

# Vitamin D: Is it really the next Super Nutrient?

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## Outline

- Background
- Dietary recommendations
- Food sources & typical intakes
- Effect of deficiency
- Summary research on health benefits
- A look into the future
- Implications to the dairy industry



## Recent Headlines

*Lack of vitamin D causes **weight gain** and stunts **growth** in girls*

*Men with vitamin D deficiency may have increased risk of **heart attack***

*Vitamin D a key player in overall health of several **body organs***

*Vitamin D deficiency is the cause of common **obesity***

*Vitamin D linked to **cognitive impairment** in older people*

*Vitamin D May Protect Against **Premenopausal Breast Cancer***

*Study links vitamin D to **colon cancer** survival*

*High Vitamin D Status May Protect Against **Type 2 Diabetes***

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## Background

Vit D is the only vitamin the human body makes itself in any significant amounts, with sufficient exposure to sunlight

Best known for its role in regulating blood calcium levels:

- Enhances calcium absorption
- Increases bone resorption
- Reduces urinary calcium excretion

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## Dietary Recommendations

In 1997, Adequate Intake (AI) levels were established by IOM assuming:

- No sunlight exposure
- Older people lose ability to synthesize vit D from sun & metabolize to its active form
- Adipose tissue may serve as irreversible 'sink' to vit D → obesity may impact requirements



## Dietary Recommendations

Age (yr)	IU/day
0-50	200
51-70	400
71+	600
Upper Level (UL)	2000

## AAP's recommendation: Revised Oct 2008

The American Academy of Pediatrics (AAP) released new guidelines on vitamin D for infants, children and adolescents

- 400 IU/day (doubled the IOM recommendation)
- Based on increasing incidence of rickets in U.S., maintaining immunity and preventing diabetes and cancer.
- For most children, this means a supplemental source of vit D is needed.

*Prevention of Rickets and Vitamin D Deficiency in Infants, Children, and Adolescents. Pediatrics 2008 122: 1142-1152.*

## Food Sources of Vitamin D

- Few food sources are naturally rich in vitamin D
- Naturally rich sources (fatty fish, organ meats) are not frequently consumed
- Natural concentrations vary by season, climate, production method
  - Farmed fish have lower levels than wild
  - Natural amounts in milk are higher in summer
- Fortified foods are the most common sources

## Vit D content of common food sources

	IU
Salmon, cooked (3.5 oz)	360
Sardines, canned (1.75 oz)	250
Tuna, canned (3 oz)	200
Fortified milk (1 cup)	100
Orange juice, fortified (1 cup)	100
Fortified soy beverage (1 cup)	100
Margarine, fortified (1 Tblsp)	60
Breakfast cereal, fortified (1 serving)	40
Egg (1 whole)	20

## Fortification Practices in USA

	<u>IU/serving</u>
Milk, fortified	100 - 150
Milk products	20*
Margarine	33*
Ca-fortified juice	100*
Breakfast cereals	100*
Grains, pastas	75*

\* Allowable levels; may vary in practice

## How much are people actually *consuming*?

Average intake from food: 160-240 IU/day

Intake from food

+ supplements: 220-380 IU/day

***These levels are inadequate for adults > 50 yr!***

## Vitamin D Deficiency

Deficiency results in:

- Rickets in children
- Osteomalacia & osteoporosis in adults
- Increased falls and fractures in elderly
- Leg muscle weakness



## Re-emergence of rickets as a public health concern

Up to 20% of 'healthy' children, and 30% of adolescents nationwide, are thought to be deficient in vit D.  
Considered an 'unrecognized epidemic.'

Caused by:

- Indoor (e.g. TV, internet, computer games) replacing outdoor activities
- Liberal use of sunscreen
- Urbanization
- Poor diets (e.g. sodas replacing milk)



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## Vitamin D Health Benefits: New Research

Prevention of:

- Cancer - breast, colon, endometrial & prostate
- Diabetes
- Heart disease
- High blood pressure
- Metabolic syndrome
- Multiple sclerosis
- Obesity
- Parkinson's disease
- Rheumatoid arthritis

Improved:

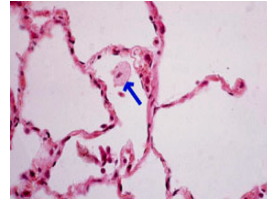
- Cognitive performance
- Dental health
- Immunity

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## Vitamin D and Immune Function

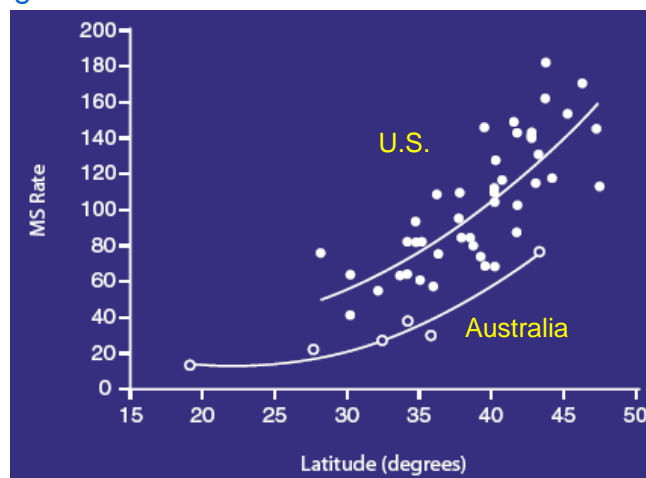
Observational studies correlate inadequate vitamin D status with increased risk of immune diseases:

- Multiple sclerosis
- Type I diabetes
- Rheumatoid arthritis
- Lupus
- Tuberculosis
- Pneumonia
- Bacterial infections of the lungs
- Gingivitis (gum disease)



Postulated mechanism: Inadequate vitamin D status may impair normal immune regulation

Multiple Sclerosis rates increase with distance from the equator, suggesting that populations with lower vit D levels are at higher risk



## Vitamin D and Cancer

Vitamin D insufficiency affects normal cell division and differentiation and may increase risk of cancer.

Universal vitamin D supplementation is estimated to reduce the occurrence of cancer by 30-50%.

4-yr, population-based, double-blind, RCT found improving calcium and vitamin D nutritional status substantially reduces all-cancer risk in postmenopausal women.

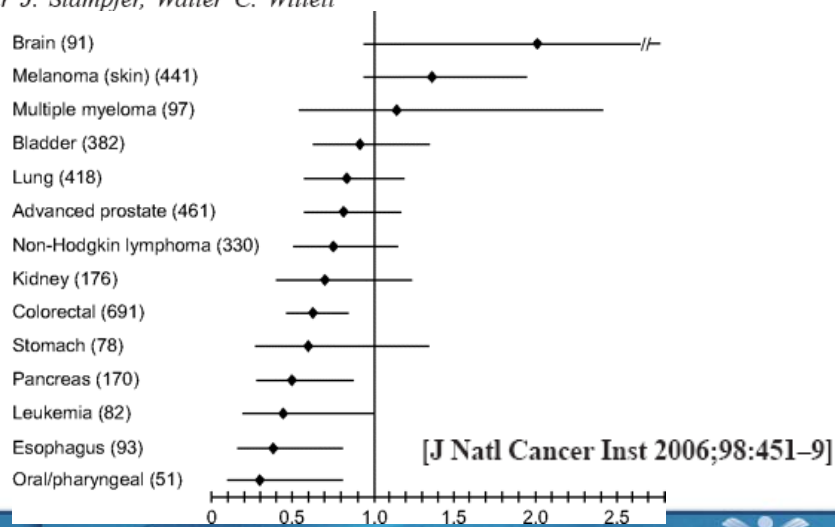
Health Professional Follow-Up Study (1986-2000) found those with better vitamin D status had lower risk of most types of cancer

*Am J Clin Nutr* 2007 Jun; 85(6): 1586-91

*J Natl Cancer Inst* 2006;48:451-9

## Prospective Study of Predictors of Vitamin D Status and Cancer Incidence and Mortality in Men

*Edward Giovannucci, Yan Liu, Eric B. Rimm, Bruce W. Hollis, Charles S. Fuchs, Meir J. Stampfer, Walter C. Willett*



## Vitamin D and Colorectal Cancer

- Higher intakes of vitamin D, calcium and dairy products have been correlated in various studies to lower rates of colorectal cancer
- 1000-2000 IU of vitamin D, obtained from supplements, sunlight exposure, or the diet, is estimated to cut the risk of colon cancer in half.

*Park SY, Murphy SP, et al, Am J Epidemiol, 2007; 165(7): 784-93.*

*Gorham et al. American Journal Preventive Medicine 32: 210-16, 2007*

## Vitamin D and Breast Cancer

**Calcium and vitamin D intakes, and blood levels of vit D, are associated with lower risk of premenopausal breast cancer.**

**Reduced breast cancer risks were associated with increasing sun exposure from ages 10 to 19, cod liver oil use and increasing milk consumption.**

*Lin et al. Arch Intern Med 2007;167:1050-1059*

*Cancer Epid Biomark Prev 2007; 16(3): 422-429*

## Vitamin D and Breast Cancer (cont)

**A recent meta-analysis found a trend toward a lower incidence of breast cancer with vit D intakes >400 IU/day.**

**But, a clinical trial found that calcium and vitamin D supplementation did *not* reduce invasive breast cancer incidence in postmenopausal women.**

*J Steroid Biochem Mol Biol. 2008 Sep;111(3-5):195-9*  
*J Natl Cancer Inst. 2008 Nov 19;100(22):1581-91.*

## Vitamin D and Prostate Cancer

- Various observational studies have shown a relationship between higher D status and lower risk of prostate cancer.
- However, a recent large prospective study do *not* support the hypothesis that vitamin D is associated with decreased risk of prostate cancer, and higher circulating 25(OH)D concentrations may be associated with *increased* risk of aggressive disease.

*J Natl Cancer Inst. 2008 Jun 4;100(11):796-804.*

## Vitamin D and Diabetes

Observational studies show low vitamin D status, calcium or dairy intake is associated with increased risk of type 2 diabetes

- People with highest blood levels of D had 64% lower risk of diabetes
- Daily intake of >1,200 mg calcium and >800 IU vitamin D was associated with a 33% lower risk of type 2 diabetes.

*Pittas AG, et al. J Clin Endocrinol Metab. 2007  
Diabetes Care. 2006 Mar;29(3):650-6.*

## Dairy and Metabolic Syndrome

Metabolic syndrome (MetS): cluster of risk factors putting one at higher risk of heart disease (obesity, abnormal blood lipids, high blood pressure)

- Data suggest an inverse association of serum vit D with MetS, independent of potential confounding factors.
- Men with highest dairy intakes had 54% lower risk of MetS compared to those with lowest intakes
- Those who drank at least 2 cups of milk per day had 62% lower risk.

*Eur J Endocrinol. 2008 Jul; 159(1): 41-8.  
J Epidemiol Community Health. 2007 Aug; 61(8): 695-8.*

## Vitamin D and Cognitive Performance/Mood

In a cross-sectional study in Alzheimer's patients, vitamin D deficiency was found to be associated with:

- low mood
- poor cognitive performance
- greater dementia severity.

*Am J Geriatr Psychiatry. 2006; 14(12): 1032-1040*

## Summary: Health Benefits

- Vitamin D is well-known to be an important factor in prevention of rickets, osteomalacia and osteoporosis.
- Emerging research is building for vit D's role in strengthening the immune system, including autoimmune diseases such as multiple sclerosis, type 1 diabetes, tuberculosis and rheumatoid arthritis.
- Emerging observational evidence suggests vitamin D may play a role in reducing risk of diabetes and MetS.
- A multitude of studies show that vitamin D may play a role in the prevention of colon, prostate, and breast cancers.
- Evidence for these roles comes primarily from in vitro, animal, and epidemiological studies. Randomized clinical trials need to be conducted to confirm these findings.

## What does the future hold for vitamin D?

- Dietary recommendations are likely to increase
- Sun exposure recommendations are being liberalized
- Food supply will offer more options for fortified foods
- Consumers will be increasingly aware of vitamin D's various health benefits, sources and their own personal status
  - Will be on the look-out for vit D-fortified foods
  - may try to improve status through supplementation

## Future Vitamin D Recommendations

In Jan 2009, the Institute of Medicine (IOM) announced the next vitamin D Food and Nutrition Board (FNB) Committee.

- will set recommendations for both adequate intake and upper limits that will extend into the next decade.

## Why Revise Vitamin D Recommendations?

### Over last 10 years studies indicate:

- Current AIs are not adequate to reap full benefits of vit D; they were based on deficiency prevention, not optimal health
- Intake level to reach optimum serum vit D level is higher than previously believed
- There are concerns about the reliability of sun exposure in different groups (e.g. African-Americans, urban children)
- New research is finding higher intakes are safe (up to 10,000 IU)

## Implications to the Dairy Industry: Opportunities

Vitamin D-fortified milks are currently one of the primary sources and easiest ways of achieving adequate intakes

Milk contains a wealth of other nutrients that may act synergistically with vitamin D (e.g. calcium)

There is potential to fortify other dairy products

Many yogurts are now fortified with D

Cheese is being investigated as a fortification vehicle

Fortifying across the product line would solidify the perception of dairy as a good source of vit D

*→ Want to be able to say “3-A-Day” for vit D as well as calcium*

## Opportunities to the Dairy Industry

- In Oct 2008, FDA amended its osteoporosis health claim to reflect the importance of vitamin D, in combination with calcium, in promoting long-term bone health.
- The rule will allow reduced fat, lowfat and fat-free milk and other eligible dairy products to display a health claim that states, "Adequate calcium and vitamin D throughout life, as part of a well-balanced diet, may reduce the risk of osteoporosis" or "may build and maintain good bone health."
- Foods must supply at least 200 mg of calcium and 80 IU of vitamin D to qualify for the new claim
  - Products containing high levels of fat, saturated fat, sodium or cholesterol are disqualified.

## Implications to the Dairy Industry: Vulnerabilities

- Vitamin D levels in milk can be variable
  - Assays for dairy products may not be reliable, leading to results showing inconsistent levels in dairy products.
- *Levels in milk/dairy products need to be standardized to maintain the perception that these are a consistent and excellent source of vitamin D.*



## Implications to the Dairy Industry: Vulnerabilities

- Competition from other vitamin D-fortified products
- Consumers will increasingly look to other sources of vitamin D, including fortified products and supplements.



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## Food supply will offer more Vit D-fortified products

Food additive provisions for direct addition of vit D permit its use in:

- Milk & milk products
- Cheese and cheese products
- Calcium-fortified fruit juice
- Soy beverages
- Infant formula
- Margarine
- Meal replacement bars
- Breakfast cereals
- Pasta and grain products

*Note: Vit D is not permitted to be added to ice cream, sherbet, water ice or frozen desserts.*

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