



Vitamin D₃ and 25-hydroxyvitamin D₃ content of white fish purchased from retail outlets in five Australian cities

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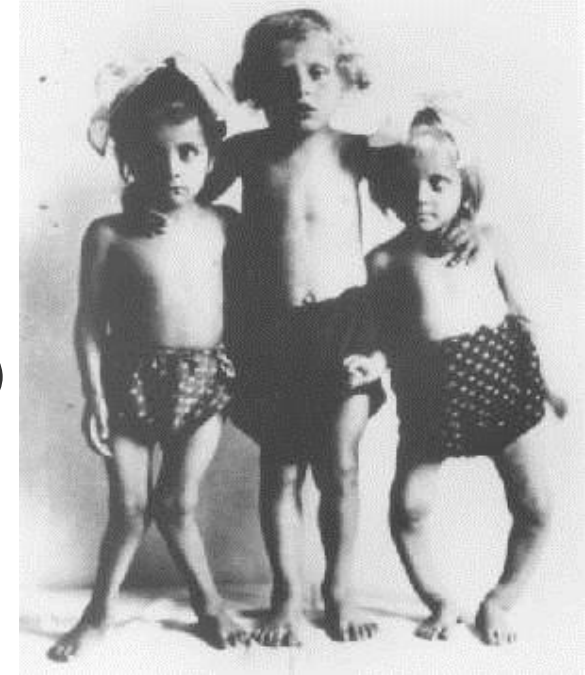
Overview

- Background
 - Vitamin D deficiency, composition data
- Aims
- Methods
 - Sampling
 - Analysis
- Results
- Future research



Vitamin D

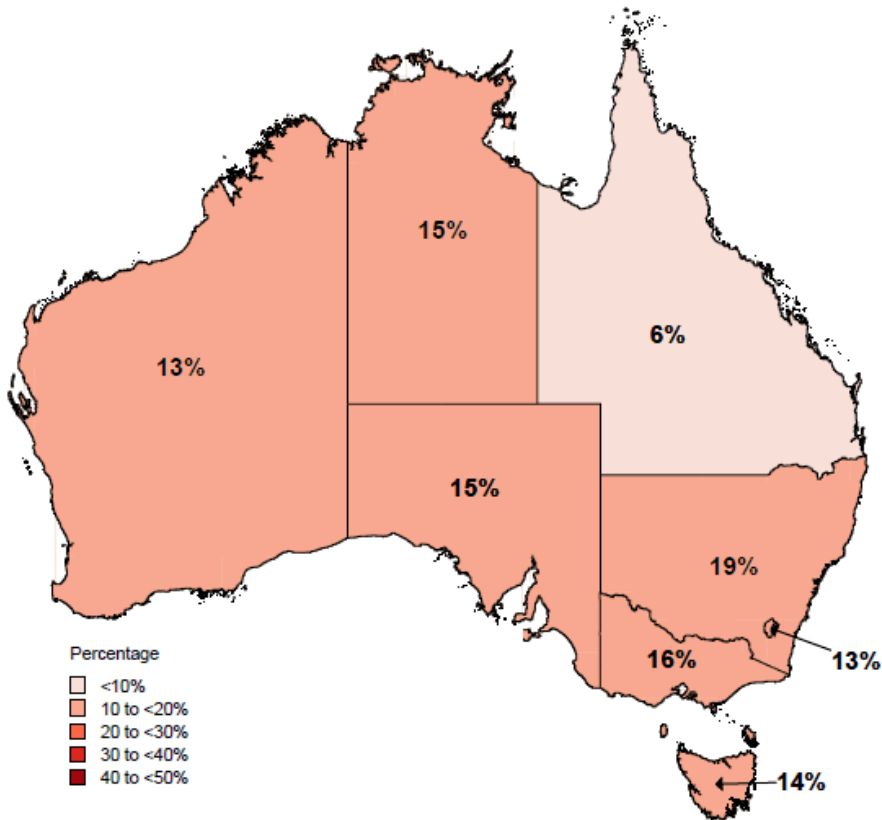
- Important for:
 - Bone health (deficiency: rickets, osteomalacia)
 - Cardiovascular, immune, mental health?
- Sources:
 - Sun exposure
 - Diet and supplements
- Nearly 1 in 4 Australian adults are vitamin D deficient
 - Serum 25-hydroxyvitamin D (25(OH)D) < 50 nmol/L¹
- Indoors lifestyle, sun-safety, cultural clothing habits



¹Australian Bureau of Statistics. Australian Health Survey: Biomedical Results for Nutrients, 2011–2012

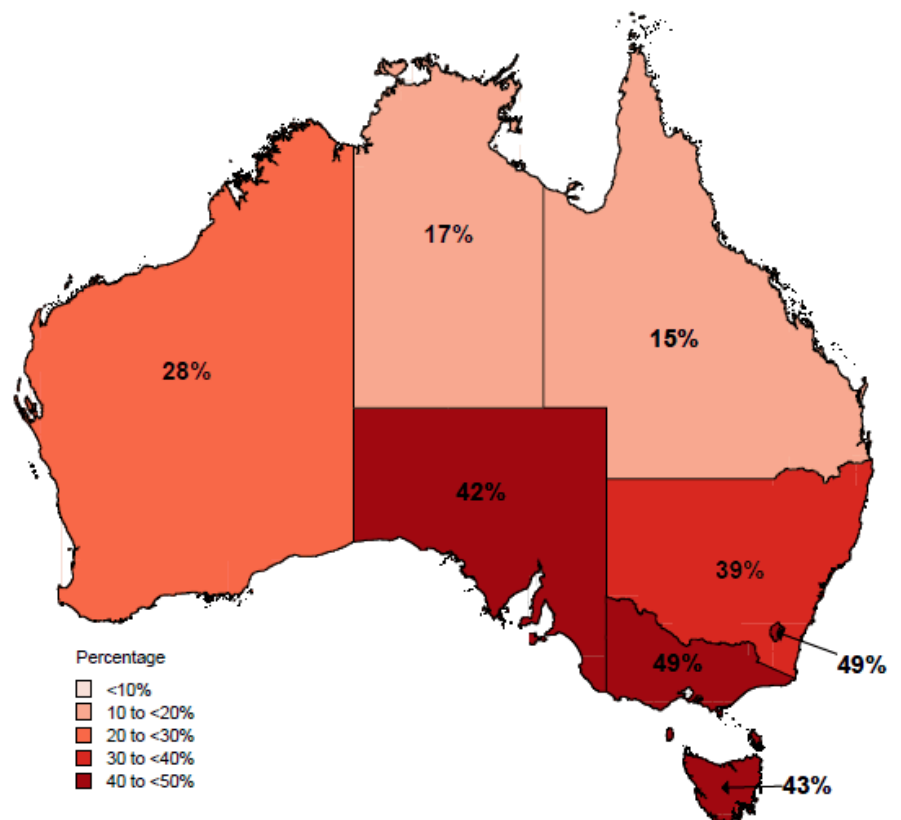
Prevalence of vitamin D deficiency

Summer



Source: Australian Health Survey: Biomedical Results for Nutrients

Winter



Source: Australian Health Survey: Biomedical Results for Nutrients

Australian Bureau of Statistics. Australian Health Survey: Biomedical Results for Nutrients, 2011–2012

Dietary sources of vitamin D

- Vitamin D₃ (cholecalciferol) & 25(OH)D₃
 - Animal sources: meat, fish, eggs, dairy
- Vitamin D₂ (ergocalciferol) and 25(OH)D₂
 - Mushrooms
- 25(OH)D₃ may be 5 times more bioactive than vitamin D₃^{1,2}
 - Frequently omitted from food composition databases



¹Cashman et al. *Am J Clin Nutr*, 2012, 95:1350-1356;

²Ovesen et al. *Ann Nutr Metab*, 2003, 47:107-113.

Australia lacks vitamin D composition data

- Vitamin D intakes in Australian unknown
- International data not appropriate for use in Australia
 - Environment, climate, production practices, feed fortification, species and types of foods
- Small, convenience samples of meat¹, seafood² and eggs³
 - Vitamin D₃ & 25(OH)D₃
 - Eggs: high-performance liquid chromatography (HPLC)
 - Meat, fish: liquid chromatography with ion trap mass spectroscopy (LC-IT-MS)

¹Strobel et al. *Food Chem*, 2013, 138:1042-1047; ²Padula et al. *Food Chem*, 2014, 193:106-111; ³Liu et al. *Nutr Diet*, 2014, 71:46-50.

Aim

- To quantify vitamin D₃ and 25(OH)D₃ in white fish purchased from retail outlets across five cities in Australia
 - Multi-city sampling (Sydney, Melbourne, Adelaide, Brisbane, Perth) reflecting the majority of the market
 - National Measurement Institute of Australia, accredited by the National Association of Testing Authorities for analysing vitamin D



Sample purchasing

- A single-species fish sample (2 kg) from each city
 - Species were those most commonly reported to be consumed in the 2011-2013 AHS
 - Fresh, skinless fillets preferred
- DNA profiling confirmed species labelling

City	Retail outlet	Description	Origin
Adelaide	Supermarket	Blue grenadier hoki	NR
Brisbane	Supermarket	Hoki, thawed	New Zealand (wild)
Melbourne	Seafood retailer	King dory	NR
Perth	Supermarket	Basa, thawed	Vietnam
Sydney	Seafood retailer	Barramundi, skin-on	Australia (wild)

Analysis of vitamin D₃ and 25(OH)D₃

- Duplicate analysis
 - HPLC with photodiode array
- Limits of reporting:
 - 0.2 µg/100 g for vitamin D₃ and 0.1 µg/100 g for 25(OH)D₃
- Quality control
 - 97% recovery for vitamin D₃ (in-house control)
 - 86% recovery for vitamin D₃, 87% for 25(OH)D₃ (spiked barramundi)
- Relative percentage difference between duplicate samples
 - 2.9% for vitamin D₃ and 12.9% for 25(OH)D₃

Results – cooked samples

Sample	Vitamin D ₃ (µg/100g)	25(OH)D ₃ (µg/100g)	VitDE* (µg/100g)	True retention, vitamin D ₃ (%)	True retention, 25(OH)D ₃ (%)
Blue grenadier hoki	0.40	0.35	2.15	354	103
Hoki, thawed	0.20	0.45	2.45	40	60
King dory	0.70	0.35	2.45	145	72
Basa, thawed	<0.1	0.60	3.00	-	163
Barramundi	0.35	0.40	2.35	13	49

Values are the average of duplicate analyses

*VitDE = vitamin D₃ + (5 x 25(OH)D₃)^{1,2}

¹Cashman et al. *Am J Clin Nutr*, 2012, 95:1350-1356; ²Liu et al. *Asia Pac J Clin Nutr*, 2012, 24:464–471.

Contribution to vitamin D requirements

- Adequate Intake, AI (Australia)¹

- 1-50 y = 5 µg/d 51-70 y = 10 µg/d >70 y = 15 µg/d

- One serve cooked white fish (100 g)

- 43% - 60% of the AI (2-3 µg)
- Assumes 5x bioactivity of 25(OH)D₃

- Recommended Dietary Allowance, RDA (USA)²

- ≤70 y = 15 µg/d (600 IU) >70 y = 20 µg/d (800 IU)

¹National Health and Medical Research Council (2006) *Nutrient Reference Values for Australia and New Zealand*; ²Institute of Medicine (2011) *Dietary Reference Intakes for Calcium and Vitamin D*

Food Standards Code

- 25(OH)D₃ is not recognised in the Food Standards Code
- 'Source of' claim: 1 µg vitamin D₃/serve
- 'Good source of' claim: 2.5 µg vitamin D₃/serve



Future research

- Other fish species; beef and lamb
 - Production practices and feed fortification
- Other vitamin D-containing foods
 - Approx. 200 foods sampled from cities across Australia
 - Liquid chromatography with triple quadrupole, tandem mass spectrometry (LC-QQQ)
- Estimate vitamin D intakes in the Australian population
- Consider food-based strategies to alleviate vitamin D deficiency
 - Food fortification/bio-fortification

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