Proceedings of the Nutrition Society (2008), **67 (OCE8)**, E368 doi:10.1017/S0029665108000426

Summer Meeting 30 June–3 July 2008

A lower heel-bone ultrasound attenuation in middle- and older-aged women is associated with a higher urine sodium excretion and lower dietary calcium intake in the EPIC-Norfolk cohort

Ailsa Welch, Sheila Bingham and K. T. Khaw
University of Cambridge, Cambridge, UK

Ca is required for maintenance of bone density and a high salt intake is a risk factor for lower bone density because it induces calciuria[1]. As homeostatic mechanisms determine Ca absorption and excretion, it is possible that the detrimental effects of high salt intakes on bone may only occur when intakes of Ca are low. The relationship between urinary Na excretion, as a proxy for Na intake, and the interaction between dietary Ca intake and heel-bone ultrasound attenuation (BUA) was therefore investigated in middle- and older-aged women in the EPIC-Norfolk cohort.

Heel BUA was measured with a clinical contact ultrasound bone analyser CUBA clinical (McCue Ultrasonics, Winchester, Hants., UK) on the left and right foot at a health check and the average of the measurements used[2]. Casual urine samples were collected and frozen without preservation. Na and creatinine concentrations were measured (mmol/l) and Na:creatinine was calculated[3]. Dietary intake of Ca was calculated using the EPIC-Norfolk FFQ and divided into categories based on the UK and EC dietary reference values[4,5]. Mean heel BUA was calculated and adjusted for age, BMI, physical activity, smoking habit and hormone-replacement therapy (HRT) medication using ANOVA. Complete data for urine and BUA and dietary FFQ data were obtained for 7273 women aged 42–81 years.

Mean heel BUA was 72.1 (SD 16.5) dB/MHz, age 61.5 (SD 9.0) years, Na:creatinine 15.5 (SD 12.1) mmol:mmol and Ca 999 (SD 288) mg/d. Heel BUA (dB/MHz) according to quartile (Q; based on mean ratio) of urine Na:creatinine (mmol:mmol) and dietary Ca intake were:

Dietary Ca (mg/d)....	<500		500–799		≥ 800	
n.....	212		1601		5460	
	Mean	SE	Mean	SE	Mean	SE
Q1 (4.8)	69.5	1.02	72.0	0.48	72.9	0.38
Q2 (9.3)	68.5	1.01	71.1	0.49	71.9	0.38
Q3 (13.1)	69.2	1.01	71.8	0.48	72.7	0.38
Q4 (18.0)	68.7	1.01	71.2	0.48	72.1	0.38
Q5 (32.3)	68.2	1.01	70.7	0.48	71.6	0.38

Adjusted for age, BMI, physical activity, smoking habit and HRT medication.

Heel BUA was lower in women with higher Na excretion ($P=0.032$ for trend) and was also lower in those women with a low Ca intake ($P<0.001$ for trend). There was an interaction between urine Na excretion and Ca intake ($P=0.0014$) in the multivariate analysis. Those women in the highest category of Ca intake and lowest category of Na excretion had the highest BUA and those in the lowest category of Ca and highest category of Na had the lowest BUA, a difference of 4.7 units dB/MHz or approximately 7%.

The study found an inverse relationship between Na urine excretion and heel BUA in middle- and older-aged women, which was modified by dietary Ca intake. There was an approximately 7% difference between those with the highest excretion of Na and lowest intake of Ca and those with the lowest Na excretion and highest Ca intake, which remained after adjustment for osteoporotic risk factors. This relationship was found despite using casual urine samples and Ca intakes from FFQ, and given the likely measurement error the true relationship between the effects of Na and Ca intake on bone could be greater. Although a high Na excretion, reflecting high Na intake, significantly affects heel BUA, the interaction between Na and Ca intake appears to be important, and further studies are required to investigate the effects of Na intake on bone loss.

1. Rafferty K & Heaney RP (2008) *J Nutr* **138**, 166S–171S.
2. Welch A, Camus J, Dalzell N *et al.* (2004) *Osteoporos Int* **15**, 217–225.
3. Khaw KT, Bingham S, Welch A *et al.* (2004) *Am J Clin Nutr* **80**, 1397–1403.
4. Department of Health (1991) *Dietary Reference Values for Food Energy and Nutrients for the United Kingdom*. London: H. M. Stationery Office.
5. World Health Organization (2003) *Prevention and Management of Osteoporosis*. Geneva: WHO.

https://doi.org/10.1017/S0029665108000426 Published online by Cambridge University Press