Associations between ultra-distal forearm bone mineral density and incident fracture in women

Kara L Holloway-Kew[1], Amelia G Betson[1], Kara B Anderson[1], Mark A Kotowicz[1,2,3] and Julie A Pasco[1,2,3,4]

[1]Deakin University, Geelong, Australia. [2]Department of Medicine - Western Health, The University of Melbourne, St Albans, Australia. [3]University Hospital Geelong, Barwon Health, Geelong, Australia [4]Department of Epidemiology and Preventive Medicine, Monash University, Prahran, Australia.

Introduction

- Bone mineral density is usually measured at the femoral neck (hip) and lumbar spine (Figure 1).
- Sometimes these sites cannot be measured for reasons such as hip replacement or prior fracture [1,2].
- In these cases, it is recommended to measure bone mineral density at the 33% forearm site [2].
- Ultra-distal forearm bone mineral density is not used however, even if it is available.
- There are few studies examining whether the ultra-distal forearm site may be useful for fracture risk predictions.

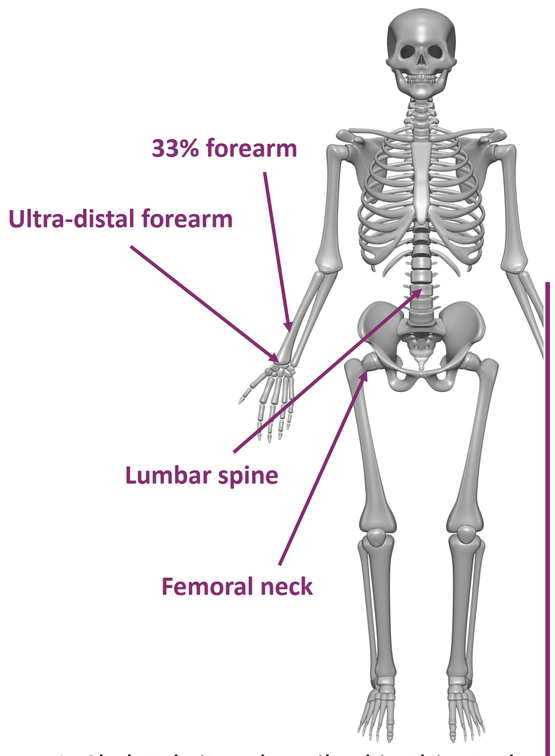

Figure 1: Skeletal sites described in this study.

Aim

1. To determine the utility of ultra-distal forearm bone mineral to predict fracture and to compare with femoral neck and lumbar spine.

Hypothesis

1. Ultra-distal forearm bone mineral density will be associated with both any incident fracture and distal radius (wrist) fractures.
2. There is no difference in ability to predict incident fracture between the ultra-distal forearm, femoral neck and spine.

Methods

- Participants were drawn from the Geelong Osteoporosis Study baseline visit for women (1993-1997) (Figure 2) [3].
- There were 1026 women aged 40-90 years who had ultra-distal forearm bone mineral density measured (Lunar DPX-L).
- Bone mineral density was expressed as (i) a continuous variable, and (ii) as a categorical variable using osteopenia/ osteoporosis cut points (0.305 and 0.244 g/cm^2, respectively [4]).
- Incident fractures ascertained by examination of radiological reports from imaging centres across the region.
- Mortality during the study period was Identified by data linkage with the National Deaths Index.

Statistical analyses

- Participants were followed from baseline to date of first fracture, date of death or the end of the study period (31 December 2016), whichever occurred first.
- Cox proportional hazard models were used for multivariable (adjusted) survival analysis.
- Areas under receiver operating characteristics (AUROC) curves were also calculated.

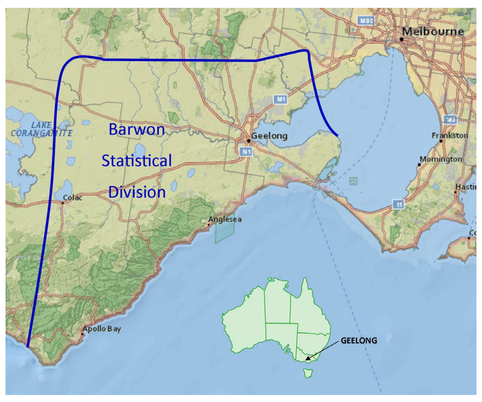

Figure 2: Location of the Geelong Osteoporosis study region.

Results

Associations between ultra-distal forearm bone mineral density and fracture

- In adjusted models, ultra-distal forearm bone mineral density expressed as a *continuous* variable was associated with both any incident fracture as well as distal radius fractures (Table 1).
- *Categorical* ultra-distal forearm bone mineral density was also associated with incident fractures.
- Women with osteoporosis at the ultra-distal forearm site were at increased risk of any incident fracture, as well as distal radius fractures (Table 1).
- Women with osteopenia at the ultra-distal forearm site had an increased risk of distal radius fracture only (Table 1).

Results (continued)

Table 1: Hazard ratios (with 95% confidence intervals) showing associations between ultra-distal forearm bone mineral density (expressed as a continuous and categorical variable) and (i) any incident fracture and (ii) distal radius fractures only.

	Any incident fracture (n=318)	Distal radius fracture (n=85)
Continuous	0.70; 95%CI 0.60-0.81*	0.48; 95%CI 0.38-0.60*
Categorical		
Osteopenia cut point	1.16; 95%CI 0.83-1.60	2.79; 95%CI 1.56-5.01*
Osteoporosis cut point	1.77; 95%CI 1.25-2.48*	5.33; 95%CI 3.05-9.30*

*p value <0.01
Models were adjusted for age, weight, height, prior fracture, parental history of hip fracture, falls, secondary osteoporosis, smoking status, alcohol consumption and medication use.

Ability to predict incident fractures

- There were no differences in areas under receiver operating characteristics (AUROC) curves between the three skeletal sites, regardless of whether the bone mineral density was considered as a continuous or categorical variable (Figure 3). However, there was one exception; *continuous* ultra-distal forearm performed better than femoral neck bone mineral density for predicting distal radius fractures (p=0.011).

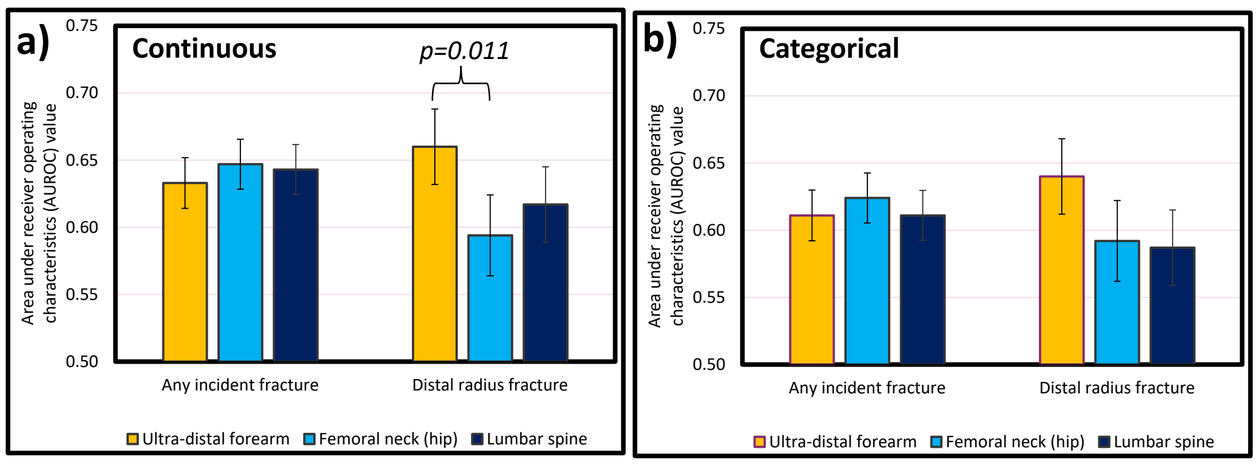

Figure 3: Areas under receiver operating characteristics (AUROC) curves, for a) bone mineral density presented as a *continuous* variable and b) as a *categorical* variable. Results presented as bar graphs for ease of interpretation. Higher value = better ability to predict incident fractures. Error bars show standard error.

Discussion

- Ultra-distal forearm bone mineral density was associated with incident fractures and performed similarly to the femoral neck and lumbar spine sites.
- Several cross-sectional studies have reported similar results, that ultra-distal forearm bone mineral density more effectively predicts distal radius fractures than other skeletal sites, or other clinical risk factors [5,6,7].
- There are some strengths of this study; participants were from a population-based sample, there was no loss to follow-up and potential confounding variables were available for inclusion into the analyses.
- Limitations include the relatively smaller number of distal radius fractures, some data was self-reported and the study included only women.

Clinical Significance: Ultra-distal forearm bone mineral density may be useful in providing more information to help decision making regarding poor bone health and elevated fracture risk in a clinical setting.

Conclusion

Ultra-distal forearm bone mineral density may have a role in fracture risk assessment, particularly for distal radius fractures, or where it is not possible to obtain bone mineral density at the hip or spine.

References

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Contact:
Kara Holloway-Kew
k.holloway@deakin.edu.au

deakin.edu.au/impact