Caffeine and bone loss

As I listened to our recent lecture and some of the common negative factors that are associated with bone density, I was intrigued, enlightened, and fearful. Many of you have heard me talk about my dad’s past medical history- rheumatoid arthritis, prolonged prednisone usage, traumatic injury to his LE resulting in multiple surgeries, and what do you know, low bone density. While my dad may not have all of the risk factors on his plate, that’s still enough to make any PT cringe. I’ve been trying to get him to cut back on the sodas (yes, dark sodas) for the last couple of years. It seems that every time I see him, his intake goes up by one or two sodas/day (averaging in at 4-6 cans of soda/day). So I thought, *I know… I’ll research how caffeine is a negative impact on bone health and give him some of the statistics.*

I’m a little saddened to report that if you sift through the clinical studies, it seems to be quite a conflicting topic. The study by Rapuri1 mentioned in our handouts2 goes on to give an overview of current literature stating:

Caffeine consumption has been reported to decrease bone mineral density3-5, increase the risk of hip fracture6-9, and negatively influence calcium retention10. However, some studies reported no associated between caffeine intake and BMD and calcium metabolism11-14. In a recent study, [we] observed that intake of caffeine in amounts of >300mg/day accelerates bone loss at the spine in women.15

In the past, the studies have been quite limited due to variations of study design, age of subjects studied, technique used for bone measurements and methods for caffeine intake estimation.16 The biggest dilemma within this area of research is the confounding variables that play a large part in bone loss (smoking, alcohol use, body weight, physical activity, and HRT). These confounding variables are typically controlled statistically instead of by experimental design.16

So you may be asking—what is the most current literature looking into to settle this controversy. The Rapuri1 article focuses on the biochemistry and molecular biology of this all and suggests that caffeine decreases vitamin D receptor (VDR) protein expression and affects osteoblast function. It also appears that they are testing the effects of different concentration so of caffeine and on which mechanism each works.

At this point, I am convinced that there is enough evidence and pending questions to say that excessive caffeine consumption (>300 mg/day) is a negative influence on bone health and could potentially lead to increased fracture risk, particularly in post-menopausal women.

PS: 16 oz of Starbucks coffee contains 330 mg caffeine.17 How ‘bout them apples!

References:

1. Rapuri PB, Gallagher JC, Nawaz Z. Caffeine decreases vitamin D receptor protein expression and 1,25(OH)2D3 stimulated alkaline phosphatase activity in human osteoblast cells. *J Steroid Biochem Mol Biol*. 2007;103(3–5):368-371. doi: [http://dx.doi.org.libproxy.lib.unc.edu/10.1016/j.jsbmb.2006.12.037](http://dx.doi.org.libproxy.lib.unc.edu/10.1016/j.jsbmb.2006.12.037" \t "_blank).
2. Gross M. PowerPoint lecture: Bone. Published 2008. Accessed 9/4/2013.
3. E.Barrett-Connor,J.C.Chang,S.L.Edelstein,Coffee-associatedosteo- porosis offset by daily milk consumption. The Rancho Bernardo study, JAMA 271 (1994) 280–283.
4. D.C. Bauer, W.S. Browner, J.A. Cauley, E.S. Orwoll, J.C. Scott, D.M. Black, J.L. Tao, S.R. Cummings, Factors associated with appendicu- lar bone mass in older women. The Study of Osteoporotic Fractures Research Group, Ann. Intern. Med. 118 (1993) 657–665.
5. S.S. Harris, B. Dawson-Hughes, Caffeine and bone loss in healthy postmenopausal women, Am. J. Clin. Nutr. 60 (1994) 573–578.
6. S.R. Cummings, M.C. Nevitt, W.S. Browner, K. Stone, K.M. Fox, K.E. Ensrud, J. Cauley, D. Black, T.M. Vogt, Risk factors for hip fracture in white women. Study of Osteoporotic Fractures Research Group, N. Engl. J. Med. 332 (1995) 767–773.
7. M. Hernandez-Avila, G.A. Colditz, M.J. Stampfer, B. Rosner, F.E. Speizer, W.C. Willett, Caffeine, moderate alcohol intake, and risk of fractures of the hip and forearm in middle-aged women, Am. J. Clin. Nutr. 54 (1991) 157–163.
8. D.P. Kiel, D.T. Felson, M.T. Hannan, J.J. Anderson, P.W. Wilson, Caffeine and the risk of hip fracture: the Framingham study, Am. J. Epidemiol. 132 (1990) 675–684.
9. H.E. Meyer, J.I. Pedersen, E.B. Loken, Tverdal A, Dietary factors and the incidence of hip fracture in middle-aged Norwegians. A prospective study, Am. J. Epidemiol. 145 (1997) 117–123.
10. L.K. Massey, S.J. Whiting, Caffeine, urinary calcium, calcium metabolism and bone, J. Nutr. 123 (1993) 1611–1614.
11. M.J. Barger-Lux, R.P. Heaney, Caffeine and the calcium economy revisited, Osteoporos. Int. 5 (1995) 97–102.
12. [C. Cooper, E.J. Atkinson, H.W. Wahner, W.M. O’Fallon, B.L. Riggs, H.L. Judd, L.J. Melton III, Is caffeine consumption a risk factor for osteoporosis? J. Bone Miner. Res. 7 (1992) 465–471.
13. M.T. Hannan, D.T. Felson, B. Dawson-Hughes, K.L. Tucker, L.A. Cup- ples, P.W. Wilson, D.P. Kiel, Risk factors for longitudinal bone loss in elderly men and women: the Framingham Osteoporosis study, J. Bone Miner. Res. 15 (2000) 710–720.
14. C. Johansson, D. Mellstrom, U. Lerner, Osterberg T, Coffee drinking: a minor risk factor for bone loss and fractures, Age Ageing 21 (1992) 20–26.
15. P.B. Rapuri, J.C. Gallagher, H.K. Kinyamu, Ryschon KL, Caffeine intake increases the rate of bone loss in elderly women and interacts with vitamin D receptor genotypes, Am. J. Clin. Nutr. 74 (2001) 694–700.
16. Lloyd T. Bone status among postmenopausal women with different habitual caffeine intakes: a longitudinal investigation. *Journal of the American College of Nutrition.* 2000-04;19:256-61.
17. Caffeine content of food & drugs. Center for Science in the Public Interest Web site. [http://www.cspinet.org/new/cafchart.htm](http://www.cspinet.org/new/cafchart.htm" \t "_blank). Updated 2012. Accessed September 5, 2013.