Conference «Lipids, Nutraceuticals and Healthy Diets throughout the Life Cycle»

Vitamin D – perspectives in human health

Nelson, November 09, 2016

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DSM Nutrition Science & Advocacy

HEALTH · NUTRITION · MATERIALS

Content

- Introduction: Vitamin D is essential
- Status and how much do we need
- Biological functions and benefits
- Intake recommendations, health claims and safety
- Summary: the optimal status provides benefits for long term health

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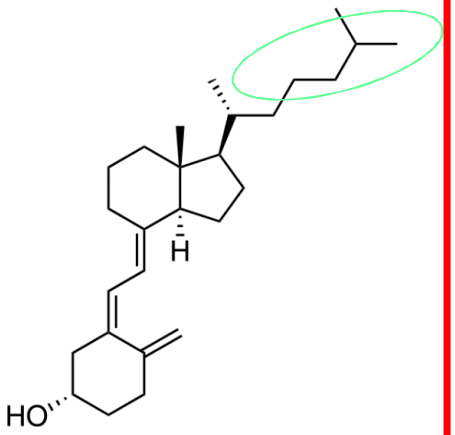
Vitamin D3 is naturally occurring in humans and animals

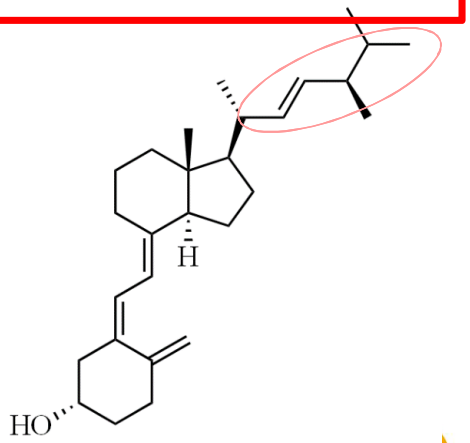
Vitamin D3: Cholecalciferol

- Formed by action of ultraviolet light on vitamin D precursors in skin
- Present in certain foods
- Precursor for biologically active hormone



Vitamin D2: Ergocalciferol

- Obtained by irradiation of plants or foods
- Vitamin D2 seems to be less potent than vitamin D3



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Dietary sources are low in vitamin D

Fortified Milk (240 mL)
50 IU

Margarine (2 tea sp)
40 IU

Salmon (115 g)
80 IU

Eggs (2 pc)
32 IU

Shitake Mushrooms (100 g)
1200 IU

[Mason R. Climateric 2010; DOI: 10.3109/13697137.2010.514366]

Vitamin D content in human milk is low (aprox. 25 IU /L -0.62 ug/L)

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To achieve the IOM recommendation 2011 of 600 IU vitamin D/d = 15 µg per person ….

…. this requires an intake of

24 l human milk or

3 l fortified milk or

37 eggs or

870 g salmon or

30 tea spoons margarine or

50 g shitake mushrooms

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Therefore:

Neither exclusive breastefeeding nor a balanced diet can provide enough Vitamin D to meet the dietary recommendations.

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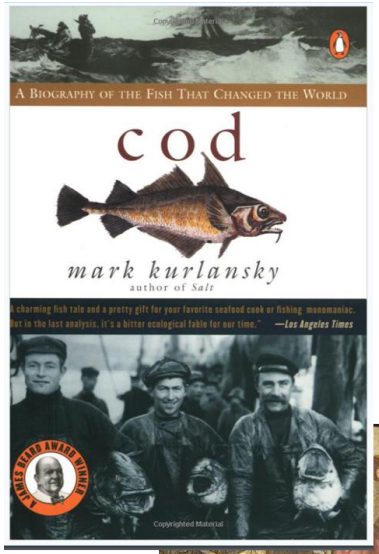
A short excursion: cod liver oil changed the world

- Cod liver oil is rich in vitamin D3, A, K and omega-3
- Cod has been an important economic commodity since the Viking period (~800 AD)
- Cod liver oil was valued like gold
- Market lasted for more than 1000 years, enduring Black Death, wars and other crises
- In the 21st century fishing off severely depleted stocks and resulted in restricted catches



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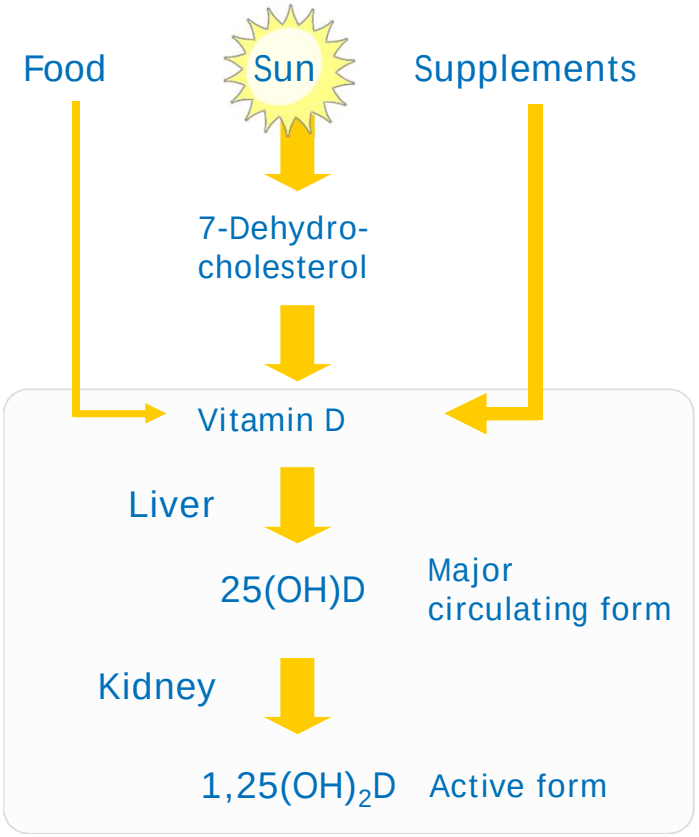
Vitamin D comes from different sources



25(OH)D serum level is the relevant indicator of Vitamin D status (IOM 1997)

nmol/L			
< 25	25 - 50	50 - 75	> 75
deficient	*insufficient*	*(in)adequate*	*desirable*
< 10	10 - 20	20 - 30	> 30
ng/ml			

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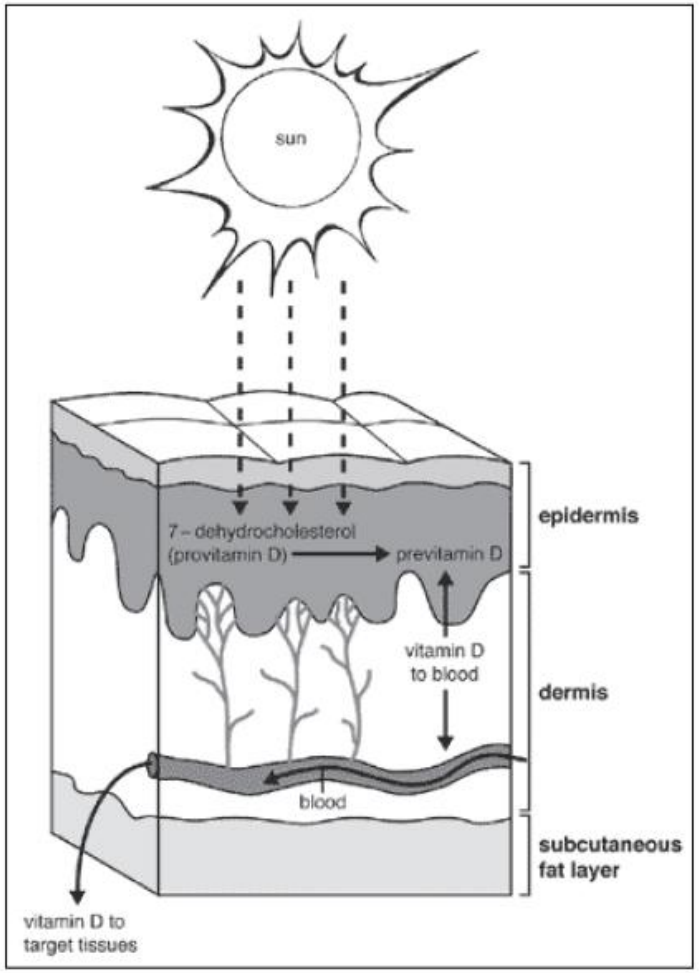
Vitamin D



Factor in Sun Exposure

- ✓Clothing
- ✓Altitude
- ✓Latitude
- ✓Time-of-day outdoors
- ✓Duration of time outdoors
- ✓Skin pigmentation
- ✓ Aging of the skin

Paradox of sunny countries …..

nutrients

MDPI

Article

High Prevalence of Vitamin D Deficiency in Cambodian Women: A Common Deficiency in a Sunny Country

Geoffry Smith [1,2,†], Sunil J. Wimalawansa [3,†], Arnaud Laillou [4,*,†], Prak Sophonneary [5], Samoeurn Un [4], Rathavuth Hong [6], Etienne Poirot [4], Khov Kuong [7,8], Chhoun Chamnan [7], Francisco N. De los Reyes [9] and Frank T. Wieringa [10,†]

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† These authors contributed equally to this work.

Sunny country unleashed ….

- Bener A, Al-Ali M, Hoffmann GF. High prevalence of vitamin D deficiency in young children in a highly **sunny** humid country: a global health problem. Minerva Pediatr. 2009;61:15-22.

- Unger MD, Cuppari L, Titan SM, Magalhães MC, Sassaki AL, dos Reis LM, Jorgetti V, Moysés RM. Vitamin D status in a **sunny** country: where has the sun gone? Clin Nutr. 2010;29:784-788.

- El-Menyar A, Rahil A, Dousa K, Ibrahim W, Ibrahim T, Khalifa R, Abdel Rahman MO. Low vitamin d and cardiovascular risk factors in males and females from a **sunny**, rich country. Open Cardiovasc Med J. 2012;6:76-80.

- Ramason R, Selvaganapathi N, Ismail NH, Wong WC, Rajamoney GN, Chong MS. Prevalence of vitamin d deficiency in patients with hip fracture seen in an orthogeriatric service in **sunny** Singapore. Geriatr Orthop Surg Rehabil. 2014;5:82-86.

Postulate

- The human species was designed to obtain the majority of its vitamin D from sun-exposure – not from the diet.

- While most populations averted overt rickets, It is probable that marginal and insufficient vitamin D status has been the norm throughout human evolution.

- Since life expectancy was only about 35 years until the 20th Century, humans tolerated the consequences of vitamin D deficiency for three decades and escaped the consequences for later life. [There was very little “later life”]

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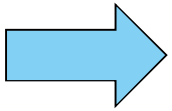
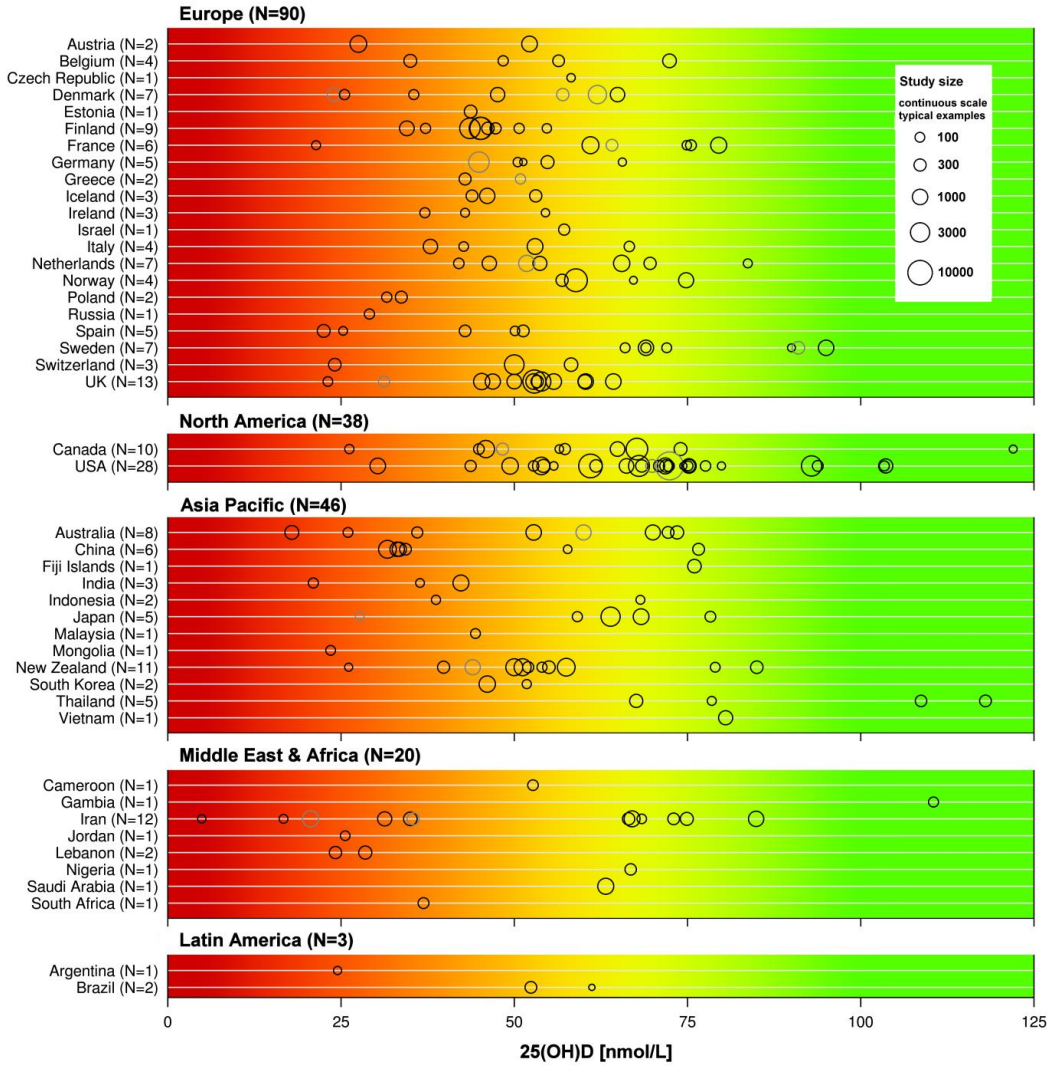
A systematic review of vitamin D status in populations worldwide

Mean 25(OH)D levels:

- Ø 6.7% below 25 nmol/l
- Ø 37.3% below 50 nmol/l
- Ø 88.1% below 75 nmo/l

Reference:
J. Hilger, Angelika, F. Raphael Herr, T. Rausch, F. Roos, D.A. Wahl, D.D. Pierroz, P. Weber, K. Hoffmann, BJN 2013





Actions derived from these findings

- Promote a wider understanding of the essentiality and newly-appreciated functions of vitamin D.
- Promote a wider understanding of the role of vitamin D in disease prevention.
- Eliminate the MYTH of vitamin D sufficiency because a country is sunny and tropical
- Establish evidence, preferably through representative national sampling, of the prevalence of insufficient and deficient vitamin D status in all countries – sunny or gray.

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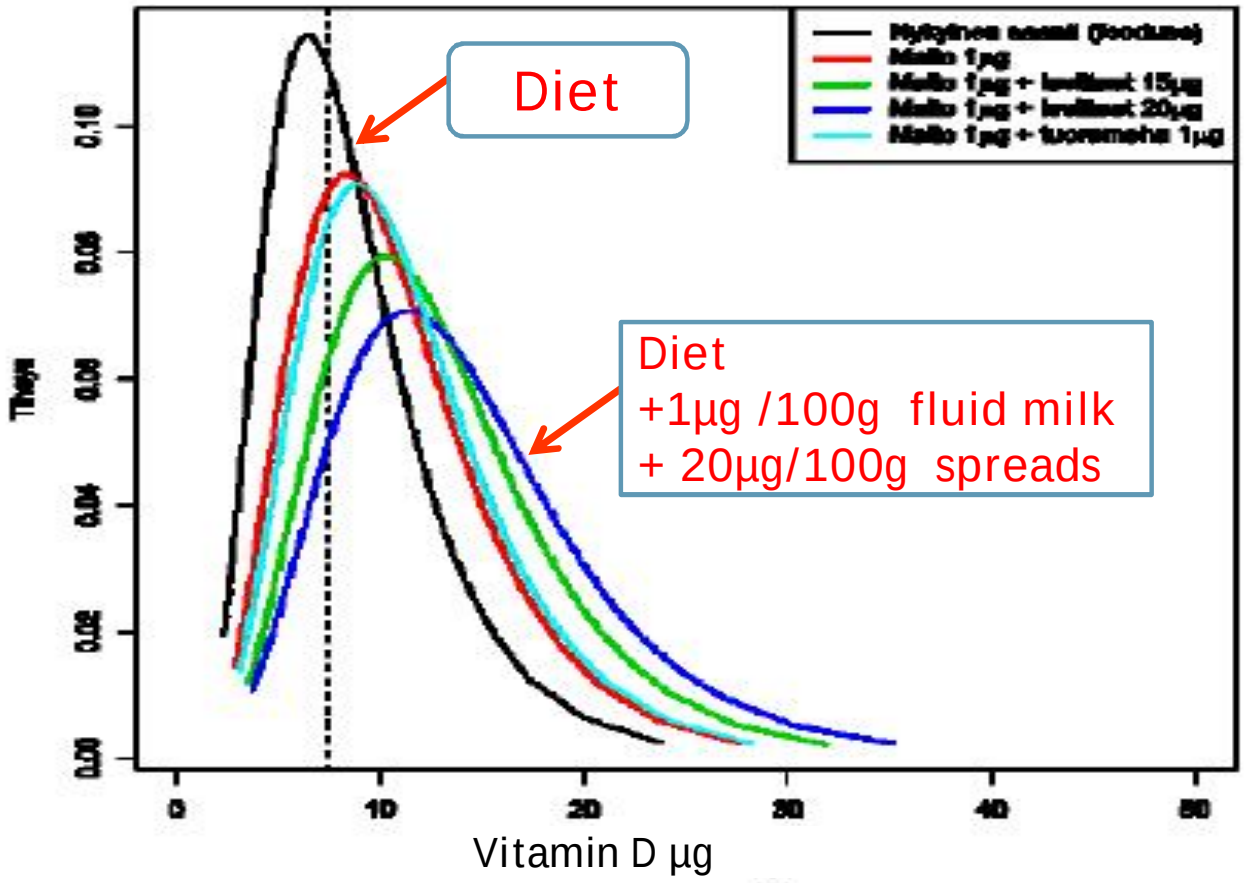
Finland acted and implemented milk fortification

Simulation of Vitamin D intake via the different carriers



Source: THL, Helsinki, 2009

Vitamin D status in Finish population after implementation of fortification

Mean	75.9
SD	22.2
Median	74.0
% <25 nmol/L	0.1
% <50 nmol/L	8.9
% <75 nmol/L	51.6

Finland may act as a role model for a successful implementation of food fortification with vitamin D3

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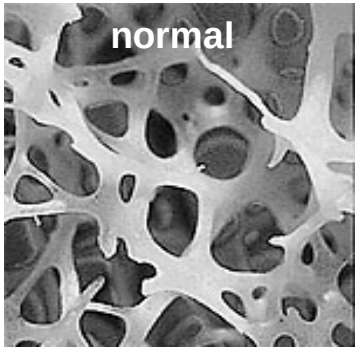
Vitamin D: the inadequate status impacts a number of body functions

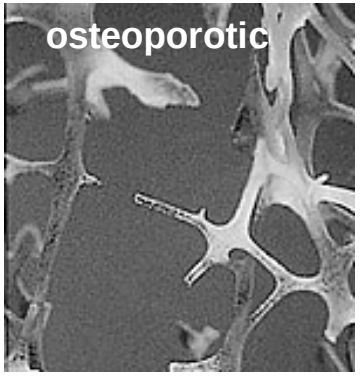
Classical role of vitamin D: bone health

- Improves bone mineral density through calcium absorption and deposition
- Necessary to prevent rickets & osteomalacia



Emerging health benefits of vitamin D

• Muscle	- Reduces risk of falling by improving muscle strength
• Immunity	- Strengthens the immune system
	- Reduces risk of multiple sclerosis and diabetes type I and II
• Cardiovascular	- Lowers blood pressure
• Cancer	- Inhibits cell proliferation



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One in three women and one in five men over the age of 50 years will sustain an osteoporotic fracture

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In women, the incidence of fractures is higher than the total incidence of cancer, heart infarction, stroke or diabetes

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Germany: Health care cost impact of low vitamin D status

Hip and vertebral fractures have the most „cost-intense“ medical implications

- Number osteoporosis patients: 8-10 mio (2010)*
- Number of hip and vertebral fractures p.a.: 150.000*

Optimized vitamin-D status reduces number of fractures by 20 %

- Reduction of 5.478 hip fractures and 18.420 less vertebral fractures (in osteoporosis-diagnosed population)

Net socio-economic benefit ranges from* : → 585 mio €

Including medical and therapeutic costs for prevention, treatment and supplementation costs vitamin D up to → 778 mio €

Including societal perspective, e.g. family care, reha costs

Costs of vit D supplementation for women > 55 with low vit D status: 180 -200 mio EUR

Source: * Sproll 2011

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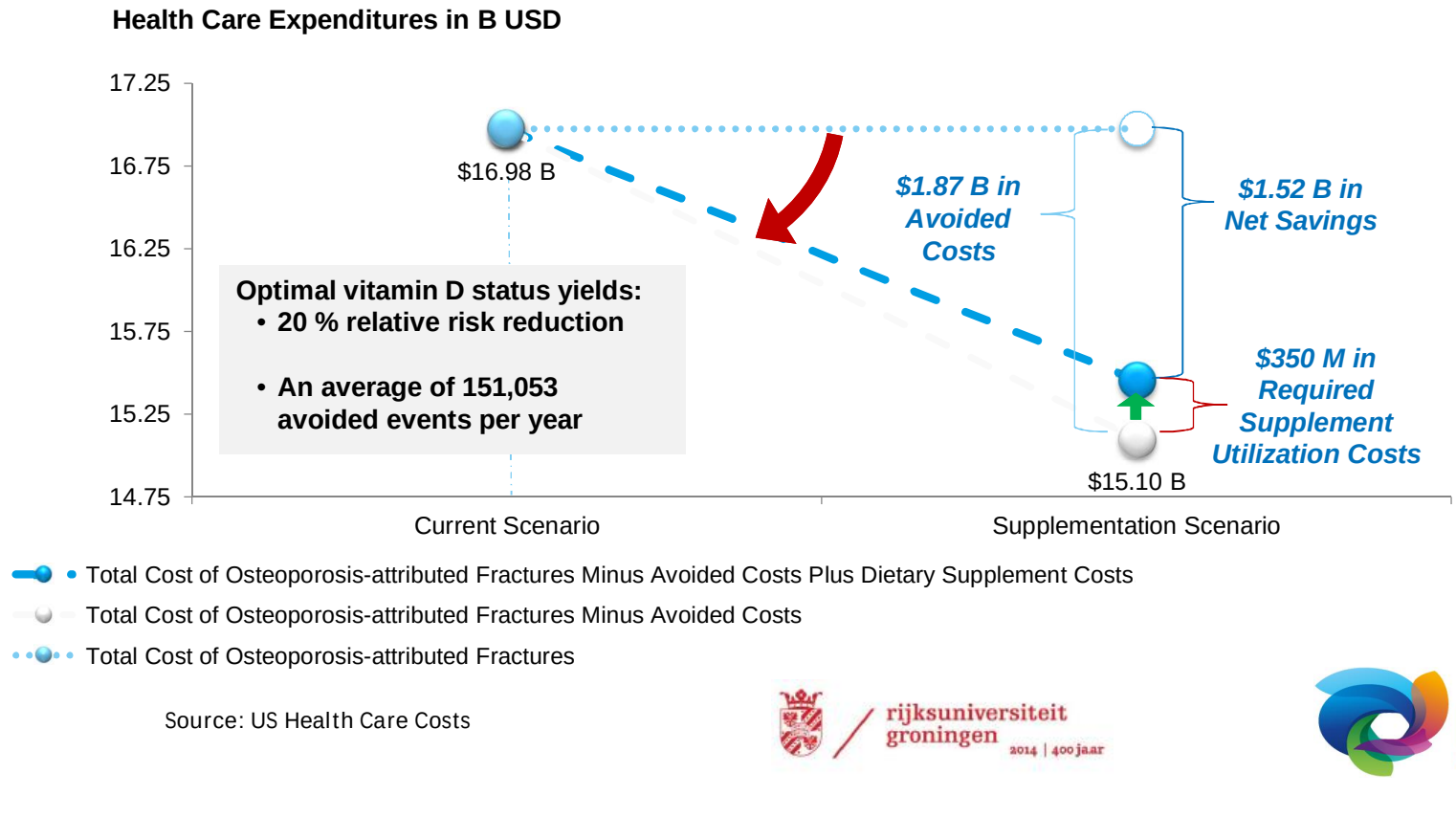
US: Potential cost savings by vitamin D supplementation

By vitamin D supplementation among all women over 55 years with osteoporosis, up to USD 1.5 billion savings per year could be realized.



Source: US Health Care Costs

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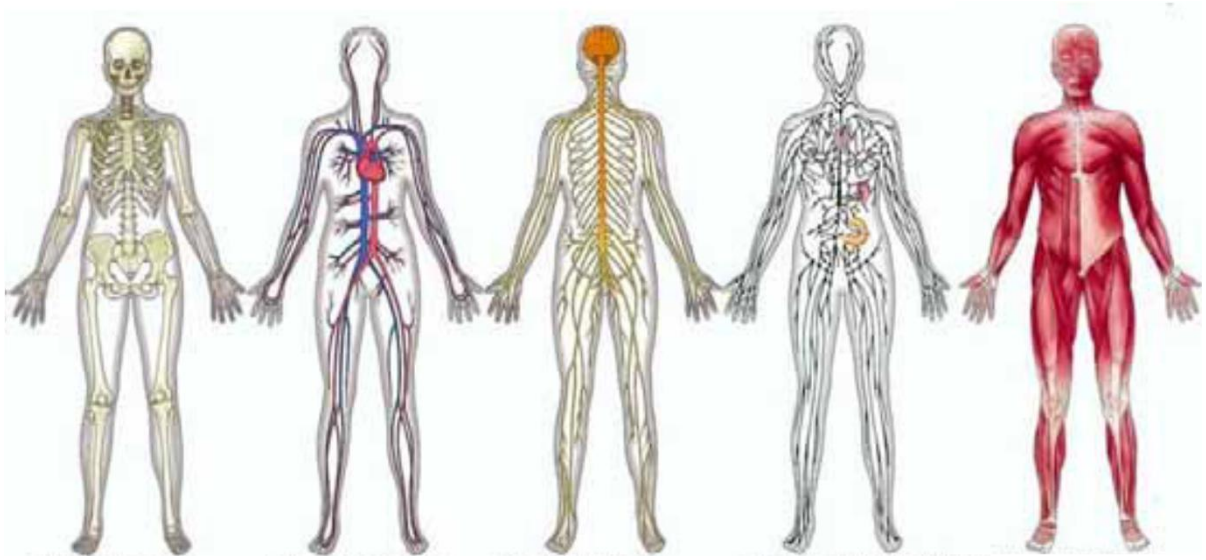
Magnitude of vitamin D considering additional health benefits



Risk reduction by optimal vitamin status:

Bone fractures	Cardio Vascular Diseases	Multiple Sclerosis	Diabetes	Cancer and others
20 %	20 %	50%	25%	25 %

Source: Grant et al 2009

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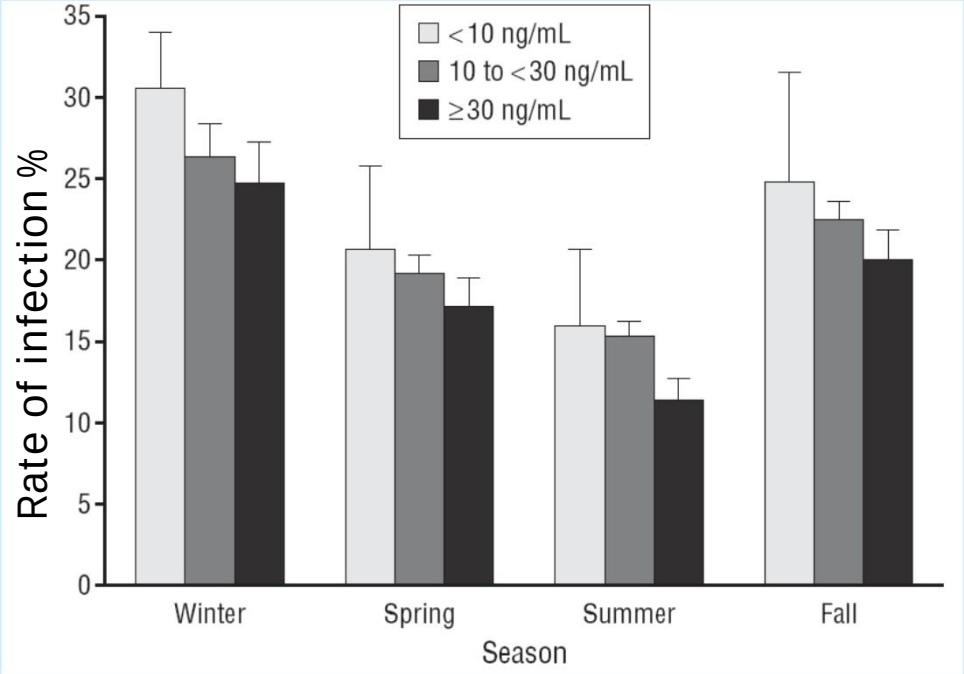
Vitamin D reduces risk for respiratory tract infections

Upper respiratory tract infections (URTI; %) in 18,883 subjects according to 25(OH)D levels (ng/mL)



§ Strong inverse association between URTI and 25(OH)D levels

§ Subjects with 25(OH)D below 75nmol/L show significantly higher risk for URTI

Conversion: ng/ml x 2.49 = nmol/l

Source: Ginde, Arch Intern Med 2009

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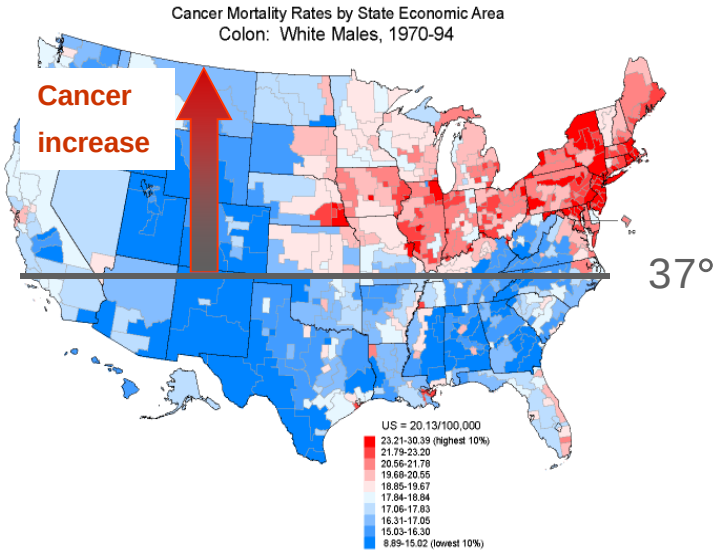
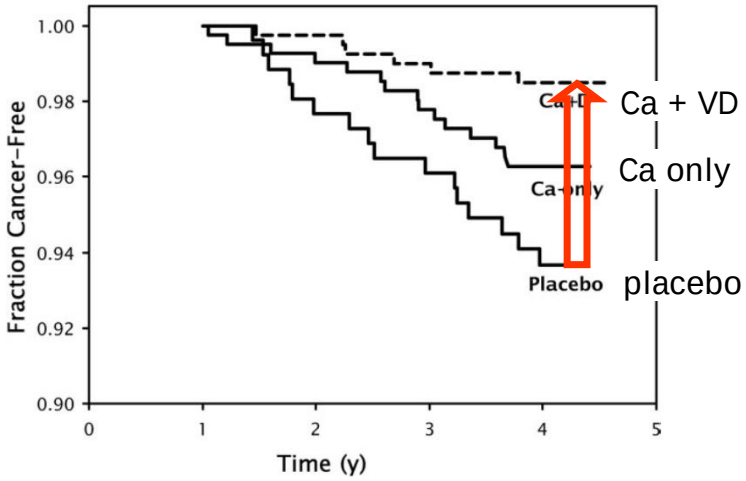
Vitamin D has an effect on cancer risk

US colon cancer geography
Sorenson, 2006



Increased cancer incidence towards North

Prevalence of all cancers in post-menopausal women given 1100 IU Vit D day
Lappe, AJCN 2007



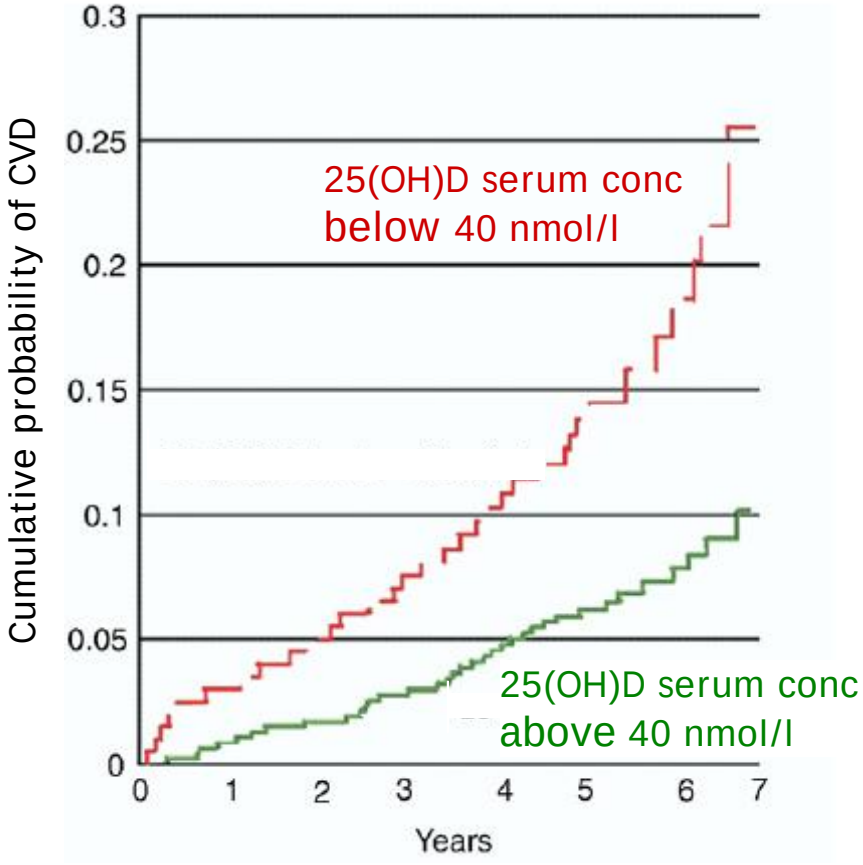
Survival after 4 years of vitamin D and Ca supplementation is significantly higher than placebo group

Consistent evidence for inverse association 25(OH)D and colorectal cancer

WHO-IARC 2008 report 'Vitamin D and Cancer'

Vitamin D status is related to risk reduction for CVD

Mean age 55 years at study



Wang, 2008

- Inverse association between 25(OH)D levels and CVD
- higher 25(OH)D levels are associated with lower risk of CVD

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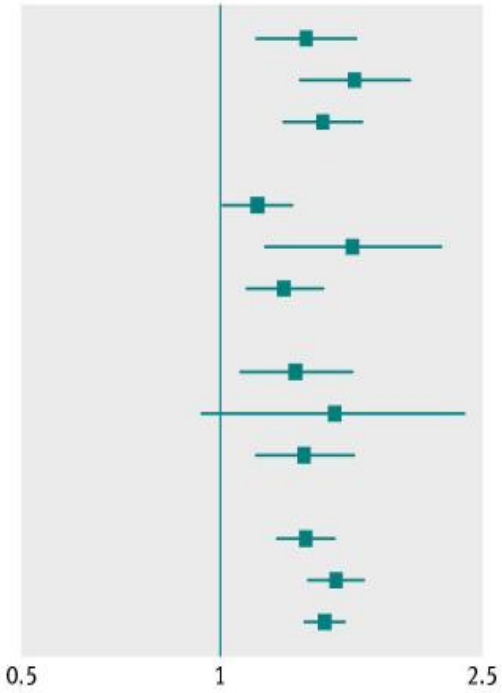
Vitamin D and risk of cause specific death: systematic review and meta-analysis of observational cohort and randomised intervention studies

	No of studies	No of participants	No of deaths	Relative risk (95% CI)* for cause specific mortality
Cardiovascular death				
Primary prevention cohorts	19	80 662	6416	1.35 (1.13 to 1.61)
Secondary prevention cohorts	10	20 987	3787	1.60 (1.32 to 1.94)
All cohorts	29	101 649	10 203	1.43 (1.25 to 1.64)
Cancer death				
Primary prevention cohorts	12	104 353	5003	1.14 (1.01 to 1.29)
Secondary prevention cohorts	5	16 382	1617	1.59 (1.17 to 2.16)
All cohorts	17	120 735	6620	1.25 (1.10 to 1.43)
Non-cardiovascular, non-cancer death				
Primary prevention cohorts	7	38 526	1444	1.30 (1.07 to 1.59)
Secondary prevention cohorts	3	13 035	1121	1.49 (0.94 to 2.35)
All cohorts	10	51 561	2565	1.34 (1.13 to 1.60)
All cause mortality				
Primary prevention cohorts	27	780 990	48 488	1.35 (1.22 to 1.49)
Secondary prevention cohorts	41	59 918	16 148	1.50 (1.36 to 1.65)
All cohorts	68	840 908	64 636	1.44 (1.34 to 1.55)



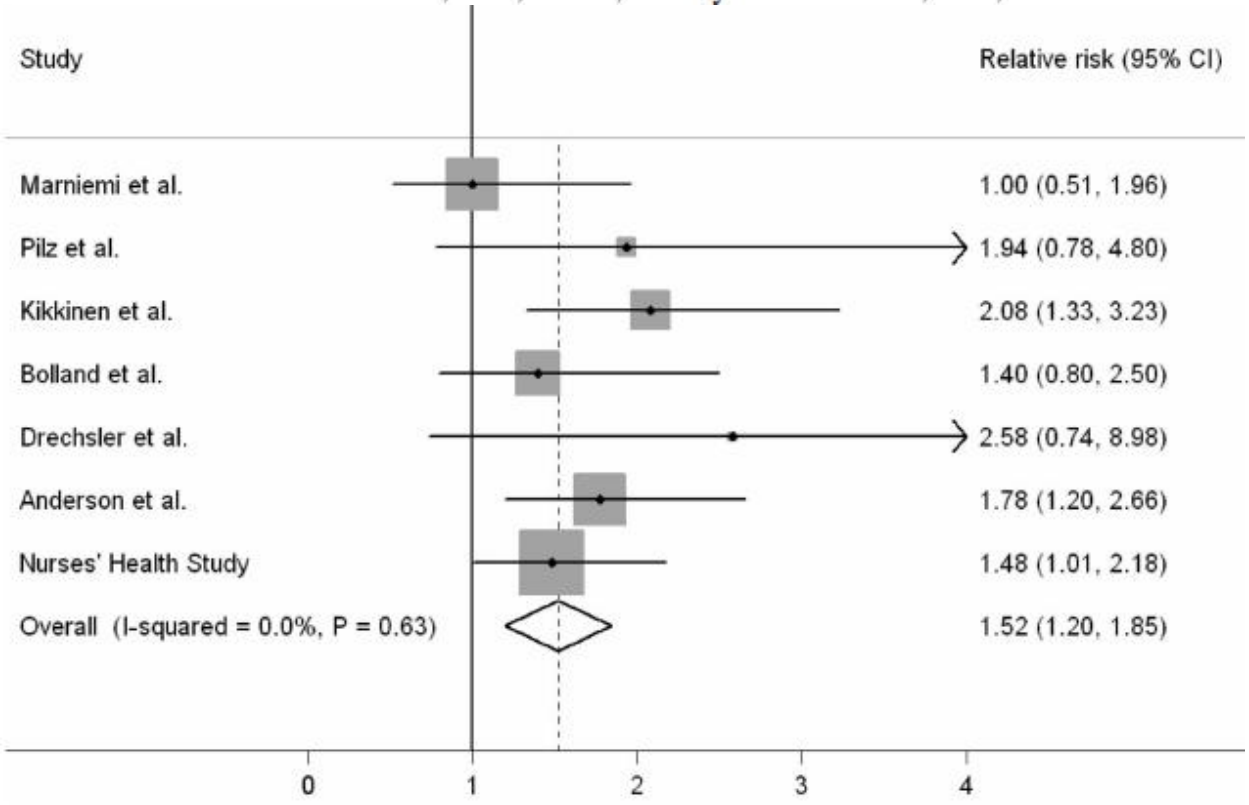
73 cohort studies and 22 randomized trials show benefit of 25OH-D in reducing risk for CVD, cancer and all-cause mortality

Chowdhury R, et al. *BMJ* 2014;348:g1903

25-Hydroxyvitamin D Levels and the Risk of Stroke

A Prospective Study and Meta-analysis

Qi Sun, MD, ScD; An Pan, PhD; Frank B. Hu, MD, PhD;
JoAnn E. Manson, MD, DrPH; Kathryn M. Rexrode, MD, MPH



Stroke. 2012;43:1470-1477.

Low vitamin D levels are associated with risk of stroke
RR 1.52

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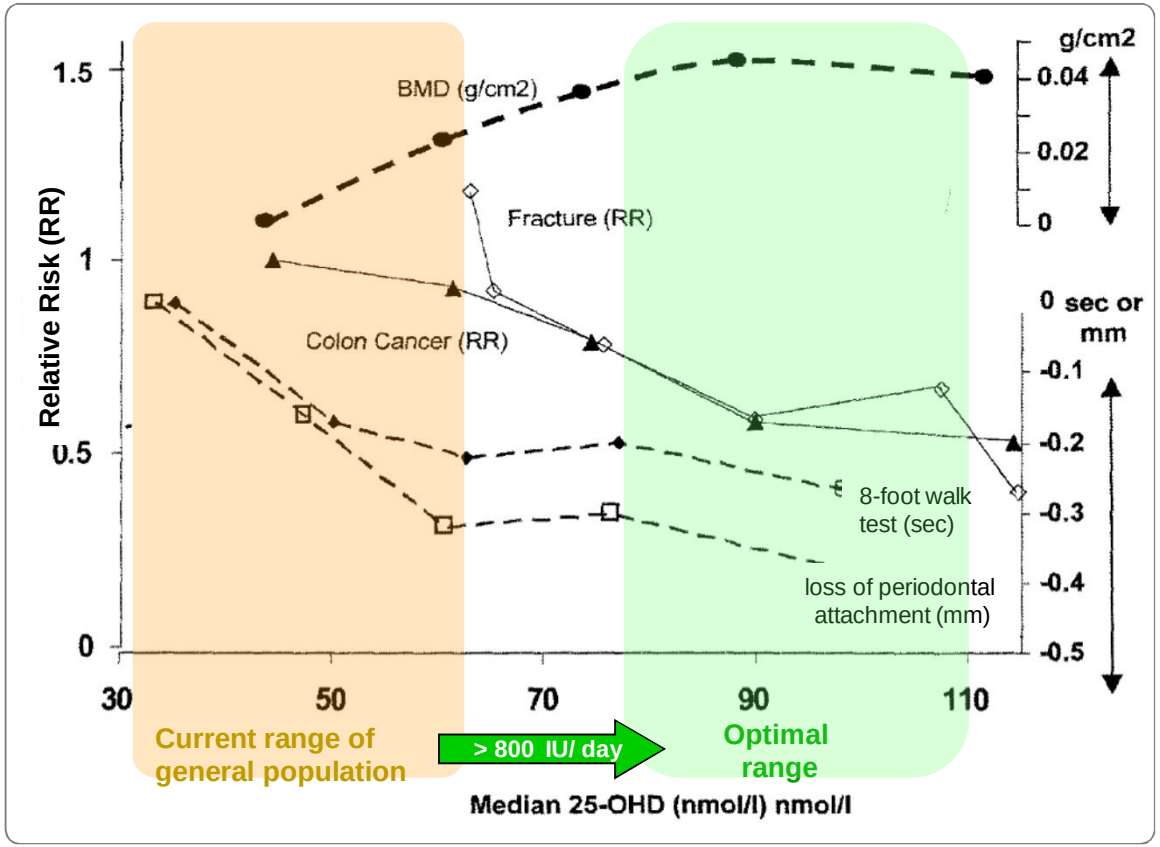
Vitamin D status important for various health outcomes



Optimum plasma level is above 75nmol/L

Daily intake of 800 IU (20mcg) will bring 50% of population up to 80nmol/L

Adapted from Bischoff-Ferrari: Optimal Serum 25-Hydroxyvitamin D levels for multiple health outcomes

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A number of professional and national health organizations advocate for optimal recommendations

EFSA has evaluated the strength of evidence for health benefits of vitamin D: Positive Scientific Opinions

Calcium and Vitamin D

- "…are needed for the maintenance of normal bone."

Childrens' Growth & Development

- "…Vitamin D is needed for normal growth and development of bone in children."
- "…Calcium and vitamin D are needed for normal growth and development of bone in children ."

Disease Risk Reduction

- "…Calcium and vitamin D may reduce the loss of bone mineral density in post-menopausal women. Low bone mineral density is a risk factor in the development of osteoporotic fractures."
- "…Vitamin D may reduce the risk of falling. Falling is a risk factor for bone fractures."

POSITIVE EFSA EVALUATIONS (cause-effect relationship established)
http://www.efsa.europa.eu/EFSA/efsa_locale-1178620753812_1211902906579.htm
http://www.efsa.europa.eu/en/scdocs/scdoc/1759.htm

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Safety of vitamin D: The safe upper limit was raised to 4000 IU/day

10,000-14,000 IU Vitamin D in 20 minutes

Benefit/Risk assessment based on clinical studies

2010 Institute of Medicine (IOM) recommendations

Safe upper intake 4000 IU / day

Bischoff-Ferrari HA, Shao A, Dawson-Hughes B, Giovannucci E, Willett WC ; Benefit-Risk Assessment of Vitamin D; OP International 2010

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A call to act

Communicate and advocate role of Vitamin D for health and well being

Install food fortification for the general population

Support supplementation for risk groups

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Large intervention studies are currently going on

NAME	PLACE	PARTICIPANTS	DOSE	MAIN OUTCOMES	CURRENT STATE	RESULTS EXPECTED
VITAL	U.S.	20,000, men: 50+ women: 55+	2000 IU D_3 daily	Cancer, Cardiovascular disease	Recruitment to finish end of 2012	2017
FIND	Finland	18,000 men: 60+, women: 65+	1600 IU D_3 daily or 3200 IU D_3 daily	Cancer, Cardiovascular disease, Diabetes	Recruitment started in spring, supplementation to start in autumn	2020
ViDA	New Zealand	5100, 50+	100,000 IU D_3 a month (200,000 IU in June)	Cardiovascular disease, Respiratory disease, Fractures	Recruitment to finish this year	2017
DOHealth	8 European cities	2150, 70+	2000 IU D_3 daily	Infections, Fractures, Blood pressure, Cognitive function, Lower extremity function	Recruiting	2017
VIDAL	U.K.	20,000, 65–84	60,000 IU monthly	Longevity and others	Planned 2-year feasibility study on 1600 patients is recruiting	2020 (if main study gets go-ahead)
DHEALTH	Australia	25000, 65-84	60,000 IU monthly	CVD, cancer, others	Recruiting	2021

Source 21 September 2012 VOL 337 Science

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Measuring status for individual feedback is the next step

- in-home vitamin D test kit
- convenient and easy to complete
- finger prick and a few drops of blood
- can be used in both adults and children
- spot card to be mailed using the return envelope
- results available online

www.vitamindcouncil.org

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Take care for yourself!

EVALUATE your personal Vitamin D status

ENRICH your diet with foods fortified in Vitamin D

ENHANCE your diet by a Vitamin D supplementation

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Who has health has hope,
who has hope has everything

Thank you!

manfred .eggersdorfer@dsm.com

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