



An update on vitamin D – how can we best meet the new recommendations?

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Research Fellow, NICHE, Ulster University, Coleraine

Dairy Council for Northern Ireland, Nutrition & Health Professional Conference, Belfast

Thursday 28th April 2016

ulster.ac.uk

Increase over last 5 decades
Resulted in >30,000 papers



Rickets returns as 1 in 4 toddlers found to be lacking in vitamin D



Call for vitamin D infant death probe



Vitamin D awareness in decline, say doctors



Medical chief highlights importance of vitamin D



Understanding The Anticancer Effects Of Vitamin D3
ScienceDaily (July 7, 2009) — The active form of vitamin D3 seems to have anticancer effects. To try and understand the underlying mechanisms, researchers previously set out to identify genes whose expression in a human colon cancer cell line is upregulated by the active form of vitamin D3.

Vitamin D deficiency a risk in north
By Chris Barnes
Young adults in Northern Ireland may be at risk of vitamin D deficiency during the winter months, according to new research. Researchers from the Northern Ireland Centre for Food and Health at the University of Ulster have published results showing "significant insufficient" levels of vitamin D among 18 to 24-year-olds. It had been thought that young adults develop enough vitamin D from sunlight and through their diet. The new research, published in the European Journal of Clinical Nutrition, shows this is not the case. Recent studies have shown that low vitamin D intake has been shown to be a risk factor in the development of cancer and autoimmune disorders, such as multiple sclerosis and rheumatoid arthritis. "This study suggests that apparently healthy people in Northern Ireland may be at increased risk of these conditions because of their low vitamin D status," one of the authors, Dr. Julie Wallace, explained. There is ongoing debate over what levels of vitamin D are sufficient for good health. Although recommended intakes are given for young children (five micrograms per day) and for people over the age of 65 (10 micrograms per day), there are no recommended intakes for young adults. Foods rich in vitamin D, such as fish oils and fortified cereals, are found in the Northern Irish diet. For most people, the main source of the vitamin is through skin exposure to sunlight. "We believe that the best way of maintaining vitamin D levels is through diet and by taking vitamin D supplements," Dr Wallace said.

Vitamin D: Magic bullet or overlooked health hope?

Chicago Tribune

For believers, vitamin D a beacon of medical hope

Vitamin D yoghurt may improve cholesterol, heart disease risk: Study
By Nathan Gray, 24-Nov-2011
Related topics: Research, Vitamins & nrae



Vitamin D Supplements Associated With Reduced Fracture Risk In Older Adults
March 30, 2009 — Oral vitamin D supplements at a dose of at least 400 international units per day are associated with a reduced risk of bone fractures in older adults, according to results of a ... > full story



Vitamin D May Give 2012 Olympic Athletes an Edge

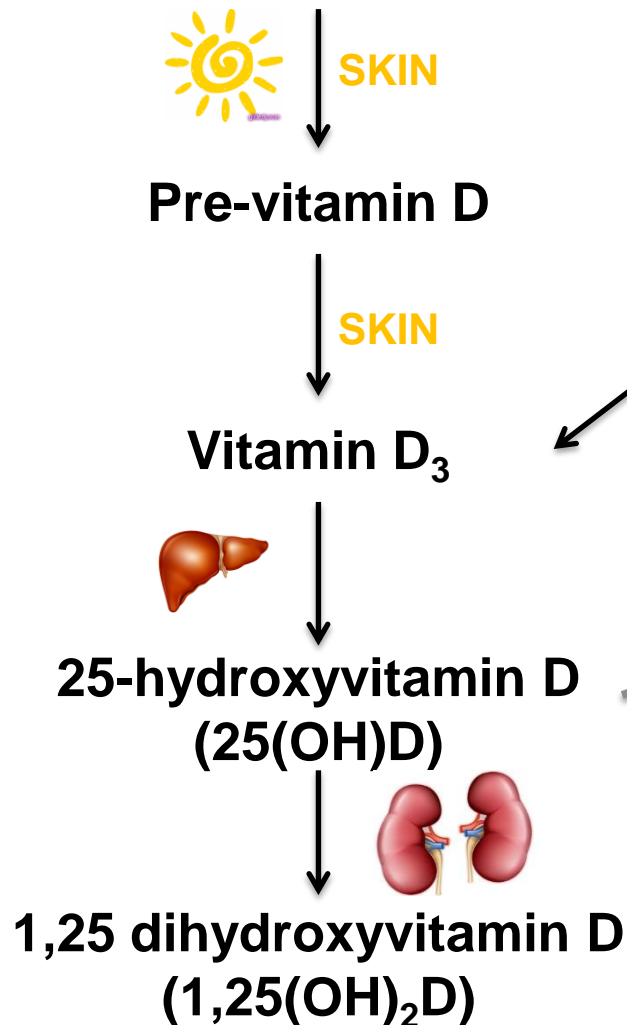
Vitamin D: how can we meet the new recommendations?

Presentation Outline

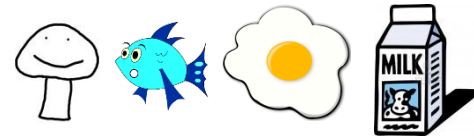
- **Brief overview of vitamin D**
- **Why do we need vitamin D?**
- **What does the evidence tell us?**
- **How much is needed?**
- **Strategies to improve vitamin D**
- **Take home messages**

Overview of vitamin D

7-dehydrocholesterol (7-DHC)



Dietary sources



| | |
|--------------|--------------|
| ≤25 nmol/l | Deficient |
| 26-49 nmol/l | Insufficient |
| ≥50 nmol/l | Sufficient |

---> ACTIONS WITHIN TARGET TISSUES

Why do we need vitamin D?

Skeletal & non-skeletal effects^{1,2}

Musculoskeletal effects

- Stimulates Ca absorption and mobilization, via PTH
 - Prevention of rickets & osteomalacia/osteoporosis
- Muscle strength & function
 - Prevention of falls

Non-musculoskeletal effects

- Immune function & infectious disease
- CVD & hypertension
- Neuropsychological functioning
- Pregnancy & lactation
- Autoimmune diseases
- Cancers

¹SACN Draft Vitamin D & Health Report, 2015

²Abrams SA et al. *Nar Rev Endocrinol* 2013;9:162-70

What does the evidence tell us?

Adults vitamin D intakes

NDNS, UK¹:

| Vitamin D intake (µg/d) | Food sources only | All sources inc. supplements |
|----------------------------|-------------------|------------------------------|
| Mean | 2.8 | 3.6 |
| median | 2.3 | 2.6 |
| SD | 2.1 | 3.8 |
| Lower-upper 2.5 percentile | 0.5-8.5 | 0.6-12.0 |

NANS, Ireland²:

- Food: 3.1 2.5µg/d / Food + supplements: 4.3 6.2µg/d

¹NDNS Years 1-4 Rolling Programme, DOH 2014

²National Adult and Nutrition Survey, 2011 www.iuna.net

What does the evidence tell us?

Adults vitamin D status

| 25(OH)D (nmol/l) | UK¹ Mean \pm SD | Ireland² Mean (95% CI) |
|-------------------------|--|---|
| Mean year round | 45.4 \pm 24.8 | 60.0 (58.6, 61.4) |
| Summer | 57.5 \pm 23.4 | 65.5 (63.6, 67.4) |
| Winter | 34.8 \pm 22.9 | 53.1 (51.2, 55.1) |
| % deficient | 22.8 (range 8-40) | 6.7 (range 3-11) |

- Low vitamin D status is a problem, particularly over the winter months³

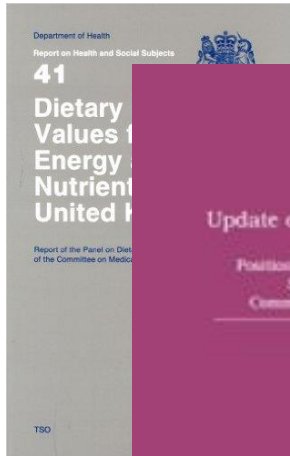
¹NDNS Years 1-4 Rolling Programme, DOH 2014

²Cashman et al. BJN 2013;109(7):1248-56

³Cashman et al. Am J Clin Nutr. 2016;103(4):1033-44

Vitamin D DRVs

Recent re-evaluations worldwide



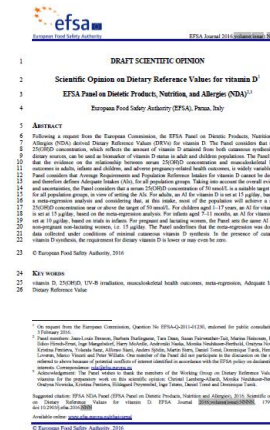
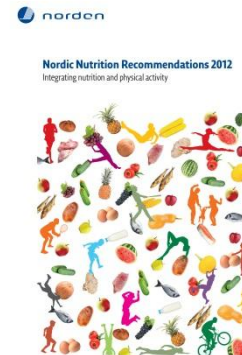
UK: 0µg



US: 15µg



NL & Nordic:
10µg



EU: 15µg



DACH: 20µg



UK: 10µg

Vitamin D DRVs

Recent re-evaluations worldwide

Revised DRVs (adults) 10-20µg/day

Set to maintain status $>25\text{nmol/l}$ OR target 50nmol/l

- ✓ Based on good bone/musculoskeletal health
- ✓ Assume minimal sunlight exposure

10µg



UK: 10µg

EU: 15µg



DACH: 20µg

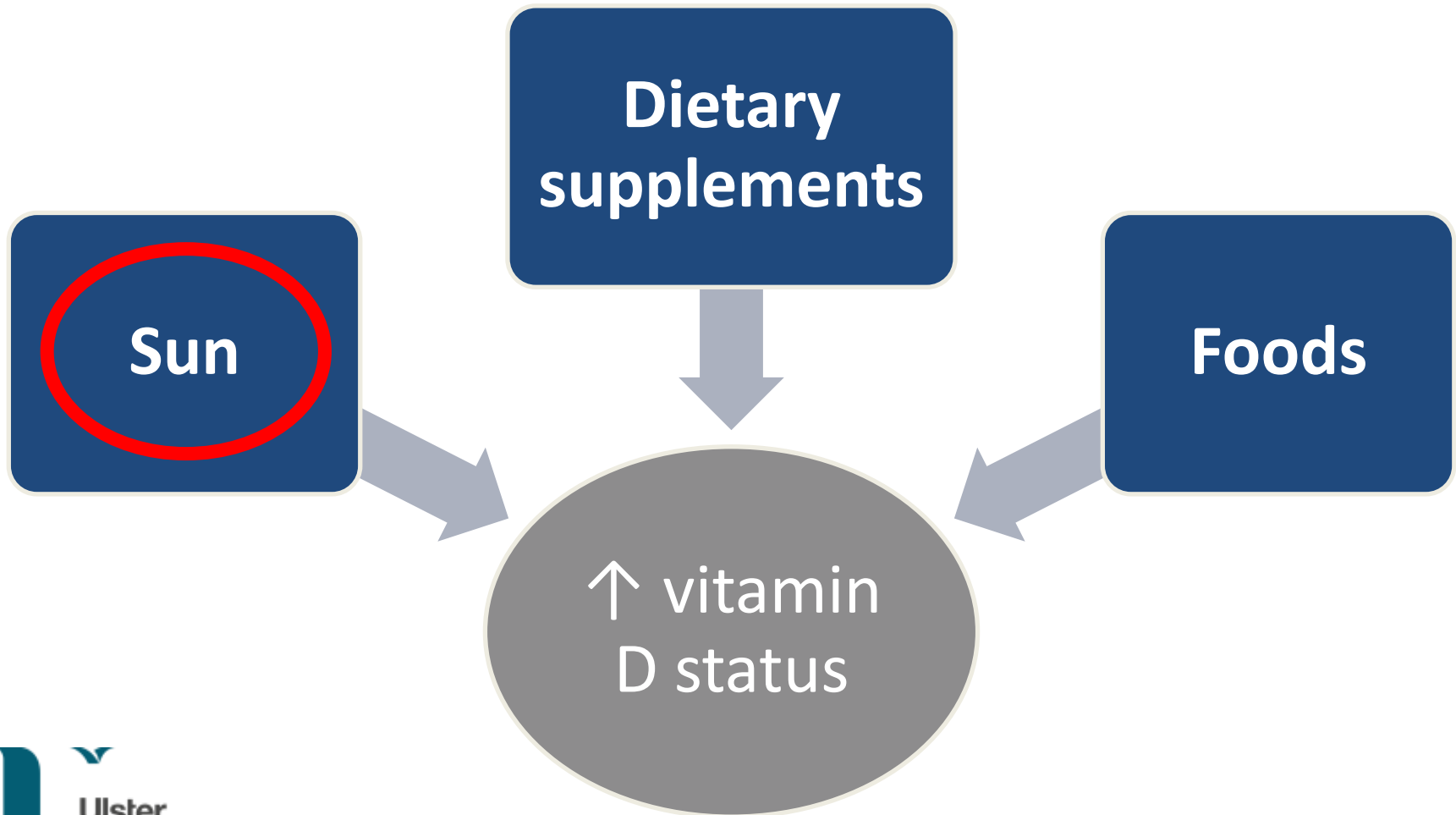
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- **Take home messages**

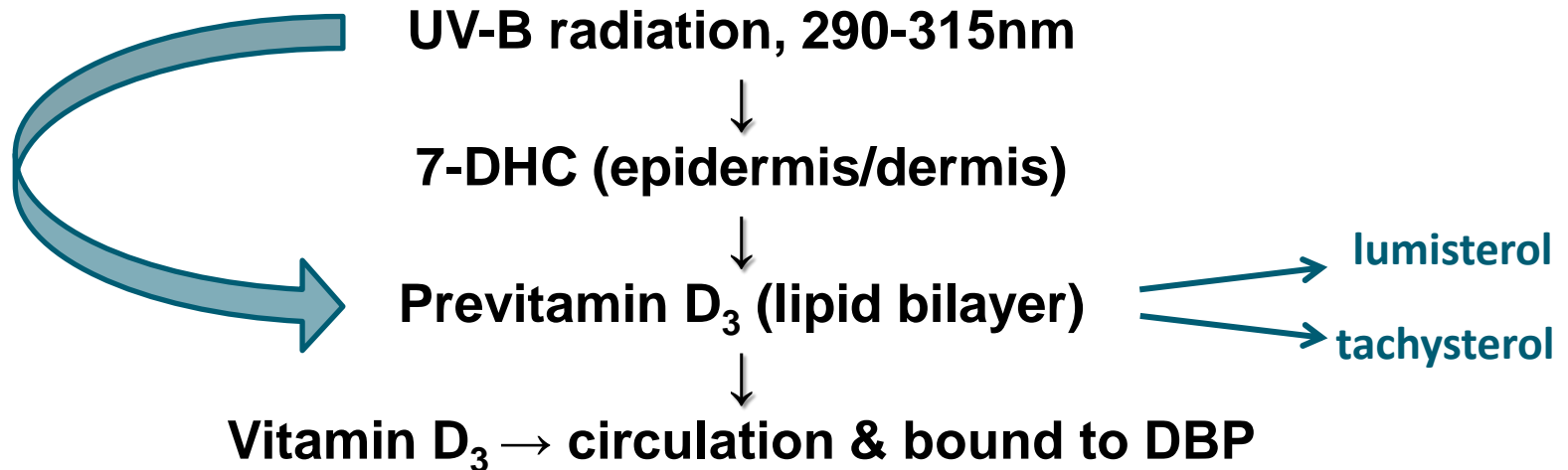
What can we do?

Strategies for increasing vitamin D



Endogenous synthesis

1 μg = 40 IU



Max synthesis (1 suberythema dose = 500 μg vitamin D)

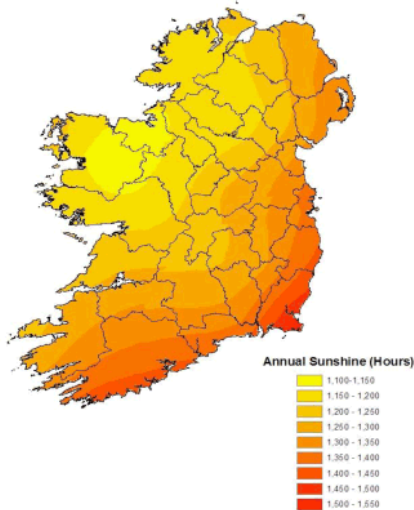
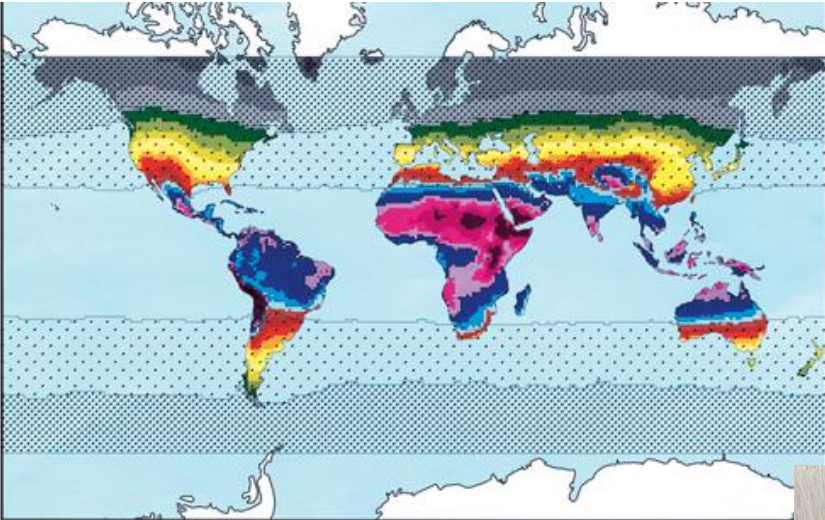
- 10-15mins midday sun on hands, face and arms = 125 μg /5000IU
- 15mins sunbathing on a beach in swimwear = 250 μg /10,000IU

Excessive exposure won't cause toxicity

- sunlight degrades excess previtamin D₃ and vitamin D₃
- plus as you tan, melanin decreases synthesis

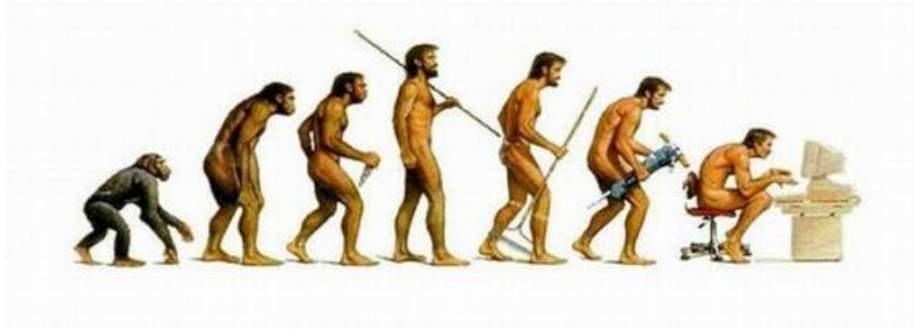
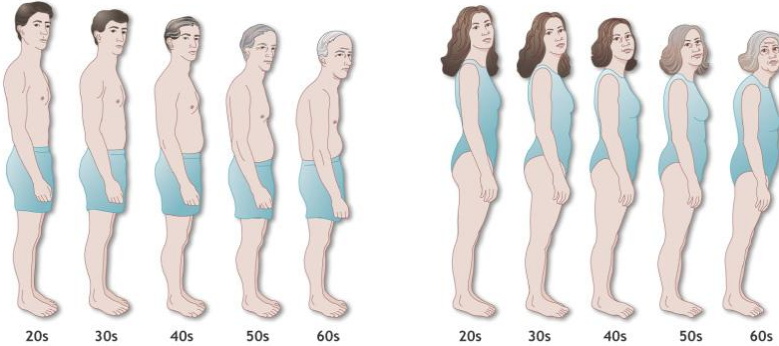
Endogenous synthesis

Limited by environmental factors:



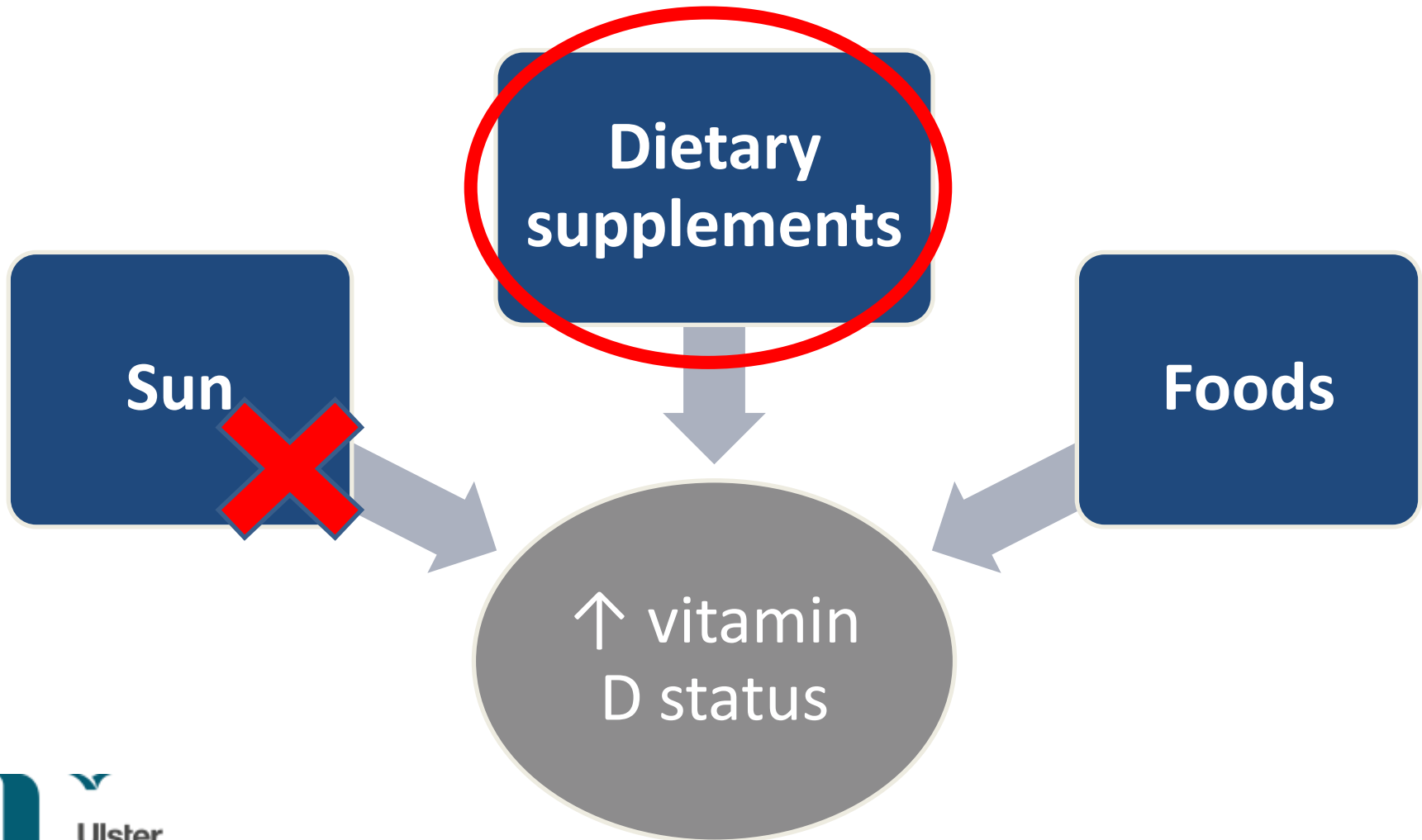
Endogenous synthesis

High individual variability:



What can we do?

Strategies for increasing vitamin D



Effect of vitamin D supplementation on vitamin D status and bone turnover markers in young adults

MS Barnes, PJ Robson, MP Bonham, JJ Strain and JMW Wallace

Estimation of the dietary requirement for vitamin D in healthy adults^{1–3}

Kevin D Cashman, Anthony P FitzGerald, Julie MW Wallace, Estimation of the dietary requirement for vitamin D in free-living adults ≥ 64 y of age^{1–3}

Kevin D Cashman, Julie MW Wallace, Geraldine Horigan, Tom R Hill, Maria S Barnes, Alice J Lucey, Maxine P Bonham, Nicola Taylor, Emeir M Duffy, Kelly Seamans, Siobhan Muldowney, Anthony P FitzGerald, Albert Flynn, JJ Strain, and Mairead Kiely

International Journal of Sport Nutrition and Exercise Metabolism, 2013, 23, 441–448
© 2013 Human Kinetics, Inc.

Vitamin D Status and Supplementation in Elite Irish Athletes

INTERNATIONAL JOURNAL OF
SPORT NUTRITION AND
EXERCISE METABOLISM
www.IJSNEM-Journal.com
ORIGINAL RESEARCH

Pamela J. Magee, L. Kirsty Pourshahidi, Julie M.W. Wallace,
John Cleary, Joe Conway, Edward Harney, and Sharon M. Madigan

Vitamin D₃ supplementation using an oral spray solution resolves deficiency but has no effect on VO₂ max in Gaelic footballers: results from a randomised, double-blind, placebo-controlled trial

Joshua J. Todd¹ · Emeir M. McSorley¹ · L. Kirsty Pourshahidi¹ · Sharon M. Madigan² · Eamon Laird³ · Martin Healy⁴ · Pamela J. Magee¹



Evidence from RCTs - Vitamin D supplementation is effective at raising vitamin D status

What does the evidence tell us?

Adults vitamin D intakes

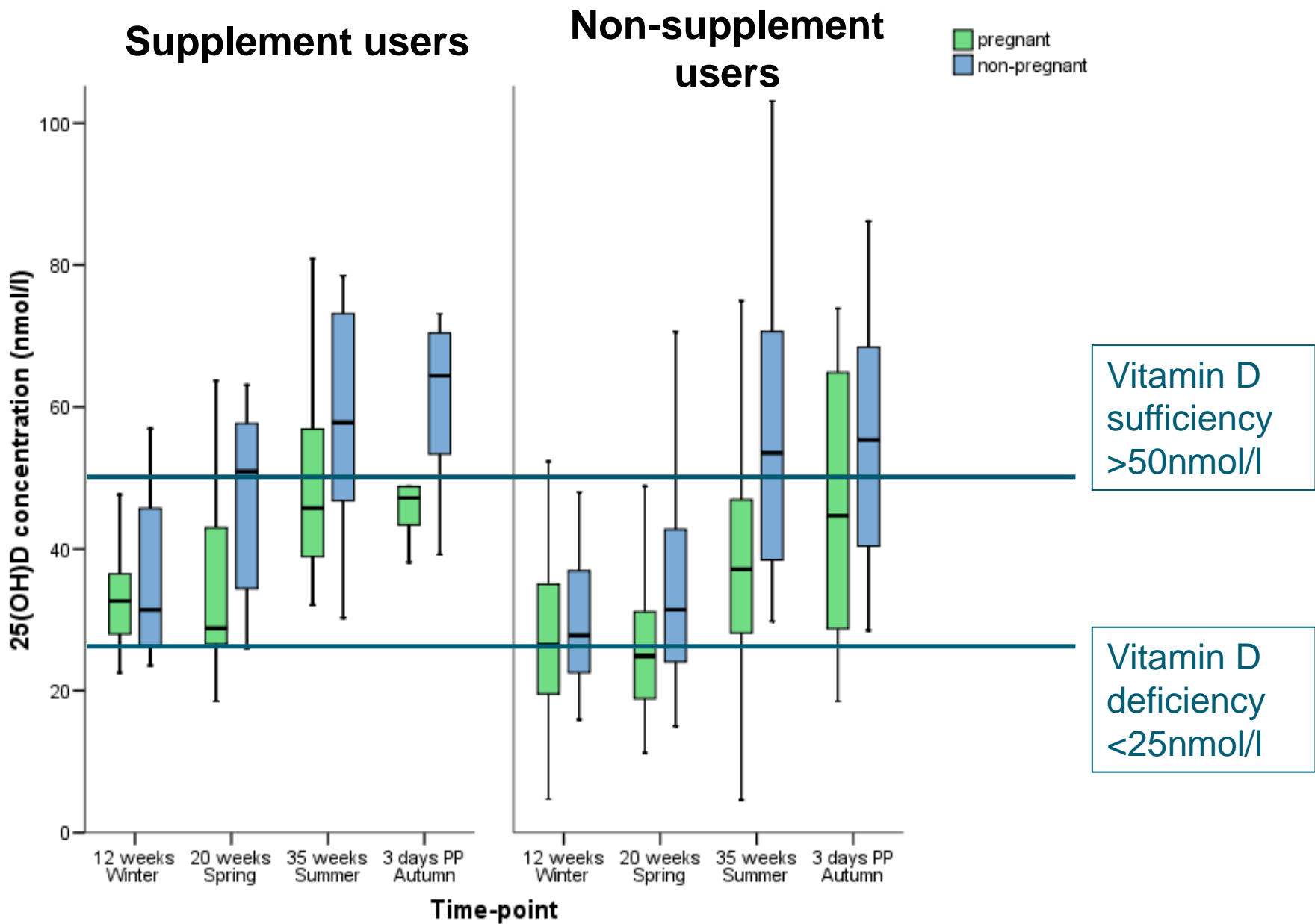
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- Dietary supplementation is not effective at the population level²

¹NDNS Years 1-4 Rolling Programme, DOH 2014

²Cashman & Kiely. J Hum Nutr Diet. 2014;27(5):434-42



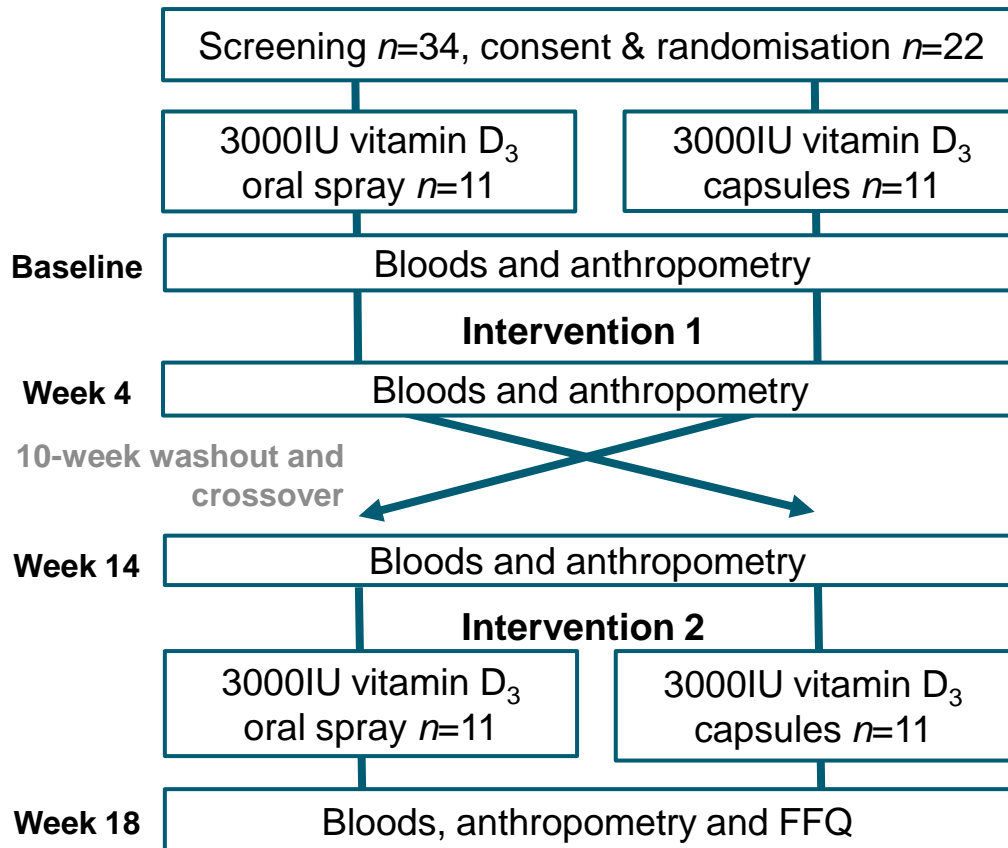
Even among supplement users, vitamin D insufficiency was common among pregnant women

Vitamin D₃: capsule vs oral spray

Wintertime randomised, open-label crossover study



Study design

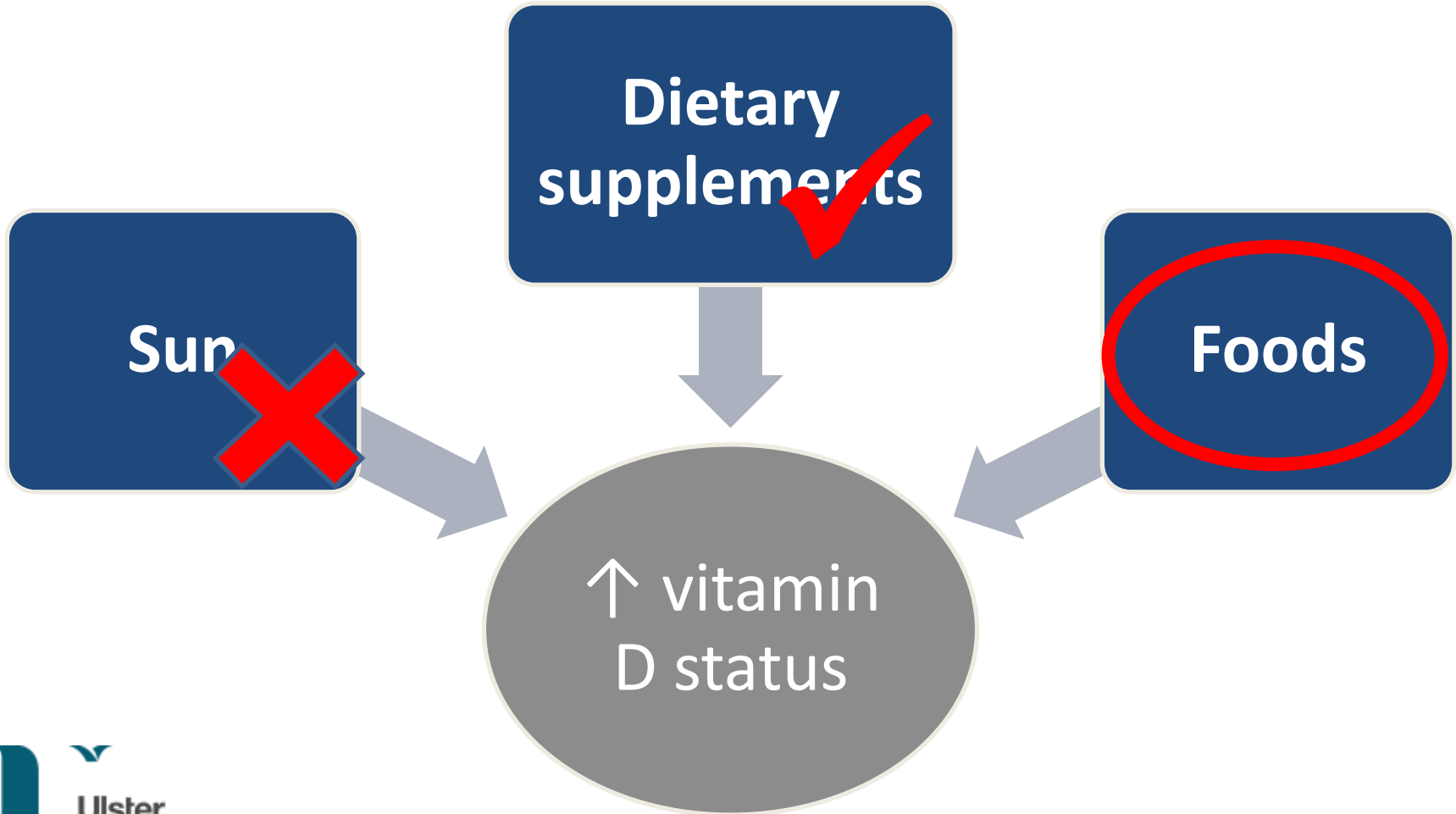


Results

Oral spray vitamin D₃ supplementation is an equally effective alternative to capsules

What can we do?

Strategies for increasing vitamin D



Strategies for increasing vitamin D

Natural sources vs. fortified foods



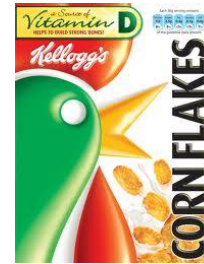
2-14 μ g



7-9 μ g



3.2 μ g



1.7-8.3 μ g



0.3-0.9 μ g



1.2-1.7 μ g



small
quantities



0.8 μ g

Per 100g/100ml

Strategies for increasing vitamin D

Voluntary fortification increasing within the food industry




**Mandatory
vitamin D
fortification is
common in
many countries**

Sweden to expand mandatory vitamin D fortification

 By Annie-Rose Harrison-Dunn+
28-May-2015
Last updated on 28-May-2015 at 14:16

Any objections? Sweden notifies EU on vitamin D fortification plans

 By Annie-Rose Harrison-Dunn+
22-Apr-2016
Last updated on 22-Apr-2016 at 14:10 GMT

 Post a comment



Vitamin D fortification

Ongoing debate on which foods?

Recommended dietary intakes for vitamin D: where do they come from, what do they achieve and how can we meet them?

K. D. Cashman^{1,2} & M. Kiely¹



Does fortification of staple foods improve vitamin D intakes and status of groups at risk of deficiency? A United Kingdom modeling study^{1,2}

Rachel E Allen,^{3,4} Alan D Dangour,⁴ Alison E Tedstone,³ and Zaid Chalabi⁴*

Endocrine (2016) 51:38–46
DOI 10.1007/s12020-015-0711-x

VIEW POINT

Tackling inadequate vitamin D intakes within the population: fortification of dairy products with vitamin D may not be enough

Kevin D. Cashman^{1,2} · Mairead Kiely^{1,3}



Cows' milk: A potential vehicle for vitamin D enrichment and fortification

DEL CAST PhD Studentship

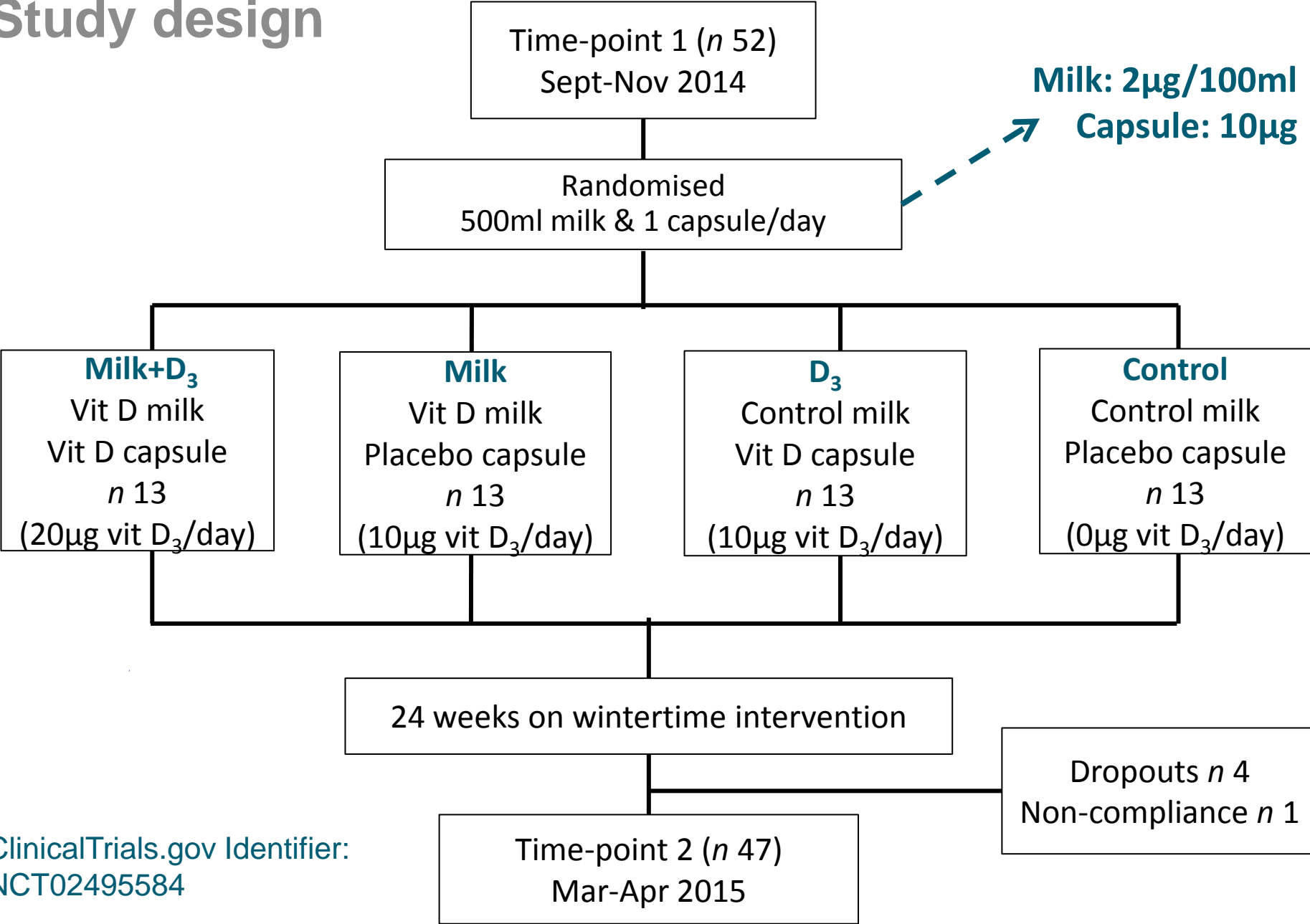
Ruth Weir

ulster.ac.uk



Can fortified milk ↑ vitamin D status?

Study design



ClinicalTrials.gov Identifier:
NCT02495584

Cows' milk: A potential vehicle for vitamin D enrichment and fortification

Summary of results

- Seasonal variation in the vitamin D₃ content of whole milk was evident
- Levels may be higher than currently estimated in food composition tables
- Vitamin D₃ fortified milk (2µg/100ml):
 - ✓ ↑ 25(OH)D over the winter months compared to control (and to the same degree as supplemental vitamin D₃)
 - ✓ Theoretically would ↑ vitamin D intakes at the population level and ∴ ↑ the % meeting the revised RNI (without risking excess intakes)



Biofortification

Natural food enhancement

“foods are fortified through the addition of nutrients to animal feed during livestock farming production, or manipulation of post-harvest food processes”

Eggs Contain More Vitamin D And Less Fat Now Than 30 Years Ago

The Huffington Post UK | By Kyrsty Hazell

Posted: 19/07/2012 17:50 BST | Updated: 22/07/2012 21:13 BST

New data has revealed that today's eggs contain 70% more vitamin D than they did 30 years ago.

According to the UK Foodcomp and [Department of Health](#), eggs today have 20% less saturated fat, 13% fewer calories and 10% less cholesterol than eggs in the 1980s.

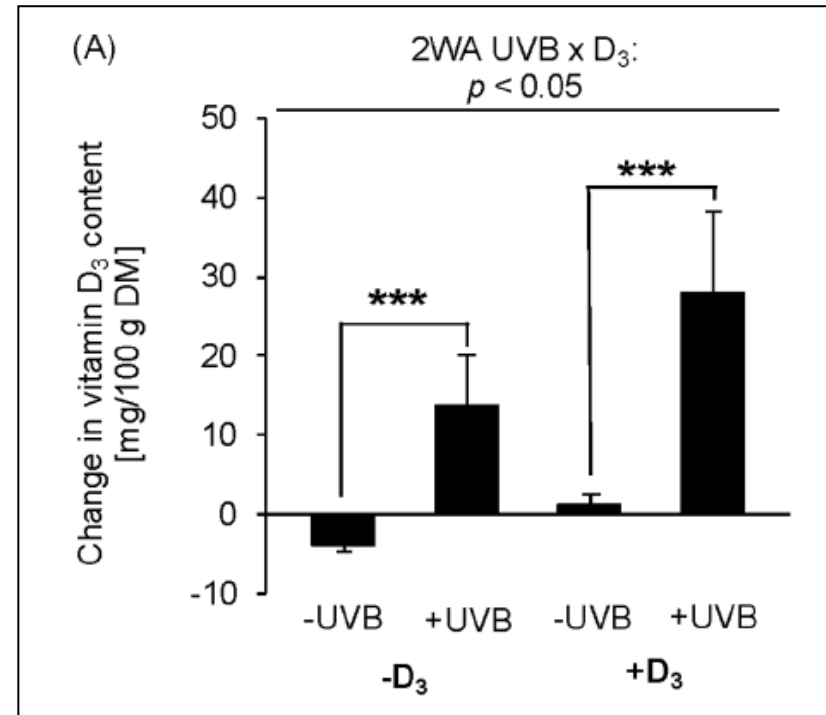
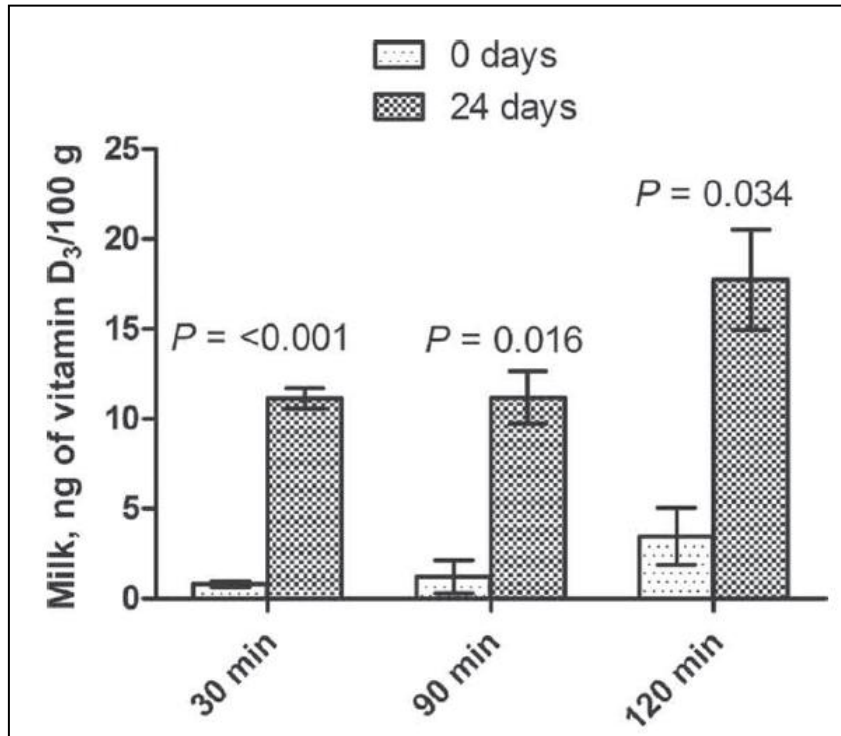
Higher total vitamin D content:

1. On-farm practices
2. Lab techniques - ↑ sensitivity to detect both:
 - ✓ Vitamin D₃
 - ✓ 25(OH)D = x5 bioavailable



Biofortification

Other animal foods



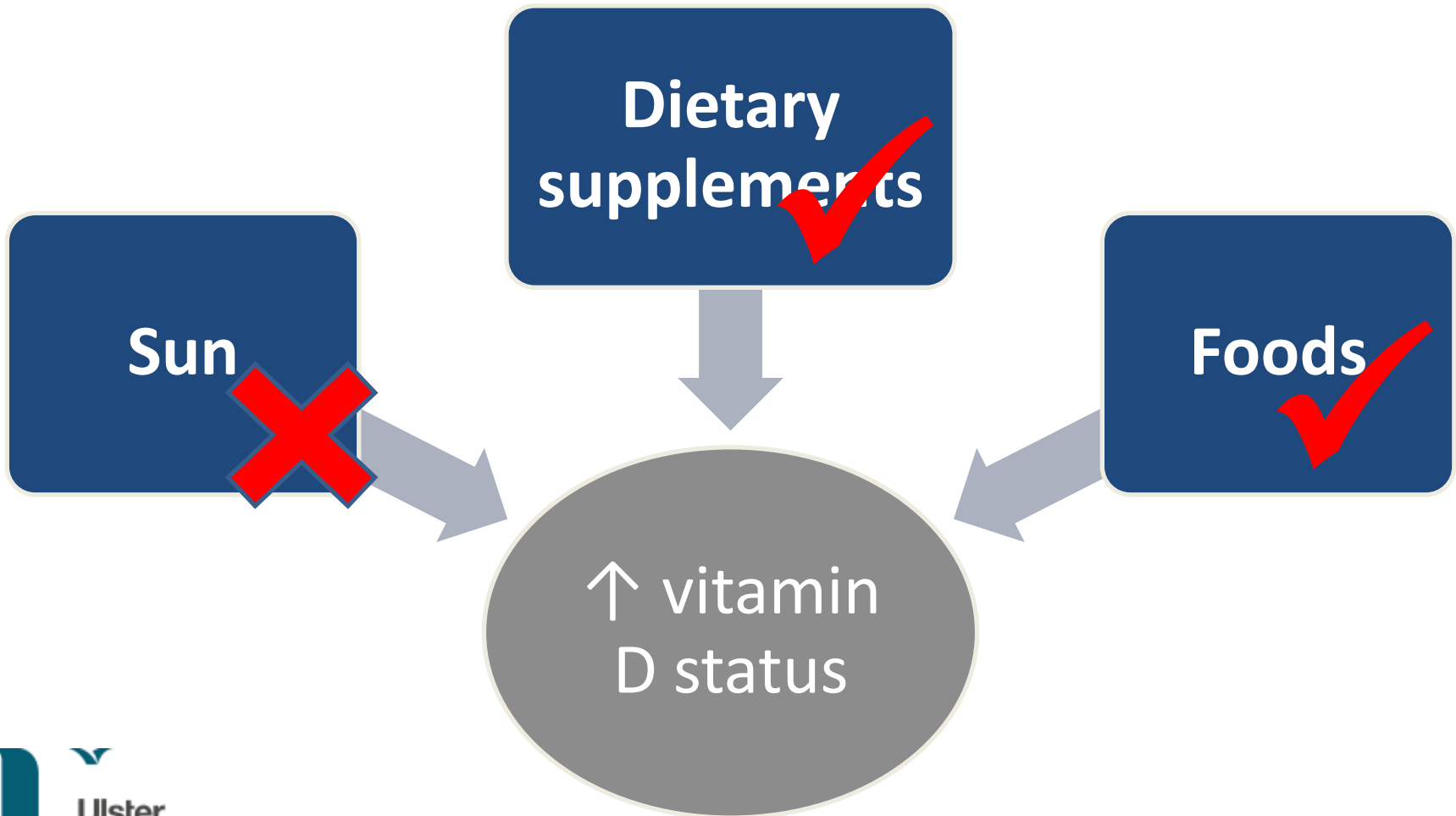
- ↑ milk D₃ after acute UVB dose¹
- Results also apparent in eggs & poultry²

¹Jakobsen et al. J Dairy Sci. 2015;98(9):6492-8

²Schutkowski et al. PLoS One. 2013;8(7):e69418

What can we do?

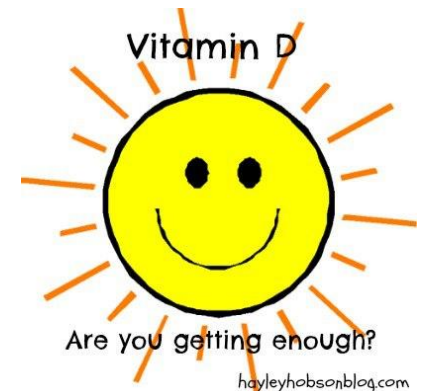
Strategies for increasing vitamin D



Take home messages

Vitamin D: Can we meet the new DRVs?

- Plethora of evidence reporting low vitamin D intakes & status
- Cannot rely on / recommend sun exposure to ↑ vitamin D status
 - Revised DRV = 10µg/day
- It is likely that a combination of food-based strategies will be required to improve vitamin D intakes & prevent deficiency
- Mandatory fortification vs. biofortification
- More widespread update of the vitamin D content of animal foods is warranted



References: journal articles

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- UK Food Comp Project (2014) <http://foodatabanks.ifr.ac.uk/nutrients/>

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