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Effect of habitual calcium intake on dietary vitamin D requirements in adults

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If dietary calcium intake is low and serum calcium concentrations decrease, the compensatory metabolic response is the accelerated conversion of 25-hydroxyvitamin D [25(OH)D] to 1,25-dihydroxyvitamin D (via parathyroid hormone), so as to normalize serum calcium levels [(1)]. These interactions between vitamin D and calcium may have implications for the regulation of 25(OH)D production and its catabolism, and consequently for the dietary vitamin D requirement [(2)]. While highlighted as a significant knowledge gap by the North American Institute of Medicine in their recent DRI report for vitamin D and calcium [(1)], to date this hypothesis has only received limited attention in human studies. The aim of this study was to test this hypothesis using relevant data from our previously published vitamin D intervention studies in 20–40 y olds [(3)] and 64+ y olds [(4)] as well as an updated version of our recent meta-regression analysis [(5)], all of which up to now have not included dietary calcium intake as a possible additional determinant of vitamin D requirements.

Within the datasets from our two vitamin D intervention studies, baseline serum 25(OH)D and response of serum 25(OH)D to vitamin D_3 intervention (0, 5, 10 or 15 μ/d) over winter months were stratified by < or ⩾ three different cut-offs for dietary calcium intake (550, 700 and 800 mg/d), representing EU estimated average requirement (EAR), UK reference nutrient intake and US EAR for calcium, respectively). Students' paired and unpaired *t*-tests were used to test differences at baseline and response of serum 25(OH)D to intervention in groups stratified according to each cut-off for calcium intake, respectively. Regression models were also run to account for possible confounding effects of sex, age, BMI, habitual vitamin D intake and study centre. In the meta-regression analysis, two new studies published since our original meta-regression in 2011[(5)] were included and habitual calcium intake was reported in each of the 13 studies.

In the meta-regression approach, the relationship between serum 25(OH)D and total vitamin D intake were not significantly different ($P>0.05$) when studies were stratified on the basis of habitual group mean calcium intakes < or ⩾ ~1000 mg/d. Data from our own two intervention studies suggest that while baseline serum 25(OH)D concentrations were significantly lower ($P<0.05$) in the < 700 mg/d calcium intakes groups compared to the > 700 mg/d in the 64+ y olds, these differences disappeared when data was adjusted for the aforementioned confounding factors. There were no other significant differences ($P>0.05$) in baseline serum 25(OH)D in 20–40 y olds or 64+ y olds when stratified by habitual calcium intake. Upon stratification on the basis of < or ⩾ three selected dietary calcium intake cut-offs, there was no significant difference in the response of serum 25(OH)D to vitamin D intervention over winter in the 20–40 y olds. Likewise, there was no significant difference in response of serum 25(OH)D to vitamin D intervention in 64 y olds stratified by < /> 550 mg/d or < /> 800 mg/d but there were lower responses to 5 μ/d (12.2 nmol/L; $P = 0.007$), 10 μ/d (14.6 nmol/L; $P = 0.008$), and 15 μ/d (9.4 nmol/L; $P = 0.097$) in those 64+ y olds with calcium intakes < compared to ⩾ 700 mg/d. Calcium intake < /> 700 mg/d remained a significant predictor ($P = 0.041$) of the change in serum 25(OH)D over winter in the regression models that accounted for treatment but also the aforementioned confounding factors.

In conclusion, *post-hoc* analysis seems to suggest that a habitual calcium intake less than 700 mg/d may lead to a more blunted response of winter serum 25(OH)D to increased vitamin D intake in older adults. This may have implications for the dietary vitamin D requirement.
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