ACP Clinical Practice
American College of Physicians
GUIDELINES

Screening for Osteoporosis in Men: A Clinical Practice Guideline from the American College of Physicians

Amir Qaseem, MD, PhD, MHA; Vincenza Snow, MD; Paul Shekelle, MD, PhD; Robert Hopkins Jr., MD; Mary Ann Forciea, MD; and Douglas K. Owens, MD, MS, for the Clinical Efficacy Assessment Subcommittee of the American College of Physicians*

Description: The American College of Physicians developed this guideline to present the available evidence on risk factors and screening tests for osteoporosis in men.

Methods: Published literature on this topic was identified by using MEDLINE (1990 to July 2007). Reference mining was done on the retrieved articles, references of previous reviews, and solicited articles from experts. The inclusion criteria for the studies were measuring risk factors for low bone mineral density or osteoporotic fracture in men or comparing 2 different methods of assessment for the presence of osteoporosis in men. This guideline grades the evidence and recommendations by using the American College of Physicians' clinical practice guidelines grading system.

Recommendation 1: The American College of Physicians recommends that clinicians periodically perform individualized assessment of risk factors for osteoporosis in older men (Grade: strong recommendation; moderate-quality evidence).

Recommendation 2: The American College of Physicians recommends that clinicians obtain dual-energy x-ray absorptiometry for men who are at increased risk for osteoporosis and are candidates for drug therapy (Grade: strong recommendation; moderate-quality evidence).

Recommendation 3: The American College of Physicians recommends further research to evaluate osteoporosis screening tests in men.

Ann Intern Med. 2008;148:680-684. www.annals.org
For author affiliations, see end of text.

Osteoporosis in men is an important public health problem. Osteoporosis in men is substantially underdiagnosed, undertreated, and underreported and inadequately researched (1, 2). Although osteoporosis is often viewed as a disease of women, studies show that osteoporotic fractures also result in substantial morbidity, mortality, and financial expenses in men (3–7). The prevalence of osteoporosis is estimated to be 7% in white men, 5% in black men, and 3% in Hispanic men. Data on prevalence in Asian-American men and other ethnic groups are lacking (2). With the aging of the population, rates of osteoporosis in men are expected to increase nearly 50% in the next 15 years, and hip fractures rates are projected to double or triple by 2040 (2).

This guideline presents the available evidence on risk factors and screening tests for osteoporosis in men. The target audience for this guideline is all clinicians, and the target patient population is all adult men older than age 50 years. These recommendations are based on the systematic evidence review by Liu and colleagues (8) in this issue and the Agency for Healthcare Research and Quality–sponsored Southern California Evidence-based Practice Center evidence report (9).

See also:

Print
Related article 685
Summary for Patients I-35

Web-Only
Conversion of graphics into slides
CME quiz

METHODS

The literature search was done by Liu and colleagues and included studies from MEDLINE from 1990 to July 2007. In addition, the authors did reference mining of retrieved articles, references of previous reviews, and solicited articles from experts. Four researchers (2 pairs of an endocrinologist and a general internist trained in health services research) reviewed the list of titles and selected articles for further review. This guideline is based on an evaluation of 389 articles, of which 176 addressed risk factors for osteoporosis and 27 addressed diagnostic tools for osteoporosis. All of the included studies measured risk factors for osteoporosis or fracture in men or compared a non–dual-energy x-ray absorptiometry (DXA) index screening test with a gold standard reference test (either DXA-defined osteoporosis [T-score threshold of −2.5] or the occurrence of an osteoporotic fracture). The back-

*This paper, written by Amir Qaseem, MD, PhD, MHA; Vincenza Snow, MD; Paul Shekelle, MD, PhD; Robert Hopkins Jr., MD; Mary Ann Forciea, MD; and Douglas K. Owens, MD, MS, was developed for the Clinical Efficacy Assessment Subcommittee of the American College of Physicians (ACP): Douglas K. Owens, MD, MS (*Chair*); Donald E. Casey Jr., MD, MPH, MBA; Paul Dallas, MD; Thomas D. Denberg, MD, PhD; Mary Ann Forciea, MD; Lakshmi Halasyamani, MD; Robert H. Hopkins Jr., MD; William Rodriguez-Cintron, MD; and Paul Shekelle, MD, PhD. Approved by the ACP Board of Regents on 13 January 2008.

ground article in this issue (8) provides details about the methods used for the systematic evidence review.

This guideline grades the evidence and recommendations by using the American College of Physicians' clinical practice guidelines grading system adopted from the classification developed by the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) workgroup (**Table**). In addition, to assess the internal validity of diagnostic studies, Liu and colleagues (8) used the Quality Assessment of Diagnostic Accuracy Studies (QUADAS) evaluation tool.

Our main interest is to determine the risk factors for osteoporotic fracture that are mediated through low bone mineral density (BMD) and thus define men who would be more likely to benefit from DXA. However, in the interest of brevity, for the remainder of the article we simplify this to "risk factors for osteoporosis." The objective of this guideline is to synthesize the evidence for the following questions:

1. What are the risk factors for osteoporosis in men?
2. Are there any validated tools (other than central BMD) to screen for osteoporosis in men?
3. What are the risk factors for low BMD–mediated fracture?

Clinical Diagnosis of Osteoporosis

The clinical diagnosis of osteoporosis is made in 2 ways: occurrence of an osteoporotic fracture and the World Health Organization's (WHO) bone density criteria. Fragility fractures are an important characteristic of osteoporotic bone disease and typically occur after a prolonged decrease in BMD and quality. Fragility fracture is defined by the WHO as a fracture from low-level trauma, meaning a fall from a standing height or lower. The bones most commonly fractured are the distal radius, proximal humerus, hip, and vertebral body. In 1994, the WHO defined osteoporosis as a BMD greater than 2.5 SDs (T-score, −2.5) below that of a young, healthy population as measured by DXA.

The standard for measuring BMD and diagnosing osteoporosis in men (and women) is DXA (10, 11). However, DXA is not universally available, is not portable, and is an imperfect predictor of future fractures. In addition, screening with DXA may not be cost-effective in all groups (expenses per quality-adjusted life-year varied from $30 000 to $248 000, depending on age) (10–14). Therefore, it is important to evaluate non-DXA osteoporosis tests that are sensitive, inexpensive, and easily implemented.

Risk Factors for Osteoporosis

A high-quality meta-analysis showed that the most important risk factors for osteoporosis in men are age (>70 years), low body weight (body mass index <20 to 25 kg/m^2 or lower), weight loss (>10% [compared with the usual young or adult weight or weight loss in recent years]), physical inactivity (participates in no physical activity on a regular basis [walking, climbing stairs, carrying weights, housework, or gardening]), use of oral corticosteroids, and previous fragility fracture (15). Most of the studies in this systematic review included participants older than age 50 years from the United States or Europe; thus the findings are limited in their generalizability to other populations.

Table. **The American College of Physicians' Guideline Grading System***

Quality of Evidence	Strength of Recommendation	
	Benefits Clearly Outweigh Risks and Burden OR Risks and Burden Clearly Outweigh Benefits	Benefits Finely Balanced with Risks and Burden
High	Strong	Weak
Moderate	Strong	Weak
Low	Strong	Weak
Insufficient evidence to determine net benefits or risks	I-recommendation	

* Adopted from the classification developed by the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) workgroup.

The authors also reviewed evidence for other potential risk factors. Alcohol use results in an increased probability of fracture but has not been associated with decreased BMD in the available studies (16–21). Androgen deprivation therapy (pharmacologic and orchiectomy) is a strong predictor of both osteoporosis and fracture (22–33). Cigarette smoking and low dietary intake of calcium are moderate predictors of an increased risk for low bone mass; they are probably also risk factors for fracture, but the supporting evidence is less clear. Spinal cord injury is a moderate predictor of both low BMD and osteoporotic fracture in men. Data are insufficient in men to determine whether the presence of respiratory disease (independent of steroid use), type 2 diabetes, dietary intake of vitamin D, thyroid disease and thyroid replacement therapy, gastrointestinal malabsorption, rheumatoid arthritis, and hyperparathyroidism increase the risk for low BMD–mediated fracture. All of these possible risk factors have plausible physiologic rationales, and some have data supporting an association with osteoporosis and fracture in women, but data in men are lacking.

Screening Tests for Osteoporosis

The diagnosis of osteoporosis is based on reduced BMD as measured by DXA (10, 11). However, DXA is expensive, and it is not portable or available everywhere (10–14). Therefore, it is important to identify and evaluate the efficacy of non-DXA screening tests. When calcaneal ultrasonography was evaluated in women, it was not suffi-

ciently sensitive or specific to serve as a screening test for diagnosis of osteoporosis (34).

The studies evaluating osteoporosis screening tests in this guideline can be broadly divided into 2 categories: those that assess a test against a BMD measurement (DXA) and those that assess a test against a fracture occurrence.

Calcaneal Ultrasonography versus DXA-Measured BMD

Calcaneal ultrasonography is a diagnostic tool in which an ultrasonography probe is placed on either heel to measure BMD. It has many advantages, including portability, low cost, and the absence of ionizing radiation. However, there is no accepted threshold for a positive T-score of the quantitative ultrasonography index, and the thresholds used in the evaluated studies varied from 0 to −2.5.

Evidence showed that a calcaneal ultrasonography T-score of −1.0 had a sensitivity of 75% and a specificity of 66% to diagnose BMD-determined osteoporosis (central DXA T-score <−2.5) (34–38). When the calcaneal ultrasonography T-score was decreased to −1.5, the specificity increased to 78% but sensitivity decreased to 47%.

Osteoporosis Self-assessment Screening Tool versus DXA-Measured BMD

The osteoporosis self-assessment screening tool (OST) is a simple test used to develop a risk score for osteoporosis by using a person's age and weight (risk score = [weight in kilograms − age in years] × 0.2). No accepted threshold for a positive OST risk score exists, and thresholds used have varied from −1 to 3 in various studies.

Evidence from 2 studies that evaluated Asian men showed that an OST risk score of −1 had a sensitivity of 70% to 90% and a specificity of 70% to diagnose BMD-determined osteoporosis (37, 39). In a study of U.S veterans, an OST threshold of 3 was associated with a sensitivity of 93% and specificity of 66% (40). However, when the OST threshold was decreased to 1, the sensitivity decreased to 75% and specificity increased to 80%.

Calcaneal Ultrasonography versus Fracture Occurrence

Evidence from 10 studies showed that calcaneal ultrasonography moderately predicts fragility fractures in men (41–48). Several studies showed that each additional SD reduction in a calcaneal ultrasonography measurement resulted in an increased risk for hip fracture and nonspinal fracture (46, 48), and ultrasonography stiffness parameters were strongly associated with previous fragility fracture (42).

Combination of Calcaneal Ultrasonography and DXA-Measured BMD

Some researchers have suggested the use of calcaneal ultrasonography to identify patients who should have a confirmatory DXA testing. The evidence is less clear on the benefit of combining calcaneal ultrasonography and DXA BMD measurements compared with either test alone to predict fractures. One study showed a strong association of fragility fractures with BMD at the hip (odds ratio, 3.4) and calcaneal ultrasonography (odds ratio, 3.2). When both tests were used, the odds ratio increased to 6.1 (42). However, analysis of receiver-operating characteristic curves from another study showed that the combination was not superior to either test alone in predicting hip fractures (area under the curve for ultrasonography alone, 0.84; for BMD alone, 0.85; and for the combination, 0.85) (48).

Summary

High-quality evidence shows that age, low body weight, physical inactivity, and weight loss are strong predictors of an increased risk for osteoporosis in men. There is also moderate-quality evidence that previous fragility fracture, systemic corticosteroid therapy, androgen deprivation therapy, and spinal cord injury are predictors of an increased risk for osteoporosis in men. Cigarette smoking and low dietary intake of calcium predict low bone mass.

Some studies suggest that OST may have higher sensitivity and specificity than calcaneal ultrasonography does in diagnosing DXA-determined osteoporosis (37, 39, 40). However, the primary outcome in the studies was not fractures, so this result should be viewed with caution because the clinical outcome of fracture is of most interest to patients and clinicians. In addition, moderate-quality evidence showed that calcaneal ultrasonography is an independent predictor of fractures in men even though its ability to diagnose DXA-determined osteoporosis is limited. Whether the combination of DXA BMD measurements and calcaneal ultrasonography to assess for fractures is better than either test alone remains uncertain.

Recommendations

Recommendation 1: The American College of Physicians recommends that clinicians periodically perform individualized assessment of risk factors for osteoporosis in older men (Grade: strong recommendation; moderate-quality evidence).

A careful assessment of risk for osteoporosis in men is important. The appropriate age to start risk assessment is uncertain. However, by age 65 years, at least 6% of men have DXA-determined osteoporosis (49), therefore, assessment of risk factors before this age is reasonable. Factors that increase the risk for osteoporosis in men include age (>70 years), low body weight (body mass index <20 to 25 kg/m^2), weight loss (>10% [compared with the usual young or adult weight or weight loss in recent years]), physical inactivity (participates in no physical activities on a regular basis [walking, climbing stairs, carrying weights, housework, or gardening]), corticosteroid use, androgen deprivation therapy, and previous fragility fracture. Risk assessments should be updated periodically for men who choose not to be screened.

Recommendation 2: The American College of Physicians

recommends that clinicians obtain DXA for men who are at increased risk for osteoporosis and are candidates for drug therapy (Grade: strong recommendation; moderate-quality evidence).

Bone density measurement with DXA is the accepted reference standard for diagnosing osteoporosis in men (10, 11). Men who are at increased risk for osteoporosis are candidates for DXA. Little evidence about alternatives to DXA exists. The 2 most studied methods are quantitative ultrasonography (usually of the calcaneus) and the OST. Available evidence indicates that neither alternative is sufficiently sensitive or specific at predicting DXA-determined bone mass to be recommended as a substitute for DXA. Although 1 study has demonstrated a strong relationship between calcaneal ultrasonography and subsequent fracture, until treatment trials establish the effectiveness of therapy for osteoporosis diagnosed by ultrasonography rather than DXA, the role of ultrasonography in initiating therapy remains uncertain. No studies have evaluated the optimal intervals for repeated screening by using BMD measurement with DXA.

The evidence review showed that calcaneal ultrasonography predicts DXA-determined osteoporosis only modestly well. However, more important, it was a strong predictor of fracture in men. This may be because ultrasonography identifies other bone properties, such as bone quality, which may not be identified on DXA. Because treatment trials have not measured the effectiveness of therapy for osteoporosis diagnosed by ultrasonography rather than DXA, the role of ultrasonography in diagnosis remains uncertain.

Recommendation 3: The American College of Physicians recommends further research to evaluate osteoporosis screening tests in men.

A major limitation of existing osteoporosis screening studies is the use of BMD measurement (DXA) as the primary outcome rather than fracture occurrence. Although there is a large body of evidence about risk factors for osteoporosis in women, more research is needed to understand whether these risk factors also apply to men. Therapy should be evaluated in terms of fracture occurrence because of the significant disability, morbidity, mortality, and expenses that are associated with osteoporotic fractures. Furthermore, the harms of screening in this age group, such as radiation exposure and false-positive results, should also be studied. In addition, more research is needed in evaluating other screening tests, such as quantitative computed tomography, other types of questionnaires, or peripheral BMD measurements, which might also be useful as screening tests in men. Further research should explore whether acceptable substitutes for DXA exist (in terms of establishing the need for pharmacologic therapy). Research that explores the age at which men should begin to consider screening for osteoporosis and effective prevention measures for osteoporosis in men is also needed.

From the American College of Physicians and University of Pennsylvania, Philadelphia, Pennsylvania; University of Arkansas, Little Rock, Arkansas; Veterans Affairs Greater Los Angeles Healthcare System and RAND, Santa Monica, California; and Veterans Affairs Palo Alto Health Care System and Stanford University, Stanford, California.

Financial Support: Financial support for the development of this guideline comes exclusively from the American College of Physicians' operating budget.

Potential Financial Conflicts of Interest: *Grants received:* V. Snow (Centers for Disease Control and Prevention, Atlantic Philanthropies, United Health Foundation, Bristol-Myers Squibb, Novo Nordisk, Endopharm, Boehringer Ingelheim, Sanofi Pasteur). Any conflict of interest of the Guideline Development Committee group members was declared, discussed, and resolved.

Requests for Single Reprints: Amir Qaseem, MD, PhD, MHA, American College of Physicians, 190 N. Independence Mall West, Philadelphia, PA 19106; e-mail, aqaseem@acponline.org.

Current author addresses are available at www.annals.org.

References

1. **Kiebzak GM, Beinart GA, Perser K, Ambrose CG, Siff SJ, Heggeness MH.** Undertreatment of osteoporosis in men with hip fracture. Arch Intern Med. 2002;162:2217-22. [PMID: 12390065]

2. **Looker AC, Orwoll ES, Johnston CC Jr, Lindsay RL, Wahner HW, Dunn WL, et al.** Prevalence of low femoral bone density in older U.S. adults from NHANES III. J Bone Miner Res. 1997;12:1761-8. [PMID: 9383679]

3. **Pacini S, Aterini S, Ruggiero M, Gulisano M.** Bone mineral density and anthropometric measures in normal and osteoporotic men. Ital J Anat Embryol. 1999;104:195-200. [PMID: 10684183]

4. **Halling A, Persson GR, Berglund J, Johansson O, Renvert S.** Comparison between the Klemetti index and heel DXA BMD measurements in the diagnosis of reduced skeletal bone mineral density in the elderly. Osteoporos Int. 2005;16:999-1003. [PMID: 15605191]

5. **Stehman-Breen CO, Sherrard D, Walker A, Sadler R, Alem A, Lindberg J.** Racial differences in bone mineral density and bone loss among end-stage renal disease patients. Am J Kidney Dis. 1999;33:941-6. [PMID: 10213653]

6. **Oefelein MG, Resnick MI.** The impact of osteoporosis in men treated for prostate cancer. Urol Clin North Am. 2004;31:313-9. [PMID: 15123410]

7. **Bano G, Rodin DA, Pazianas M, Nussey SS.** Reduced bone mineral density after surgical treatment for obesity. Int J Obes Relat Metab Disord. 1999;23:361-5. [PMID: 10340813]

8. **Liu H, Paige NM, Goldzweig CL, Wong E, Zhou A, Suttorp MJ, et al.** Screening for osteoporosis in men: a systematic review for an American College of Physicians guideline. Ann Intern Med. 2008;148:685-701.

9. **Shekelle P, Munjas B, Liu H, Paige N, Zhou A.** Screening Men for Osteoporosis: Who & How. (Prepared by the Greater Los Angeles Veterans Affairs Healthcare System/Southern California/RAND Evidence-based Practice Center.) Washington, DC: U.S. Department of Veterans Affairs; 2007.

10. **Brunader R, Shelton DK.** Radiologic bone assessment in the evaluation of osteoporosis. Am Fam Physician. 2002;65:1357-64. [PMID: 11996418]

11. **Kanis JA, Black D, Cooper C, Dargent P, Dawson-Hughes B, De Laet C, et al. International Osteoporosis Foundation.** A new approach to the development of assessment guidelines for osteoporosis. Osteoporos Int. 2002;13:527-36. [PMID: 12111012]
12. **Schuit SC, van der Klift M, Weel AE, de Laet CE, Burger H, Seeman E, et al.** Fracture incidence and association with bone mineral density in elderly men and women: the Rotterdam Study. Bone. 2004;34:195-202. [PMID: 14751578]
13. **Bateman C.** South Africa under-prioritises osteoporosis. S Afr Med J. 2006; 96:19-20. [PMID: 16440105]
14. **Schousboe JT, Taylor BC, Fink HA, Kane RL, Cummings SR, Orwoll ES, et al.** Cost-effectiveness of bone densitometry followed by treatment of osteoporosis in older men. JAMA. 2007;298:629-37.
15. **Espallargues M, Sampietro-Colom L, Estrada MD, Solà M, del Rio L, Setoain J, et al.** Identifying bone-mass-related risk factors for fracture to guide bone densitometry measurements: a systematic review of the literature. Osteoporos Int. 2001;12:811-22. [PMID: 11716183]
16. **Kanis JA, Johansson H, Johnell O, Oden A, De Laet C, Eisman JA, et al.** Alcohol intake as a risk factor for fracture. Osteoporos Int. 2005;16:737-42. [PMID: 15455194]
17. **Roy DK, O'Neill TW, Finn JD, Lunt M, Silman AJ, Felsenberg D, et al.** European Prospective Osteoporosis Study (EPOS). Determinants of incident vertebral fracture in men and women: results from the European Prospective Osteoporosis Study (EPOS). Osteoporos Int. 2003;14:19-26. [PMID: 12577181]
18. **Høidrup S, Grønbaek M, Gottschau A, Lauritzen JB, Schroll M.** Alcohol intake, beverage preference, and risk of hip fracture in men and women. Copenhagen Centre for Prospective Population Studies. Am J Epidemiol. 1999;149: 993-1001. [PMID: 10355374]
19. **Naves M, Díaz-López JB, Gómez C, Rodríguez-Rebollar A, Serrano-Arias M, Cannata-Andía JB.** Prevalence of osteoporosis in men and determinants of changes in bone mass in a non-selected Spanish population. Osteoporos Int. 2005;16:603-9. [PMID: 15448987]
20. **Bakhireva LN, Barrett-Connor E, Kritz-Silverstein D, Morton DJ.** Modifiable predictors of bone loss in older men: a prospective study. Am J Prev Med. 2004;26:436-42. [PMID: 15165661]
21. **Hannan MT, Felson DT, Dawson-Hughes B, Tucker KL, Cupples LA, Wilson PW, et al.** Risk factors for longitudinal bone loss in elderly men and women: the Framingham Osteoporosis Study. J Bone Miner Res. 2000;15:710-20. [PMID: 10780863]
22. **Shahinian VB, Kuo YF, Freeman JL, Goodwin JS.** Risk of fracture after androgen deprivation for prostate cancer. N Engl J Med. 2005;352:154-64. [PMID: 15647578]
23. **Melton LJ 3rd, Alothman KI, Khosla S, Achenbach SJ, Oberg AL, Zincke H.** Fracture risk following bilateral orchiectomy. J Urol. 2003;169:1747-50. [PMID: 12686824]
24. **Smith MR, Lee WC, Brandman J, Wang Q, Botteman M, Pashos CL.** Gonadotropin-releasing hormone agonists and fracture risk: a claims-based cohort study of men with nonmetastatic prostate cancer. J Clin Oncol. 2005;23: 7897-903. [PMID: 16258089]
25. **Chen Z, Maricic M, Nguyen P, Ahmann FR, Bruhn R, Dalkin BL.** Low bone density and high percentage of body fat among men who were treated with androgen deprivation therapy for prostate carcinoma. Cancer. 2002;95:2136-44. [PMID: 12412167]
26. **Diamond TH, Bucci J, Kersley JH, Aslan P, Lynch WB, Bryant C.** Osteoporosis and spinal fractures in men with prostate cancer: risk factors and effects of androgen deprivation therapy. J Urol. 2004;172:529-32. [PMID: 15247721]
27. **Yaturu S, DjeDjos S, Alferos G, Deprisco C.** Bone mineral density changes on androgen deprivation therapy for prostate cancer and response to antiresorptive therapy. Prostate Cancer Prostatic Dis. 2006;9:35-8. [PMID: 16276350]
28. **Krupski TL, Smith MR, Lee WC, Pashos CL, Brandman J, Wang Q, et al.** Natural history of bone complications in men with prostate carcinoma initiating androgen deprivation therapy. Cancer. 2004;101:541-9. [PMID: 15274067]
29. **Daniell HW, Dunn SR, Ferguson DW, Lomas G, Niazi Z, Stratte PT.** Progressive osteoporosis during androgen deprivation therapy for prostate cancer. J Urol. 2000;163:181-6. [PMID: 10604342]
30. **Stoch SA, Parker RA, Chen L, Bubley G, Ko YJ, Vincelette A, et al.** Bone loss in men with prostate cancer treated with gonadotropin-releasing hormone agonists. J Clin Endocrinol Metab. 2001;86:2787-91. [PMID: 11397888]
31. **López AM, Pena MA, Hernández R, Val F, Martín B, Riancho JA.** Fracture risk in patients with prostate cancer on androgen deprivation therapy. Osteoporos Int. 2005;16:707-11. [PMID: 15714259]
32. **Oefelein MG, Ricchuiti V, Conrad W, Seftel A, Bodner D, Goldman H, et al.** Skeletal fracture associated with androgen suppression induced osteoporosis: the clinical incidence and risk factors for patients with prostate cancer. J Urol. 2001;166:1724-8. [PMID: 11586210]
33. **Hatano T, Oishi Y, Furuta A, Iwamuro S, Tashiro K.** Incidence of bone fracture in patients receiving luteinizing hormone-releasing hormone agonists for prostate cancer. BJU Int. 2000;86:449-52. [PMID: 10971270]
34. **Nayak S, Olkin I, Liu H, Grabe M, Gould MK, Allen IE, et al.** Meta-analysis: accuracy of quantitative ultrasound for identifying patients with osteoporosis. Ann Intern Med. 2006;144:832-41. [PMID: 16754925]
35. **Adler RA, Funkhouser HL, Holt CM.** Utility of heel ultrasound bone density in men. J Clin Densitom. 2001;4:225-30. [PMID: 11740064]
36. **Adler RA, Funkhouser HL, Petkov VI, Elmore BL, Via PS, McMurtry CT, et al.** Osteoporosis in pulmonary clinic patients: does point-of-care screening predict central dual-energy X-ray absorptiometry? Chest. 2003;123:2012-8. [PMID: 12796183]
37. **Kung AW, Ho AY, Ross PD, Reginster JY.** Development of a clinical assessment tool in identifying Asian men with low bone mineral density and comparison of its usefulness to quantitative bone ultrasound. Osteoporos Int. 2005;16:849-55. [PMID: 15611839]
38. **Mulleman D, Legroux-Gerot I, Duquesnoy B, Marchandise X, Delcambre B, Cortet B.** Quantitative ultrasound of bone in male osteoporosis. Osteoporos Int. 2002;13:388-93. [PMID: 12086349]
39. **Li-Yu JT, Llamado LJ, Torralba TP.** Validation of OSTA among Filipinos. Osteoporos Int. 2005;16:1789-93. [PMID: 16027957]
40. **Adler RA, Tran MT, Petkov VI.** Performance of the Osteoporosis Self-assessment Screening Tool for osteoporosis in American men. Mayo Clin Proc. 2003;78:723-7. [PMID: 12934782]
41. **Donaldson MM, McGrother CW, Clayton DG, Clarke M, Osborne D.** Calcaneal ultrasound attenuation in an elderly population: measurement position and relationships with body size and past fractures. Osteoporos Int. 1999;10:316-24. [PMID: 10692982]
42. **Gonnelli S, Cepollaro C, Gennari L, Montagnani A, Caffarelli C, Merlotti D, et al.** Quantitative ultrasound and dual-energy X-ray absorptiometry in the prediction of fragility fracture in men. Osteoporos Int. 2005;16:963-8. [PMID: 15599495]
43. **Rothenberg RJ, Boyd JL, Holcomb JP.** Quantitative ultrasound of the calcaneus as a screening tool to detect osteoporosis: different reference ranges for caucasian women, african american women, and caucasian men. J Clin Densitom. 2004;7:101-10. [PMID: 14742894]
44. **Stewart A, Felsenberg D, Kalidis L, Reid DM.** Vertebral fractures in men and women: how discriminative are bone mass measurements? Br J Radiol. 1995; 68:614-20. [PMID: 7627484]
45. **Travers-Gustafson D, Stegman MR, Heaney RP, Recker RR.** Ultrasound, densitometry, and extraskeletal appendicular fracture risk factors: a cross-sectional report on the Saunders County Bone Quality Study. Calcif Tissue Int. 1995;57: 267-71. [PMID: 8673863]
46. **Varenna M, Sinigaglia L, Adami S, Giannini S, Isaia G, Maggi S, et al.** Association of quantitative heel ultrasound with history of osteoporotic fractures in elderly men: the ESOPO study. Osteoporos Int. 2005;16:1749-54. [PMID: 15976988]
47. **Welch A, Camus J, Dalzell N, Oakes S, Reeve J, Khaw KT.** Broadband ultrasound attenuation (BUA) of the heel bone and its correlates in men and women in the EPIC-Norfolk cohort: a cross-sectional population-based study. Osteoporos Int. 2004;15:217-25. [PMID: 14745486]
48. **Bauer DC, Ewing SK, Cauley JA, Ensrud KE, Cummings SR, Orwoll ES, et al. Osteoporotic Fractures in Men (MrOS) Research Group.** Quantitative ultrasound predicts hip and non-spine fracture in men: the MrOS study. Osteoporos Int. 2007;18:771-7. [PMID: 17273893]
49. **Kanis JA, Johnell O, Oden A, De Laet C, Mellstrom D.** Diagnosis of osteoporosis and fracture threshold in men. Calcif Tissue Int. 2001;69:218-21. [PMID: 11730254]

Current Author Addresses: Drs. Qaseem and Snow: 190 N. Independence Mall West, Philadelphia, PA 19106.
Dr. Shekelle: 1776 Main Street, Santa Monica, CA 90401.
Dr. Hopkins: 4301 West Markham Street, Little Rock, AR 72205.
Dr. Forciea: 3615 Chestnut Street, Philadelphia, PA 19104.
Dr. Owens: 117 Encina Commons, Stanford, CA 94305.