population, a 3-month pilot program was initiated.

An education program was presented to 101 veterans followed by a risk factor assessment for osteoporosis. Based on a positive risk assessment, 53 veterans aged > 48 years with chronic alcohol use were sent for a BMD scan and laboratory tests. Treatment was initiated on 27 patients found to be at high risk for low bone mass or osteoporosis.

To ensure the feasibility and sustainability of the program, 3 clinical questions needed to be answered:

(1) Do veterans with chronic alcohol use have an increased risk of low bone density?

(2) Do veterans with chronic alcohol use and low BMD have deficiencies in testosterone and vitamin D?

(3) Are the benefits greater than the cost of implementing an osteoporosis prevention program?

## OSTEOPOROSIS: A NEW APPROACH TO SCREENING AND TREATMENT

### Methods

The target population for this program was male veterans aged > 48 years, with chronic alcohol use who participated in the Residential (inpatient) and Outpatient Substance Abuse Units. Veterans who had alcohol or drug problems were interviewed by substance abuse staff, and they were either admitted to the 21-day program or assigned to an unlimited outpatient substance abuse program based on a history of abuse, the inability to maintain sobriety in an outpatient setting, and other medical conditions. Residential substance abuse veterans were required to attend a 1-hour medical education program as a requirement of the program. Outpatient participation was optional since outpatient substance abuse treatment was not regulated.

### Educational Presentation

The osteoporosis education class was conducted in a classroom format every 3 weeks to ensure that inpatients and outpatients were able to attend the class during their substance rehabilitation program. The participating veterans were shown a slide presentation that described the basic disease pathology of osteoporosis, benefits of weight-bearing exercise, and avoidance of excessive smoking and alcohol. To improve intake of vitamin D and calcium, counseling regarding dietary changes and supplements was also offered.

### Alcohol-Use Assessment

Literature on the effects of alcohol intake and its relationship with BMD and fracture risk is inconsistent.[12] Some literature indicates that high intake of alcohol increases fracture risk, whereas moderate daily consumption may actually improve bone density.[13,14] For the purposes of data collection in this study, an alcohol use history was gathered during the pilot phase to see whether there was any correlation between chronic alcohol use and bone density. In order to identify a possible relationship between the duration of alcohol use and osteoporosis, questions regarding lifetime number of years of drinking were assessed as well as the patient's osteoporosis risk factors.

### Fracture Risk Assessment Tool (FRAX®)

BMD testing alone has a high specificity but low sensitivity, so some fracture risk may be underidentified in patients at risk for osteoporosis if levels alone were evaluated.[14] By combining specific risk factors that contribute to fracture risk, in addition to the body mass index (BMI), a better identification of fracture prediction can be achieved.[15] Therefore, the veteran's osteoporosis risk factors were identified by assisting the patients in the completion of Part 1, an 11-question risk factor assessment for osteoporosis.[15,16] The Facture Risk Assestment Tool (FRAX®) is a sophisticated risk assessment instrument developed by the University of Sheffield in association with the World Health Organization (WHO). It uses risk factors in addition to dual-energy X-ray absorptiometry (DEXA) measurements for improved fracture risk estimation. It is a useful tool to aid clinical decision making about the use of pharmacologic therapies in patients with low bone mass. The International Osteoporosis Foundation (IOF) supports the maintenance and development of the FRAX. The clinical risk factors in the FRAX algorithm (age, sex, height, weight, prior fragility fracture, use of oral glucocorticoids, parental history of fracture, current smoking habits, excess alcohol intake, secondary osteoporosis, and rheumatoid arthritis) have been validated in 60,000 men and women from 12 prospective, population-based cohorts in diverse geographic territories.[17] The FRAX questionnaire was used to determine the need for BMD screening per DEXA scan in veterans with chronic alcohol use and was developed by the WHO in conjunction with the IOF. The FRAX consists of 2 parts. Part 1 of the FRAX is an osteoporosis risk factor analysis to determine a need for BMD testing. Part 2 of the FRAX tool calculates the 10-year probability of hip or other potential fractures by analyzing the patient's femoral neck T-score and osteoporosis risk factors. Any score > 3% of the 10-year probability of hip fracture or > 20% of the 10-year probability of a major osteoporotic fracture is considered an indication for treatment.[18]

### BMD Testing and Laboratory Tests

Bone mineral density was measured by DEXA scan T-scores of the hip, spine, and femoral neck. A T-score measurement is based on how a patient's BMD value compares with the BMD of normal young subjects, and any difference in T-score is interpreted by standard deviation (SD) variations from the normal range. Although, the FRAX assessment calculates only fracture risk based on T-scores of the femoral neck, the T-score of the spine and hip were also evaluated and considered in treatment decisions. Any DEXA T-score between + 1.0 to – 1.0 is considered to indicate healthy bone. Any score of < – 1.0 SD from normal is associated with healthy bone.[18] For

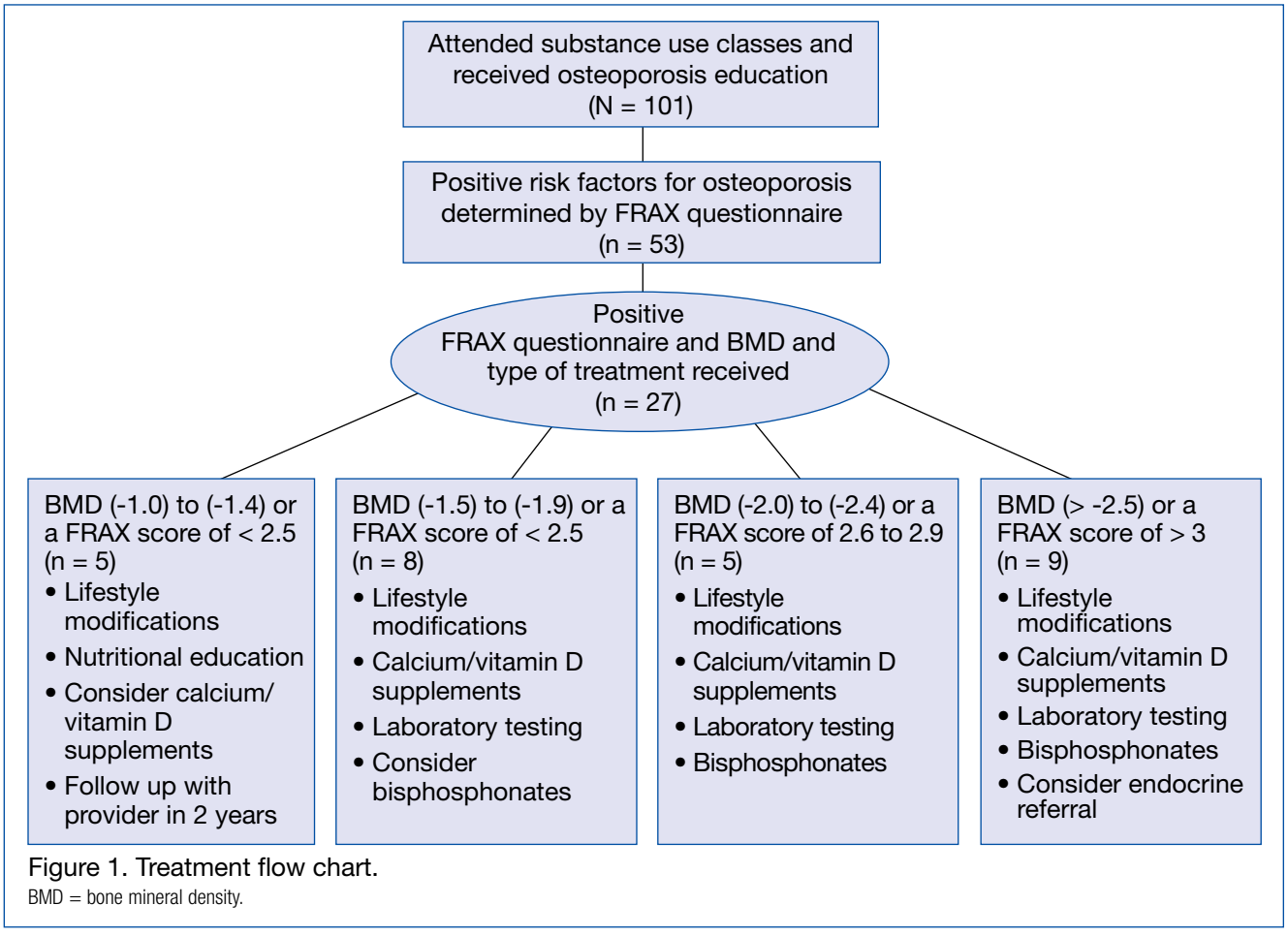


Figure 1. Treatment flow chart.
BMD = bone mineral density.

those men who demonstrated low bone mass by a T-score of ≤ – 1.5 in the spine, hip, or femoral neck, serum testosterone, vitamin D, and phosphorus tests were ordered.[19] Of the 101 veterans screened, 53 patients had a positive FRAX risk factor assessment questionnaire and had serum calcium, albumin, and thyroid-stimulating hormone (TSH) drawn as a routine screen for admission to the substance abuse program. Other tests were ordered, such as, parathyroid hormone if hyperparathyroidism was suspected or gonadotropins (luteinizing hormone and follicular-stimulating hormone), if hypogonadism was suspected to be a cause of osteoporosis.[20]

## Treatment of Osteopenia and Osteoporosis

Osteopenia and osteoporosis treatment regimens were determined based on osteoporosis risk factors and clinical evaluation of low bone mass. Forty-eight veterans had a T-score of ≥ –1.0 in the femur, hip, or spine per DEXA scan or a FRAX score of < 3% and were considered at low risk for low bone mass. Lifestyle counseling was initiated to reduce the risk of osteoporosis and included stopping or reducing alcohol and nicotine use and having adequate dietary calcium and vitamin D intake.[21] For veterans with DEXA scan T-scores of < – 1.0 or high normal fracture risk probability, clinical judgment was used to determine treatment with bisphosphonates based on the veteran's individual risk factors (Figure 1).[22]

Bisphosphonate treatment was initiated in all patients with a history of hip or vertebral fracture, a T-score < – 2.5 indicating osteoporosis (with secondary causes excluded), or a 10-year probability of > 3% for a hip fracture or > 20% for major osteoporosis fracture.[18] All veterans who were treated for low bone mass were referred to their primary care provider for follow-up treatment and repeat BMD assessments every 2 years or earlier, depending on the severity of their disease.

**Table 1. VAMC end of course evaluation: Results**

Directions: Please rate each of the items of the educational program described for you in terms of each statement, using the scale below. We encourage comments in the space provided.

| Evaluation items | Scale | | | | | |
|---|---|---|---|---|---|---|
| | Not at all 1 | Slightly 2 | Somewhat 3 | Substantial 4 | Very much 5 | Does not apply |
| 1. Was the material, pace, duration of the session suitable for understanding the content? | | | 4 | 32 | 65 | |
| 2. Were the teaching methods effective? | | | 3 | 28 | 70 | |
| 3. Do you feel you have a better understanding of osteoporosis? | | | 3 | 28 | 70 | |
| 4. Do you feel you understand your risk factors for osteoporosis? | | 2 | 2 | 28 | 69 | |
| 5. Do you understand how you could lower your risk factors for osteoporosis? | | 2 | 2 | 27 | 70 | |
| 6. Would your recommend the program be repeated? | 1 | 2 | 3 | 25 | 70 | |
| Comments: | | | | | | |

## OUTCOMES

### Osteoporosis Education and Identification of Veterans at Risk

The 4 osteoporosis education classes were attended by 101 veterans. After classroom programs were completed, the veterans responded to a Likert-like evaluation, which addressed 5 statements about the course objectives that included teaching methods, understanding of osteoporosis, and identification of risk factors (Table 1).[23] Veterans specifically indicated they had a better understanding of osteoporosis, and the majority (94.0%) indicated they thought the class should continue.

### Alcohol Use Assessment and Correlation to Osteoporosis Incidence

Of the 101 veterans who attended the classes, 53 were found to have a positive FRAX and completed an alcohol use history. Veterans reported drinking ≥ 3 drinks per day over a range of 5 to 48 years of consumption. All veterans had a high incidence of BMD loss, but there was no correlation between the effect in the severity of osteopenia or osteoporosis and the number of years of drinking. The Spearman rank correlation was used to evaluate the significance of the relationship between lifetime number of years of drinking and the veteran's BMD. There was no statistically significant association between the number of years of use and the incidence of low BMD of the hip, spine, or femur ($P = .092$).

### FRAX Results

Out of the 101 veteran's completing Part 1 of the FRAX, 53 veterans were also found to be at risk for osteoporosis per risk factor analysis and completed a DEXA scan of the femoral neck, hip, and spine.

Twenty-seven of the 53 veterans were found to have positive DEXA scans of ≥ – 1.0, indicating low bone mass. Twenty-six of the 53 were African American, and 9 (35%) of those were found to have some degree of bone loss, which is higher than the national average of 5%.[24]

The DEXA scan results were then added to Part 2 of the FRAX, and the 10-year probability of hip fracture was calculated (Table 2). Nine of the 53 patients had a 10-year probability of a hip fracture score of > 3.0%, which indicated a need for osteoporosis treatment. An additional 5 patients had a 10-year probability of hip fracture risk scores of 2.6% to 2.9% or a DEXA scan of below – 2.0, suggesting they were also approaching a high risk for fracture.

Although only DEXA scans of the femoral neck were used for the FRAX calculation, DEXA scans of the spine were also evaluated. Thirteen patients had abnormal DEXA scans of the spine, and of those, 6 patients had significant osteopenia of the spine, requiring treatment with minimal deficiencies of the hip or femur. If the T-score of only the hip was evaluated as a clinical indicator for osteoporosis as recommended by the FRAX, fractures of the spine would have gone undetected.

A BMI of < 19 is considered to be a risk factor for osteoporosis.25 In this study, about one-half of both African American and white male veterans aged 48 to 65 years had low bone mass, and all had normal BMI scores of ≥ 19.

### Treatment Results

A crucial component of the program involved being able to differentiate the patients at high fracture risk from those where interventions will have little value. Although the FRAX risk assessment along with femoral neck T-score measurements enhanced the clinical evaluation for low bone mass, the decision to treat was based on the clinical evaluation of each case, taking into consideration risks vs benefits. Because of the effects of chronic alcohol use, many of the patients had factors that complicated treatment regimens (ie, vitamin D and testosterone deficiencies). Because of this comorbidity, many patients were referred to the Endocrine Clinic for comprehensive treatment.

### Laboratory Results

All veterans had baseline laboratory tests of calcium, albumin, and thyroid levels that were mostly normal. Bisphosphonate treatment was being considered for 19 patients; therefore, vitamin D, phosphorous, and testosterone levels were ordered in addition to the above laboratory data. The most notable laboratory findings were the abnormally low vitamin D and testosterone levels (Table 3). Of note, 18 of 19 patients or (94.7%) had either vitamin D deficiency or insufficiencies. These findings are consistent with the literature that indicates vitamin D deficiency is highly prevalent in veterans and that many veterans have not received treatment or received inadequate treatment.[26,27] Testosterone levels were also found to be low in 36.8% of the veterans with low bone mass, indicating another contributing risk factor for osteoporosis that occurs in men with chronic alcohol use.

**Table 2. Characteristics of male veterans with chronic alcohol use and positive FRAX scores**

| Characteristics | Low BMD (N = 27) | Normal BMD (N = 26) | Positive DEXA scan or 10-year probability of fracture (N = 9) |
|---|---|---|---|
| **Age (y)** | | | |
| 48-50 | 4 | 3 | 1 |
| 51-55 | 8 | 9 | 4 |
| 56-60 | 7 | 7 | 1 |
| 61-65 | 8 | 4 | 3 |
| 66-70 | 0 | 3 | 0 |
| **Smoking status** | | | |
| Nonsmoker | 6 | 6 | 3 |
| Smoker | 21 | 20 | 6 |
| **BMI** | | | |
| < 21 | 6 | 4 | 3 |
| 22-25 | 8 | 4 | 2 |
| 26-29 | 6 | 9 | 2 |
| > 30 | 7 | 9 | 2 |
| **Years of alcohol use** | | | |
| < 5 | 0 | 1 | 1 |
| 6-15 | 3 | 1 | 0 |
| 16-24 | 7 | 5 | 1 |
| 25-34 | 5 | 8 | 1 |
| 35-44 | 7 | 7 | 2 |
| 45-54 | 5 | 4 | 4 |

BMD = bone mineral density; BMI = body mass index; DEXA = dual-energy X-ray absorptiometry; FRAX = Fracture Risk Assessment Tool.

## DISCUSSION

The current study evaluated the incidence of low bone mass in veterans with chronic alcohol use. The analyses suggest that veterans with chronic alcohol use do not fit the typical description of the patient at risk for osteoporosis. According to the National Osteoporosis Foundation, at-risk individuals are primarily white women or men of advanced age with low body weight or with a family history

**Table 3. Laboratory results of veterans screened for osteoporosis**

| | Abnormal | Normal |
|---|---|---|
| Calcium (8.6-10.2 mg/dL) | 1 | 52 |
| TSH (0.4-5.4 ulu/mL) | 0 | 53 |
| Albumin (3.5-5.0 g/dL) | 3 | 50 |
| Testosterone, total (2.5-8.0 ng/mL) | 7 | 12 |
| Vitamin D, 25-hydroxy (30-80 ng/mL) | 18 | 1 |
| Phosphorous (2.5-4.5 mg/dL) | 5 | 14 |

TSH = thyroid-stimulating hormone.

of hip fracture.[1] Although the causes of the low bone mass are likely multifactorial, contributing factors also include alcohol and nicotine dependence.

The laboratory data indicated that the veterans' albumin, TSH, and calcium levels were normal with and without low bone mass, suggesting that these laboratory values tests were not valuable indexes of low bone mass. A better laboratory indicator of the cause of low bone mass in this osteoporosis risk group may be vitamin D and testosterone levels, as they are influenced by alcohol use and prevent adequate calcium absorption contributing to low bone mass. Routinely testing veterans for osteoporosis and vitamin D and testosterone deficiencies should be performed in veterans with chronic alcohol use, aged ≥ 50 years, and with defined risk factors. Because maintaining dietary requirements while abusing substances is difficult, the addition of calcium and vitamin D supplements should be considered.

When developing a treatment plan, a key consideration is that clinicians need to evaluate the risk-benefit ratio when prescribing therapy. All fragility fractures, regardless of BMD results, warrant intervention, as repeat fractures tend to occur within 5 years after the initial fracture.[28] According to the Academy of Orthopedic Surgeons, the average cost of hip fracture care is $26,912.[29] Direct medical costs of fracture care were $13.7 billion in 2005, representing a significant health care burden.[30] Men account for 29% of fractures and 25% of its cost.[30]Alendronate, risedronate, and zoledronic acid have been approved for treatment of osteoporosis in men.[1,31] The cost of 3 years of intravenous zoledronic acid therapy is $1,800, and the cost of 3 years of weekly oral bisphosphonates (alendronate) is about $720 for veterans. Alcohol misuse is associated with medication nonadherence.[32] Intravenous bisphosphonates may be the more effective treatment. Using support systems and calendar reminders may help improve compliance with oral regimens of bisphosphonates.

Long-term safety profiles for risedronate and alendronate have been well established through evaluation of 10 years of treatment.[31,33] Although osteonecrosis of the jaw seems to be a concern for providers, a causal relationship has not been established. The risk of osteonecrosis associated with bisphosphonate treatment is estimated to be between 1 in 10,000 and < 1 in 100,000 in patient-treatment years.[34] Osteonecrosis of the jaw was reported mainly in cancer patients receiving high doses of intravenous bisphosphonates while undergoing dental procedures.[34] Despite the respective safety profile, treatment does need to be considered on an individual basis. Patients with low calcium, renal impairment, gastrointestinal, or esophageal issues may not be candidates for bisphosphonates.

This study identified that 27 of 101 veterans with chronic alcohol use had osteopenia or osteoporosis. The importance of the osteoporosis risk assessment cannot be overemphasized. Osteoporosis education needs to be included in the education curriculum of physicians, nurse practitioners, and physician assistants.

Unfortunately, there is an absence of randomized controlled trials of fracture prevention in men at risk for osteoporosis. Although this program evaluation included only male veterans, it is likely that osteoporosis exists in the general population who engage in chronic alcohol use. Research evaluating the effects of alcohol on low bone mass, prevention, and treatment are needed. Larger sample sizes with a control group, noting the incidence of low bone mass in younger males and African American men who have normal basal metabolic indexes with chronic alcohol use, needs to be examined, as this group of veterans have not been identified to have osteoporosis risk.

## CONCLUSION

Quality of life and premature death can be associated with osteoporosis-related fractures. A clinician should be proactive in screening and treating veterans with low bone mass instead of waiting until the patient has a fragility fracture to initiate treatment. A significant finding in this program was the prevalence of low bone mass in middle-aged men who have chronic alcohol use and do not fit the normal profile for being at high risk for developing osteoporosis. It is imperative that men, as well as women with a history of chronic alcohol use, have thorough osteoporosis education, screening, and treatment. Providers need to be cognizant that osteoporosis is no longer simply a disease of elderly, white women. ●

### *Author disclosures*

*The author reports no actual or potential conflicts of interest with regard to this article.*

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