

A cross-sectional association of phalangeal bone mineral density versus hip bone mineral density with osteoporosis and non-vertebral fracture: The Rancho Bernardo Study



Diane Claflin, Denise von Mühlen & Elizabeth Barrett-Connor
University of California, San Diego



ABSTRACT

Background: Osteoporotic fractures are a major public health problem. It is estimated that 1 in 2 women and 1 in 4 men over the age of 50 will have an osteoporosis-related fracture in their lifetime. Bone mineral density (BMD) at the hip is the preferred diagnostic test to predict a first osteoporotic fracture.

Method: We compared BMD of the phalanges (Accudexa) with BMD of the total hip (DXA) in 1131 participants aged 71 ± 9 years from the Rancho Bernardo Study to determine the cross-sectional association between a single finger BMD (1) with osteoporosis defined by DXA, and 2) with self-reported non-vertebral osteoporotic fractures.

Results: Single phalange BMD was positively and significantly correlated with hip BMD (DXA) in both sexes ($r=0.61$ in women and $r=0.53$ in men, $p<0.001$). At baseline, 82.2% of the participants were correctly classified as being either normal or osteoporotic by both tests; 11.6% were classified as osteoporotic by Accudexa only and 6.2% were osteoporotic by DXA only, with significant agreement (Kappa=0.33, $p<0.001$). Altogether 212 (18.8%) participants (136 women and 76 men) reported a non-vertebral osteoporotic fracture. Logistic regression models showed that BMD at the hip and at the phalange were equivalent in their association with clinical non-vertebral osteoporotic fractures independent of sex, age and body size.

Conclusion: BMD at the phalanges might be an inexpensive tool to identify older adults at increased risk for an osteoporotic fracture.

BACKGROUND & AIM

- Osteoporotic fractures are a major public health problem; it is estimated that 1 in 2 women & 1 in 4 men age >50yrs will have an osteoporosis-related fracture in their lifetime (<http://www.nof.org>).
- BMD at the hip and spine are known to predict osteoporotic fractures (Blake, Knapp et al. 2006; Finigan, Greenfield et al. 2008)
- DXA measurements are expensive and it is not feasible or cost-effective to recommend bone densitometry for all adults who might be in risk of an osteoporotic fracture
- Finger BMD measurements were related to a recent vertebral fracture in postmenopausal women in the Hawaii Osteoporosis Study (Ortisa, Michaei et al. 2002)

AIM

To compare bone mineral density (BMD) of the finger with BMD of the total hip, and to determine the clinical value of measuring a single peripheral site (finger) in identifying older men and women with osteoporosis.

METHODS

STUDY POPULATION

- 460 men and 671 women, aged 43-93 years attended a clinic visit; mean age 71 (SD=9.2), healthy, community-dwelling

DATA COLLECTION (1999-2002)

- Bone mineral density (BMD) at the hip measured by DXA; BMD at the finger measured by peripheral low dose x-ray
- Prevalence of osteoporotic fractures assessed and validated

BONE MEASUREMENTS

- Total hip BMD included the greater trochanter, femoral neck, and intertrochanter area - obtained using dual energy x-ray absorptiometry measured by a Hologic QDR 1000 scanner (Hologic Inc., Bedford, MA)
- Finger BMD was obtained with accuDEXA - a bone densitometer that estimates bone mineral density of the middle finger of the non-dominant hand employing dual energy x-ray absorptiometry technology.

STATISTICAL ANALYSES

- Correlations, chi-square, analyses of covariance, linear and logistic regression
- Analyses adjusted for sex, age, and body size

Table 1. Population characteristics

	Men (n=460)	Women (n=671)	P value
	Mean (SD)	Mean (SD)	
Age	73.8 (10.0)	74.5 (10.3)	0.26
BMI	27.1 (3.8)	25.8 (4.6)	<0.001
Finger BMD	0.572 (0.086)	0.448 (0.091)	<0.001
Total hip BMD	0.955 (0.153)	0.808 (0.148)	<0.001
Osteoporosis	%	%	
By total hip T score	7.2	17.0	<0.001
By finger T score	10.0	23.8	<0.001
Fractures			
After age 45	17.8 (n=82)	30.6 (n=206)	<0.001
Osteoporotic fractures*	16.6 (n=76)	20.3 (n=137)	0.11

* hip, wrist, femur, forearm

Table 2. Prevalence of osteoporosis by total hip BMD with DXA and finger BMD with accuDEXA

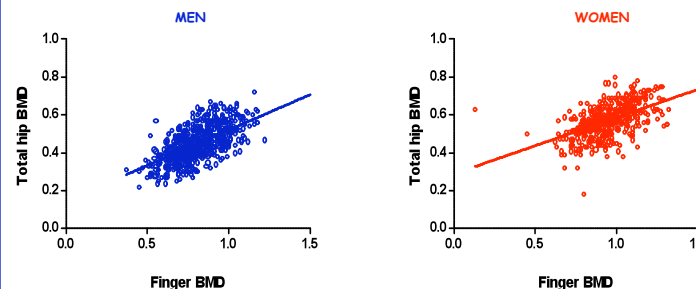
	N (%)
Normal BMD by both instruments	857 (75.8)
Osteoporosis by both instruments	75 (6.6)
Osteoporosis by total hip T score only	68 (6.0)
Osteoporosis by finger T score only	131 (11.6)

Table 3. Osteoporotic fracture odds ratio (OR) for one SD increase in total hip BMD or finger BMD

BMD measurements	OR	95% CI	P value
Total hip BMD (DXA)	0.64	0.52-0.80	0.001
Finger BMD (AccuDEXA)	0.69	0.55-0.85	0.001

Note: individual models adjusted for sex, age and BMI

Figure. Age and body size adjusted linear regression between finger BMD and total hip BMD



Beta coefficient: 0.81 (95%CI 0.67-0.95), $p<0.001$ for men; 0.86 (95% CI 0.75-0.97), $p<0.001$ for women



RESULTS

- Finger BMD was positively and significantly correlated with total hip BMD before (Pearson $r = 0.67$, $r^2 = 0.45$ $p<0.001$) and after (partial correlation = 0.62, $p<0.001$) adjustments for age and body size

TABLE 1

- Men had higher total hip and finger BMD than women; women were more likely to have hip & finger osteoporosis than men
- Women were more likely to report a fracture after the age of 45 years, but the prevalence of osteoporotic fractures was similar in both sexes

TABLE 2

- There is a significant agreement between the diagnostic of osteoporosis by total hip T score (WHO) and accuDEXA T-score

TABLE 3

- Logistic regression models showed that BMD at the hip and at the finger were equivalent in their association with clinical non-vertebral osteoporotic fractures independent of sex, age and body size

FIGURE

- Shows sex specific age and BMI adjusted linear regression lines for the association between finger and total hip BMD in both sexes

CONCLUSIONS

- In this community-based sample of older men and women finger bone mineral density might be a useful diagnostic tool to identify older adults who might be at risk for an osteoporotic fracture