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Increased bone resorption is associated with greater seasonal fluctuation or ‘cycling’ of 25-hydroxyvitamin D

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It is established that adequate vitamin D (25-hydroxyvitamin D (25(OH)D) status is required for healthy bone mineralisation¹. It is unknown whether seasonal fluctuations in 25(OH)D also impact on bone health². If large seasonal fluctuations in 25(OH)D were associated with increased bone resorption (‘breakdown’) this would suggest a detriment to bone health. This analysis assessed whether there is an association between seasonal variation in 25(OH)D and bone resorption. The participants were n = 279 Caucasian (C) and n = 88 South Asian (A) women who participated in the D-FINES (Diet, Food Intake, Nutrition and Exposure to the Sun in Southern England) study (2006–2007). The main outcomes were serum 25(OH)D and the bone resorption marker urinary N-telopeptide of collagen (uNTX; creatinine adjusted), sampled once per season for each participant. N = 154 women (mean (±SD) age 51.5y (12.7) had full data for all four seasons of the year for 25(OH)D, uNTX and body mass index (BMI) and were entered into this analysis. The average log 25(OH)D concentration over the course of the year (mesor) and the change in log 25(OH)D concentration from the highest to the lowest point of the year (amplitude) were calculated. This was expressed as a ratio (amplitude/mesor) to represent seasonal change in log 25(OH)D status. Non-linear mixed modelling showed that this ratio was predictive of uNTX (estimate = 0.21, 95% CI (0.18,0.24), p < 0.001)(see table). The corresponding value for the mesor alone was: estimate = -0.035, 95% CI (-0.04,-0.03), p < 0.001. Therefore, individuals with a higher seasonal change in log 25(OH)D, adjusted for overall log 25(OH)D concentration, showed increased levels of uNTX. Notably the effect size for the amplitude/mesor ratio (13.4) was larger than that of the mesor (9.1) which showed a negative association with uNTX.

Model for uNTX	Estimate	SE	95% CI	P value	Effect Size
Pre C vs Post C ^a	-0.124	0.934	(-1.95,1.71)	0.894	0.13
Post A vs Post C ^b	0.316	1.885	(-3.38,4.01)	0.867	0.17
Pre A vs Post C ^c	0.303	2.363	(4.33,4.94)	0.898	0.13
Body Mass Index (BMI) kg/m ²	0.073	0.043	(0.01,0.16)	0.085	1.72
25(OH)D mesor≠ (nmol/L)	-0.035	0.004	(-0.04,-0.03)	<0.001	9.13
25(OH)D ratio ((amplitude/mesor)≠ -2 log likelihood	0.213	0.015	(0.18,0.24)	<0.001	13.41

≠log transformed; pre = premenopausal; C = Caucasian, A = Asian, post = postmenopausal; abc = control dummy variables for comparisons between ethnic and menopausal status groups and reference group (Post Cauc).

These findings suggest a possible detriment to bone health via increased levels of bone resorption in individuals with a larger seasonal change in 25(OH)D concentration. Also, the amount of seasonal change in 25(OH)D might be as important as overall 25(OH)D concentration for bone health. Further research is now required to investigate whether bone mineral density or fracture risk is affected by seasonal change in 25(OH)D.

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