

ODIN Case Study

ODIN - Food-based Solutions for Optimal Vitamin D
Nutrition and Health Through the Life Cycle



About the Project

ODIN is an EU funded project that involved a multi-disciplinary team of 30 partners from 18 countries, which commenced a 4-year program of research in November 2013.

ODIN aims to provide high quality scientific evidence to prevent vitamin D deficiency in European citizens and improve nutrition and public health through food.

The FP7 funded project was lead by University College Cork . It aimed to provide evidence to prevent vitamin D deficiency in Europe. As well as this, it aimed to improve nutrition and public health through food by establishing an internationally standardised analytical platform for 25OHD (Calcifediol- vitamin D). ODIN also aimed to support planned EFSA revisions of dietary requirements of vitamin D during pregnancy, childhood and adolescence using dose-response randomised control trials.

"A key aim of the ODIN project was to apply the approaches devised by the Vitamin D Standardization Program to data from 18 European studies of children, teenagers, adults, and elderly, including a total of 55,844 individuals, and spread from as southerly as Crete (35oN) to as northerly as Tromsø, Norway (69oN). This allowed for more valid comparisons of vitamin D status across European studies and a more accurate overall estimate of the prevalence of vitamin D for Europe. The benefits of using this standardization approach can be illustrated by the results of the ODIN study which showed, as just two examples, that ~10 million few German adults and a quarter of a million more Irish adults had vitamin D deficiency using the standardized vitamin D levels compared to non-standardized levels."

Source: UCC Press Release

The Problem

Vitamin D

Vitamin D is a nutrient that has captured the attention of the scientific community, regulatory agencies, the food industry and the public alike over the past 15 years. While there are many controversial issues in relation to vitamin D requirements and the impact of vitamin D intake and status on human health, there is a general agreement that prevention of vitamin D deficiency is a public health priority. The major source of vitamin D in humans is sunshine; ultraviolet blue (UVB) radiation stimulates cutaneous synthesis of cholecalciferol, which is stored in adipose tissue or undergoes hydroxylation in the liver to 25-hydroxyvitamin D, (25OHD), a biomarker of vitamin D status, and further hydroxylation in the kidney to 1,25-dihydroxyvitamin D, (1,25(OH)₂D), the biologically active metabolite.

Several environmental factors, such as latitude and prevailing weather conditions, determine whether sunshine of sufficient strength is available to stimulate the conversion of 7-dehydrocholesterol in the skin to pre-cholecalciferol. Personal attributes, such as skin pigmentation, age, attire, sunscreen, working environment, physical activity and sun exposure behaviour can also prevent or impede vitamin D synthesis. Vitamin D occurs in the diet, both naturally and as a fortificant as cholecalciferol (D₃) and ergocalciferol (D₂) and in nutritional supplements. Vitamin D intakes are typically low as it occurs naturally in few foods and in low concentrations.

Substantial proportions of the European population, including all who reside at latitudes greater than around 40°N, rely on body stores and dietary vitamin D to maintain a healthy vitamin D status all year round. Given that body stores are dependent on sun

exposure, the importance of food in maintaining vitamin D status is a corollary of sunshine deficit. In Europe in particular, there is increasing evidence that the dietary supply is currently unable to offset the seasonal sunshine deficit, which increases with latitude and the duration of winter. While nutritional supplements contribute a high proportion to total vitamin D intake among users, supplement intake is voluntary, and tends to be highest among infants and elderly adults and lowest among children, adolescents and young adults, who are also at risk of deficiency.

Source: ODIN Project Overview

Overall Objective of ODIN

To develop effective, safe and sustainable solutions to prevent vitamin D deficiency and improve vitamin D related health outcomes using a food-first approach. A triage approach was adopted to selecting the most critical issues for attention.

The following extract from the **CORDIS - ODIN Final Report Summary** lists the prioritised questions of the project.

Vitamin D status and exposure

- What is the actual prevalence of vitamin D deficiency in Europe and how do countries compare with each other and the rest of the world?
- What is the distribution of vitamin D intake in Europe?
- How will increasing vitamin D in the food supply affect this distribution and reduce the prevalence of inadequate intakes?
- What is the potential contribution from UVB to circulating 25(OH)D across the European latitude gradient (~35-70oN).
- What is the dose-response of 25(OH)D to UVB at habitual skin exposure levels?

Food-based strategies to meet dietary requirements for deficiency prevention

- What changes in the food supply will increase population intakes of vitamin D sufficiently to modify the distribution of 25(OH)D and prevent deficiency?
- How can we harness technological advances in food production and animal nutrition to increase vitamin D in the food supply with consideration for dietary diversity and local preferences?

Nutritional requirements for vitamin D?

- What are the dietary requirements during pregnancy, childhood and adolescence to prevent vitamin D deficiency?
- What is the impact of ethnicity on dietary requirements for vitamin D in adults?
- Health and safety
- Are associations between 25(OH)D and non-skeletal health in adults independent of pre-existing risk, body composition, co-morbidities and compromised nutritional status and possible modulation by genetic variation?
- Are associations between vitamin D and perinatal outcomes robust in well powered, prospective, clinically validated, disease-specific pregnancy and birth cohorts?
- Does vitamin D status modulate physical growth and development in early life?
- Are high vitamin D intakes and serum 25(OH)D concentrations safe in the long term?

Project Organisation and Architecture

The following extract from the **CORDIS - ODIN Final Report Summary** lists the prioritised questions of the project.

Organisation and Architecture

ODIN assembled a world-leading, multidisciplinary partnership of scientific and medical researchers from academia and research organizations with complementary expertise in the area of vitamin D nutrition and health to work closely with significant food and nutrition industries and SMEs active in food and ingredient development. The ODIN consortium of 20 European academic and research institutional partners, 10 industry and SME partners across 19 countries, as well as the Office of Dietary

Supplements of the National Institutes of Health (NIH) in the US as a non-funded collaborator (see Part 2 of the report for partner list), was configured to have the expertise and excellence, necessary ethos of cooperation and collaboration as well as overall skill sets required to address the prioritised research questions and to define food-based strategies and solutions which would be feasible, safe and effective for the prevention of vitamin D deficiency in Europe.

ODIN implemented an integrated program of research across nine RTD work-packages (WPs) dealing with vitamin D status and exposure (diet and sun), dietary requirements, food-based solutions, human health and safety, as per the priority questions posed, as well as a dedicated WP for project coordination and a WP providing an innovative technology transfer and stakeholder engagement strategy to generate and translate the knowledge required to prevent vitamin D deficiency through food and confirm European leadership of vitamin D public health nutrition globally.

These WPs were:

- WP1: Vitamin D status: distribution of standardized serum 25-hydroxyvitamin D concentrations in European populations [VDSP Europe]
- WP2: Dietary exposure to vitamin D in European populations
- WP3: Sunlight exposure: risk-benefit analysis, implications for vitamin D requirements and status
- WP4: Dietary requirements for vitamin D during pregnancy, childhood and adolescence using dose-response RCTs
- WP5: Food- and food-technology-based solutions for prevention of vitamin D deficiency: Natural sources, fortification and biofortification with vitamin D2/D3 and 25-hydroxyvitamin D
- WP6: Proof of effectiveness of food-based solutions to prevent vitamin D deficiency using food-based RCT
- WP7: Vitamin D and health outcomes in pregnancy and early-life
- WP8: Vitamin D and health outcomes in adults: mortality and CVD
- WP9: Safety considerations in relation to increasing vitamin D intake and serum 25OHD levels
- WP10: Technology transfer, stakeholder engagement & dissemination
- WP11: Management and coordination

Results/Benefits

ODIN aimed to test the efficacy and safety of the fortified products in food based randomised control trials varying in scale from small product-specific trials to a large total diet study in vulnerable indigenous and immigrant sub-groups.

In the ODIN project, Creme Global were involved in investigating sun and dietary exposure to vitamin D. Within ODIN innovative food-based solutions to increase vitamin D intake were developed through the bio-fortification of meats, fish, eggs, and dairy products. This data was used within Creme Global's dietary models to assess the impact of multiple scenarios of optimising vitamin D intakes via biofortification of selected food products. This involved assessing the changes in vitamin D content of the food supply on vitamin D intakes accounting for diversity across the European latitude (~34-70°N). As part of the study Creme Global investigated the consumer safety of a range of fortification and dietary supplementation scenarios into the European food supply.

The ODIN consortium organised and hosted two very successful workshops at the European Commission to disseminate and discuss the issues of vitamin D status and stimulate innovative solutions for public health. Among the attendees were regulatory bodies from the European Commission, European food, health and consumer agencies and relevant

food companies. The first workshop on the 3rd of March 2016 was a 'One-day symposium to outline the implications of new research data on vitamin D from the ODIN project for public health policy and food innovation in Europe' presented on ODIN's research findings on vitamin D status, intakes and food-based solutions. The second workshop 24th of March 2017 was on the 'Dietary Requirements for Vitamin D in Children, Adolescents, Black-skinned adults and pregnant women in Europe' addressed the findings on vitamin D requirements in various under-researched population subgroups.

Post project Prof. Kiely from UCC concluded that: *"The ODIN hypothesis – careful application of fortification and biofortification strategies could safely increase intakes of vitamin D across the distribution and prevent deficiency – appears to be technically feasible. There is lots more to be done – we need to pay particular attention to ethnic minority groups resident at northerly latitude. Adolescents and young adults must be prioritised for the health of future generations."*

References

[Vitamin D deficiency is widespread across Europe – Data from University College Cork Nutrition Scientists highlight the need for food-based strategies](#)

[Assessing vitamin D safety following fortification and supplementation intake scenarios using the EFSA Comprehensive Database: the ODIN approach](#)

[Final Report Summary - ODIN \(Food-based solutions for Optimal vitamin D Nutrition and health through the life cycle\)](#)

[ODIN - Vitamin D FAQ](#)



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