

Reduced-fat Gouda-type cheese enriched with vitamin D₃ effectively prevents vitamin D deficiency during winter months in postmenopausal women in Greece

There is a considerable mismatch between current intakes of vitamin D by many European populations and recommended target intakes for the vitamin [1]. Fortification of a wider range of foods with vitamin D has been proposed as a strategy for increasing intake that would have the greatest impact on the population [2]. There is evidence from a number randomised controlled trials (regarded as the highest form of evidence) that fortifying foods with vitamin D increases vitamin D status [3, 4]. In these studies, milk was the most commonly used food to which vitamin D was added while there are fewer studies in which the effectiveness of vitamin D-enriched cheese has been studied, and the results of these studies have been quite mixed [5-7]. This may be related to the quality of the studies but also to the fact that there are technical issues in the fortification of cheese with vitamin D, particularly for reduced-fat cheese.

One of the aims of the ODIN project was to investigate the effectiveness of daily consumption of vitamin D₃-enriched, reduced-fat Gouda-type cheese on maintaining serum 25-hydroxyvitamin D [25(OH)D] concentrations in postmenopausal women during winter, when vitamin D status would be expected to decline. Postmenopausal women were chosen as the study participants as they have a relatively high risk for both vitamin D deficiency and osteoporosis.

In an 8-week randomised controlled trial under the direction of Professor Yannis Manios and colleagues at Harokopio University, Athens, Greece, seventy nine postmenopausal women (aged 55–75 years) completed a food-based dietary intervention during winter (January–March 2015) in which they were randomly allocated either to an Intervention or a Control group. The groups were instructed to consume as part of their normal daily diet 60g (provided as 2 slices) of, either:

- Vitamin D₃-enriched, reduced-fat Gouda-type cheese (Intervention group) or
- Non-enriched reduced-fat Gouda-type cheese (Control group).

Sixty grams of the vitamin D₃-enriched, reduced-fat Gouda-type cheese provided 5.7µg of vitamin D per day.

Serum 25(OH)D concentration (the best indicator of vitamin D status) was measured at baseline and at the end of the 8-week study using a CDC-certified liquid chromatography tandem mass spectrometry method [8] at the *Cork Centre of Vitamin D and Nutrition Research* at University College Cork.

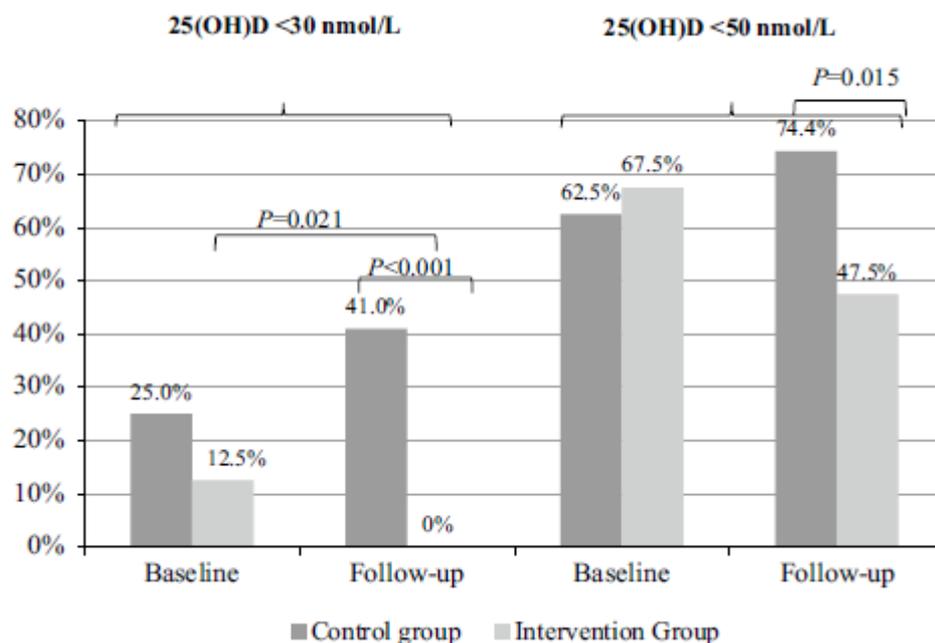
The study showed that while the average serum 25(OH)D concentration increased significantly in the Intervention group who consumed the vitamin D₃ enriched cheese, it decreased significantly in the Control group, as would be expected in winter in individuals not taking additional vitamin D. None of the women in the Intervention group who received the vitamin D₃-enriched cheese were vitamin D deficient (defined as serum 25(OH)D <30 nmol/L) after the 8-week study compared with 41% of women in the Control group, a significant difference ($P=0.001$) (see **Figure 1**).

Overall, this ODIN study showed that consumption of 60 g of vitamin D₃-enriched, reduced-fat Gouda-type cheese provided a daily dose of 5.7 µg of additional vitamin D₃ and was effective in increasing mean serum 25(OH)D concentration and in counteracting vitamin D deficiency during winter months in postmenopausal women in Greece, with a usual dietary intake of vitamin D of ~2 µg.



Click on the following link to access the paper describing the full study.
<http://link.springer.com/article/10.1007%2Fs00394-016-1277-y>

Figure 1 Differences between study groups and changes within study groups from baseline to follow-up in the percentage of study participants with serum 25(OH)D concentrations <30 nmol/L and <50 nmol/L. *P* values derived from Chi-square tests.



References

1. Kiely M, Black LJ. Dietary strategies to maintain adequacy of circulating 25 hydroxyvitamin D concentrations. *Scand J Clin Lab Invest Suppl.* 2012; 243:14-23.
2. Cashman KD, Kiely M. Tackling inadequate vitamin D intakes within the population: fortification of dairy products with vitamin D may not be enough. *Endocrine.* 2016; 51:38-46.
3. Black LJ, Seamans KM, Cashman KD et al. An updated systematic review and meta-analysis of the efficacy of vitamin D food fortification. *J Nutr* 2012; 142:1102-1108.
4. O'Donnell S, Cranney A, Horsley T et al. Efficacy of food fortification on serum 25-hydroxyvitamin D concentrations: systematic review. *Am J Clin Nutr* 2008; 88:1528-1534.
5. Johnson JL, Mistry VV, Vukovich MD et al (2005) Bioavailability of vitamin D from fortified process cheese and effects on vitamin D status in the elderly. *J Dairy Sci* 2005; 88:2295-2301.
6. Wagner D, Sidhom G, Whiting SJ et al. The bioavailability of vitamin D from fortified cheeses and supplements is equivalent in adults. *J Nutr* 2008; 138:1365-1371.
7. Bonjour JP, Benoit V, Pourchaire O et al. Inhibition of markers of bone resorption by consumption of vitamin D and calcium-fortified soft plain cheese by institutionalized elderly women. *Br J Nutr* 2009; 102:962-966.
8. Cashman KD, Kiely M, Kinsella M et al/. Evaluation of vitamin D standardization program protocols for standardizing serum 25-hydroxyvitamin D data: a case study of the program's potential for national nutrition and health surveys. *Am J Clin Nutr* 2013; 97: 1235-1242.

