Dietary calcium and VDR allele status in twin pairs aged 9-26 years

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Genetic and environmental factors are known to influence bone mineral density, but the interaction between dietary intake and specific genes is not clear. Morrison et al have demonstrated a relationship between the vitamin D receptor (VDR) genotype and bone density in which the BB genotype was associated with lower bone density (1). We investigated the interaction between VDR genotype and dietary calcium on bone mineral density (BMD) in a young female twin population aged 9 to 26 years.

One hundred and thirty eight pairs of female twins were studied as part of a longitudinal study. Measurements included height, weight and BMD (dual energy x-ray absorptiometry (DXA) using a QDR 1000W instrument (Hologic Inc, Waltham MA, USA). VDR genotype (BB, Bb or bb) was determined by polymerase chain reaction followed by BSM 1 endonuclease digestion. A short food frequency questionnaire was completed to determine dietary calcium (2). Twins were divided into two age groups (<18 years and >18 years) and two levels of calcium (<500mg/day and >500mg/day). No significant differences in BMD were found between low and high calcium groups. However, those >18 years had higher bone density at all sites ($p<0.0001$). No significant difference in BMD was found between the three VDR genotype groups (spine: bb 0.97 (0.19) g/cm2 (n = 74), Bb 0.95 (0.18) g/cm2 (n = 146), BB 0.94 (0.21) g/cm2(n = 38), mean (SD)).

	Total	Calcium <500 mg	Calcium >500 mg	Age <18 yrs	Age >18 yrs
N	258-262	102	156	186	76
Age (yrs)	16.17 (4.48)	16.9 (4.7)	15.8 (4.3)	13.8 (2.6)	21.93 (2.51)
Weight (kg)	54.23 (17.09)	55.6 (17.6)	53.7 (16.8)	50.96 (17.78)	62.00 (12.28)**
Height (cm)	157.33(10.70)	158.3 (10.4)	157.0 (10.7)	155.2 (11.23)	162.40 (7.15)**
Calcium (mg/d)	654.0 (377.3)	318.8 (136.9)	873.3 (318.5)	692.5 (386.0)	562.0 (340.6)*
Spine (g/cm^2)	0.95 (0.19)	0.98 (0.20)	0.94 (0.18)	0.90 (0.19)	1.07 (0.13)**
Total hip (g/cm^2)	0.93 (0.16)	0.95 (0.17)	0.92 (0.14)	0.90 (0.15)	1.01 (0.14)**
TBMC ψ (g/cm^2)	1788.4 (555.9)	1868.2 (573.5)	1747.9 (539.3)	1634.8 (542.6)	2164.2 (384.4)**

ψ Total bone mineral content; *P<0.01; ** P<0.001 <18 yrs v >18 yrs

In younger subjects with the BB genotype, there was a relationship between calcium intake and bone density, ie, BMD was higher in the high calcium group (n = 13) (spine: 0.9769 (0.19) g/cm^2, TBMC: 1779.74 (459.12) g/cm^2) compared with the low calcium intake group (n = 11) (spine: 0.7836 (0.214) g/cm^2 TBMC: 1305.92 (656.53) g/cm^2)($P<0.05$). There was no other detectable effect of VDR genotype on bone density.

Although the effect of VDR genotype on bone density remains unclear, these findings suggest an interactive effect between genotype and calcium intake in young females.

1. Morrison MA, Qi JC, Tokita A, Kelly PJ, Crofts L, Nguyen TV, Sambrook P, Eisman JA. Prediction of bone density from vitamin D receptor alleles. Nature 1994;367:284-7.
2. Angus RM, Eisman JA. Osteoporosis: the role of calcium intake and supplementation. Med J Aust 1988;148:630-3.