

## Effect of vitamin D<sub>3</sub> supplementation on serum 25-hydroxyvitamin D status among adolescents aged 14–18 years: a dose-response, randomised placebo-controlled trial

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Vitamin D insufficiency is a common problem across Europe, particularly during the winter months when cutaneous synthesis of vitamin D is negligible. Recent data has highlighted that European adolescents may be at increased risk of vitamin D deficiency compared to younger children and adults<sup>(1)</sup>. Adolescence is a period of rapid growth and maintaining an adequate vitamin D status may be essential in ensuring development of peak bone mass<sup>(2)</sup>. However, few intervention studies have investigated the vitamin D requirements of adolescents. Therefore, the aim of the present study was to investigate the effect of different doses of vitamin D<sub>3</sub> supplementation (0, 10 and 20 µg/day) on serum 25-hydroxyvitamin D (25(OH)D) concentrations in UK dwelling (51°N) male and female adolescents aged 14–18 years during the winter-time.

In a double-blind, placebo-controlled, dose-response trial, 110 adolescents (mean age 15.9 ± 1.4 years; 43 % male) were randomised to receive daily supplements containing either 10 µg or 20 µg vitamin D<sub>3</sub>, or placebo, for 20 weeks throughout the winter-time, from October 2014 to March 2015. Serum 25(OH)D concentration was measured by liquid chromatography tandem mass spectrometry at University College Cork, Ireland.

Mean serum 25(OH)D concentrations increased significantly from baseline to post-intervention in the 10 and 20 µg/day groups (p = 0.001 and p < 0.001 respectively) and significantly decreased in the placebo group (p < 0.001). At baseline, 5 % of subjects were vitamin D deficient (defined as 25(OH)D < 30 nmol/l), while 45 % had adequate vitamin D concentrations (defined as 25(OH)D ≥ 50 nmol/l). Post-intervention, 73 % and 91 % of subjects in the 10 and 20 µg/day groups respectively had serum 25(OH)D concentrations ≥ 50 nmol/l and no subjects in either vitamin D supplemented group had post-intervention 25(OH)D concentrations < 30 nmol/l. In the placebo group 49 % and 97 % of subjects had post-intervention serum 25(OH)D concentrations < 30 and < 50 nmol/l respectively.

Serum 25(OH)D (nmol/l)	Placebo		10 µg/day		20 µg/day		p value <sup>1</sup>
	Mean	SD	Mean	SD	Mean	SD	
Baseline	46.8	11.4	49.2	12.0	51.7	13.4	0.095
Post-intervention	30.7 <sup>ab</sup>	8.6	56.6 <sup>ac</sup>	12.4	63.9 <sup>bc</sup>	10.6	< 0.001
Total change	-16.3 <sup>de</sup>	8.7	6.7 <sup>d</sup>	9.9	12.1 <sup>e</sup>	10.6	< 0.001

<sup>1</sup>One-way ANOVA with post-hoc Tukey's test. Values in the same row with the same subscript letters are significantly different (<sup>a</sup>p < 0.001; <sup>b</sup>p < 0.001; <sup>c</sup>p = 0.018; <sup>d</sup>p < 0.001; <sup>e</sup>p < 0.001)

The results from the present study suggest that supplementation with 10 or 20 µg/day vitamin D<sub>3</sub> maintained mean serum 25(OH)D concentrations above 50 nmol/l in adolescents throughout the winter-time, although a larger proportion of adolescents achieved this level of adequacy via supplementation with 20 µg/day. As it is difficult to achieve vitamin D intakes of ≥ 10 µg/day, due to limited food sources naturally rich in vitamin D and low uptake and adherence to dietary supplements, alternative strategies to increase intake need to be considered in order to help populations achieve sufficient intakes and maintain adequate vitamin D status during times of minimal sun exposure.

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1. Cashman *et al.* 2016 *Am J Clin Nutr* (Epub ahead of print).
2. Viljakainen *et al.* 2006 *J Bone Min Res*, 21, 836–844.