

## Vitamin D: How much, how often and what formulation to prevent and treat vitamin D deficiency?

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## Conflicts of Interest

- None
- A conflict of interest exists when an individual is in a position to profit directly or indirectly through application of authority, influence, or knowledge in relation to the affairs of PENS. A conflict of interest also exists if a relative benefits or when the organization is adversely affected in any way.

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## Objectives

- To discuss:
  - Importance of vitamin D
  - Incidence and risk factors for vitamin D deficiency
  - Interventions and outcomes
    - 3 case studies

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## Importance of Vitamin D

- Necessary for the formation and maintenance of healthy bones and teeth as it helps the body absorb calcium and phosphorous.
- If deficient
  - Can have a decrease in BMD
  - Reduced peak bone mass
  - Skeletal deformities in young children (rickets)
  - Increase risk of fracture
  - Aches and pains in bones and muscle
  - Muscle weakness

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## Importance of Vitamin D

- New studies showing Vitamin D is involved in regulation of cell growth, immunity and cell metabolism.
- If deficient has been linked to
  - Osteoporosis
  - Autoimmune diseases (RA, MS, IBD, diabetes)
  - Disturbed muscle function
  - Some types of cancer
  - Cardiovascular disease

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## Definition of Vitamin D Deficiency (Canadian Pediatric Society, Jan.2015)

25(OH)D level	ng/mL	nmol/L	Calgary, Alberta nmol/L
Deficient	<10	<25	<25
Insufficient	10-30	25-75	25-80
Optimal	30-90	75-225	80-200
Pharmacological (potential adverse effects)	>90	>225	
Potentially toxic	>200	>500	>250

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**Risk Factors for Vitamin D Deficiency**

- Dark-coloured skin or the elderly - less efficient at making vitamin D from the sun.
- Limited sun exposure - from being indoors or reducing exposure with clothing or sunscreen. (Sunscreen with a protection factor of 30 reduces vitamin D synthesis in the skin by more than 95%).
- Breast fed babies, especially if Mom is vitamin D deficient.

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**Risk Factors for Vitamin D Deficiency**

- Over weight - fat cells hold on to the vitamin and alter its release into the bloodstream.
- Medical conditions that reduces the intestinal tract's ability to absorb dietary fat and fat-soluble vitamins – liver and GI conditions can be associated with fat malabsorption.
- Certain medications such as anticonvulsants, glucocorticoids and antifungals – interfere with absorption.

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**Incidence of Vitamin D Deficiency**

- Statistics Canada conducted a Canadian Health Measures Survey on 3-79 year olds from August 2009 to November 2011
- Approximately 32% of Canadians had Vitamin D levels below 50 nmol/L - a level well below the optimal range of 75-225 nmol/L.

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## Incidence of Vitamin D Deficiency

- Studies Reported in 2004 - 2005 described more than 50% of Hispanic and African-American adolescents in Boston and 48% of white preadolescent girls in Maine had vitamin D levels less than 50 nmol/L (20 ng/ml).

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## Vitamin D Intake Guidelines Health Canada - March 2013

Age group	Recommended Dietary Allowance per day	Tolerable Upper Intake Level per day
Infants 0-6 months	400 IU (10 mcg)	1000 IU (25 mcg)
Infants 7-12 months	400 IU (10 mcg)	1500 IU (38 mcg)
Children 1-3 years	600 IU (15 mcg)	2500 IU (63 mcg)
Children 4-8 years	600 IU (15 mcg)	3000 IU (75 mcg)
Children and Adults 9-70 years	600 IU (15 mcg)	4000 IU (100 mcg)
Adults > 70 years	800 IU (20 mcg)	4000 IU (100 mcg)

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## Sources of Vitamin D

1. Sun
2. Dietary intake
3. Supplementations

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**Sources of Vitamin D**

**1. Sun exposure**

- Vitamin D is unique because it can be made by the body through exposure to sunlight while most vitamins need to be ingested.
- The body's ability to produce vitamin D is affected by factors such as latitude (distance from the sun), season, time of day, cloud cover, smog, clothing coverage, and sunscreen use.

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**Sources of Vitamin D**

**1. Sun exposure**

- Skin pigmentation is also linked to vitamin D levels. Melanin in the skin acts as a natural sunscreen. Those with darker skin pigment have more difficulty producing vitamin D from the sun.
- The body's ability to produce vitamin D from the sun also declines with age. A person aged 70 makes, on average, 25% of the vitamin D that a 20-year-old makes when exposed to the same amount of sunlight.

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**Sources of Vitamin D**

**2. Dietary intake – the main source is fortified foods.**

Adding vitamin D to cow's milk and margarine is mandatory in Canada and USA. It is also added to some foods such as: goat's milk, fortified plant-based beverages (such as fortified soy beverages), some yogurts, cheeses, cereals and calcium-fortified orange juice.

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## Sources of Vitamin D

### 3. Supplementation

- Oral
  - Many products including tablets, drops, chews, and gel caps of varying strengths. Most common are 400 IU and 1000 IU but can go up to 50,000 IU per portion.
  - Given daily to every 12 months
  
- Injection
  - Sterogyl IM injection
  - Given every 3-4 months

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### Case Study 1 (DOB - Mar 2003)

(Calgary optimal levels 80-200 nmol/L)

Date	Vitamin D level	Treatment (oral doses)	Comments
Oct 2007	50.8	1000 IU daily	Dark skin, decreased exposure to sun, decreased milk intake
Mar 2010	29.0		Non adherence
Jan 2011	36.6		Non adherence
Nov 2011	32.4		Non adherence
Jun 2012	71.0		Non adherence
Oct 2012	54.0	150,000 IU x once and continue 1000 IU daily	Given by nurse Home doses not given
May 2013	36.0	150,000 IU every 3 months	Given by pharmacist
July 2014	102.0		
Dec 2014	93.7	250,000 IU every 3 months	Given by pharmacist
Oct 2015	142.0		

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### Case Study 2 (DOB - Dec 1999)

(Calgary optimal levels 80-200 nmol/L)

Date	Vitamin D level	Treatment (oral doses)	Comments
Jan 2012	49.0	2000 IU daily	Dark skin, no dairy intake, little sun exposure
Jun 2012	45.7		Not in Calgary
Sep 2014	10.1		Not in Calgary
Jan 2015	26.6	50,000 IU weekly x 6	Never did follow up labs. No further Vit D taken
Jul 2015	33.4	500,000 IU in clinic + 20,000 IU weekly at home	Non adherent
Nov 2015		50,000 IU caps x 5 + 21,000 IU weekly	Non adherent
Mar 2016	41.9	3200 IU daily (8 gummies)	

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### Case Study 3 (DOB - Jun 2013) (Calgary optimal levels 80-200 nmol/L)

Date	Vitamin D level	Treatment (injection)	Comments
Feb 2014	10.5	300,000 IU IM	Liver failure with fat soluble vitamin deficiency
Apr 2014	153.0	(2000 IU daily oral doses)	
Aug 2014	57.9	300,000 IU IM every 3-4 months	Stop oral doses
Sep 2014	104.0		
Dec 2014	75.1		
Aug 2015	106.0		
Dec 2015	144.0	150,000 IU IM every 3 months	

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### Summary

- Vitamin D deficiency is prevalent in Canada and USA.
- There are many options for vitamin D supplementation, however adherence can be an issue. The challenge is finding a formulation and dosing schedule that lessens non adherence. (One described option - an annual oral dose of 150,000 IU).
- Minimum and maximum recommended doses for vitamin D supplementation have a wide range. Monitoring of serum vitamin D levels is required to determine response and individual dose adjustment.

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### Thank you!

- Questions and Comments?

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