



# Vitamin D- The Sunshine Vitamin

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# Outline

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- Background information
- Sources of vitamin D
- Factors influencing vitamin D
- Functions of vitamin D
- Vitamin D & health outcomes
- Vitamin D requirements
- Vitamin D status assessment
- Vitamin D deficiency

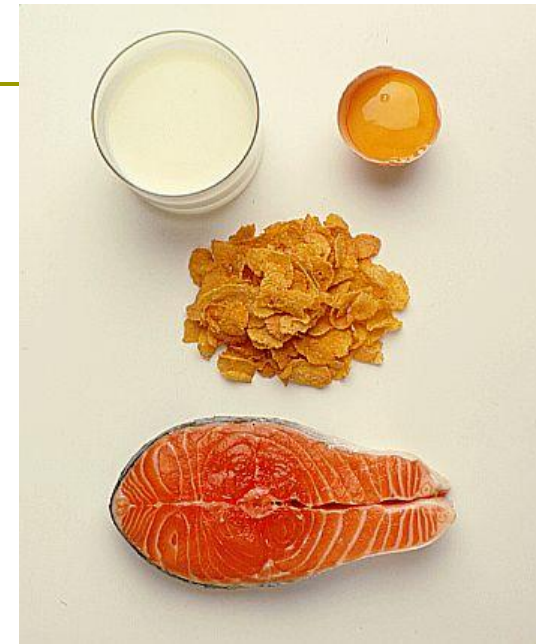
# Forms of Vitamin D

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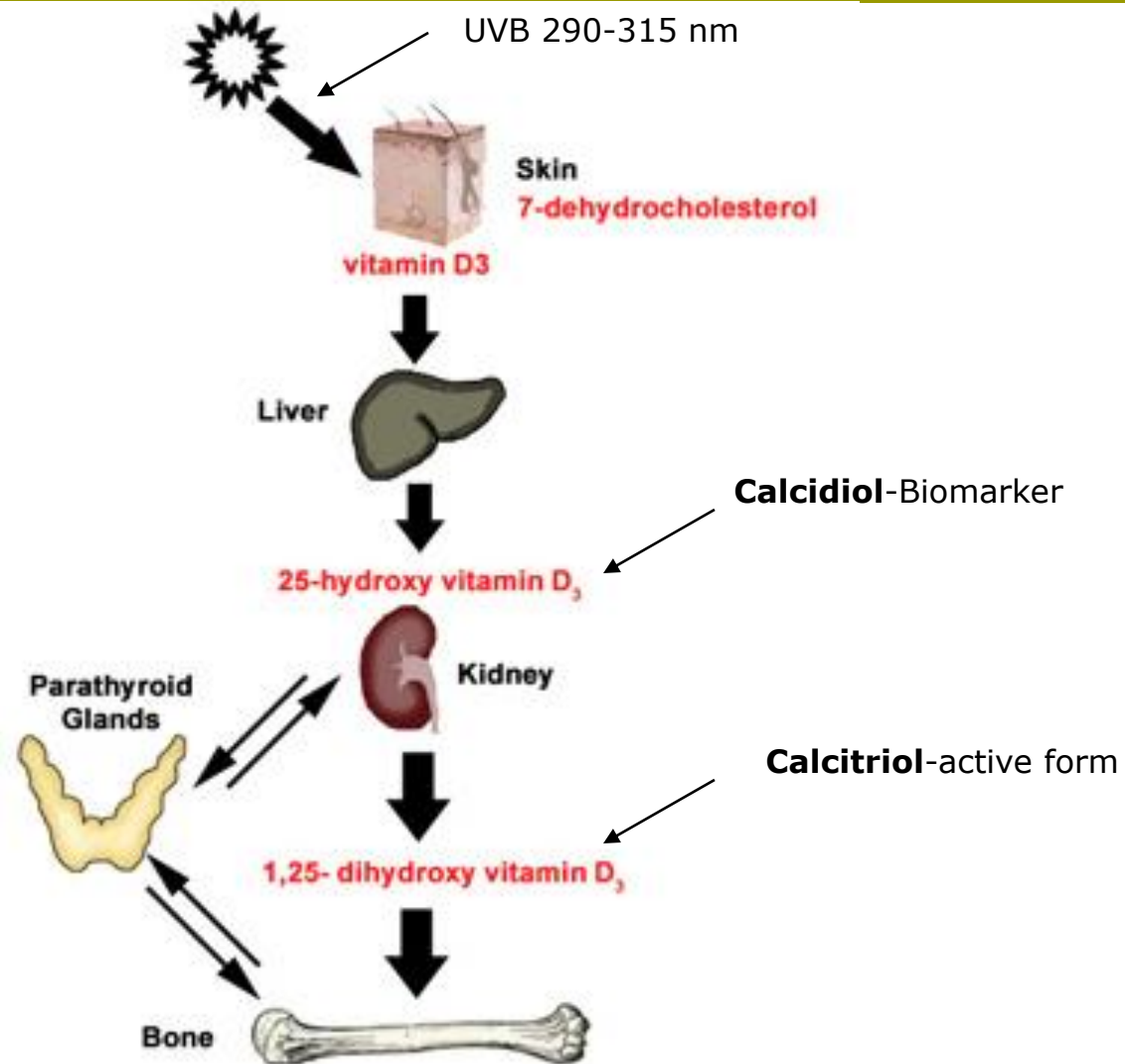
- A prohormone
- A group of chemically related compounds
  - Cholecalciferol (vitamin D3)
  - Ergocalciferol ( vitamin D2)
- D3 originates from 7-dehydrocholesterol in skin.
- Vitamin D2 is formed from irradiating yeast and plant ergosterol.

# Sources of Vitamin D

- ❑ Natural food sources (rare)
  - Salt water & oily fish
  - Egg yolk
  - Liver
  - Dairy Products
  
- ❑ Fortification- Milk products
  
- ❑ Endogenous Production



# Endogenous Production of Vitamin D

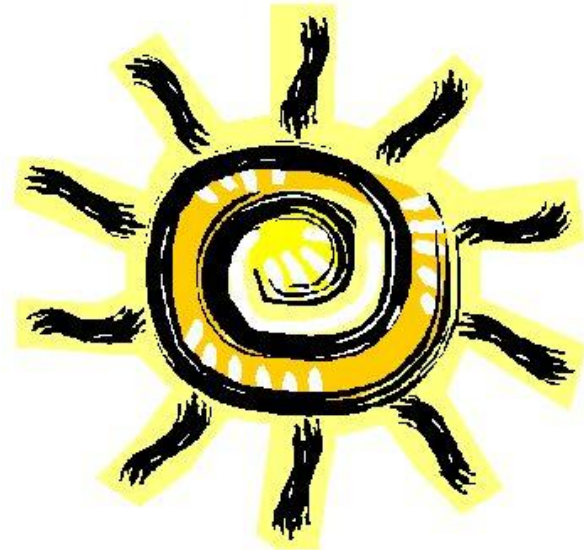


# Factors Influencing Vitamin D Synthesis

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Cutaneous synthesis of vitamin D is affected by

- Geographical latitude
- Season
- Atmospheric pollution
- Cloud cover of sun
- Time of day
- Skin pigmentation
- Clothing
- Sunscreen
- Age



# Functions of Vitamin D

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## □ Calcium homeostasis

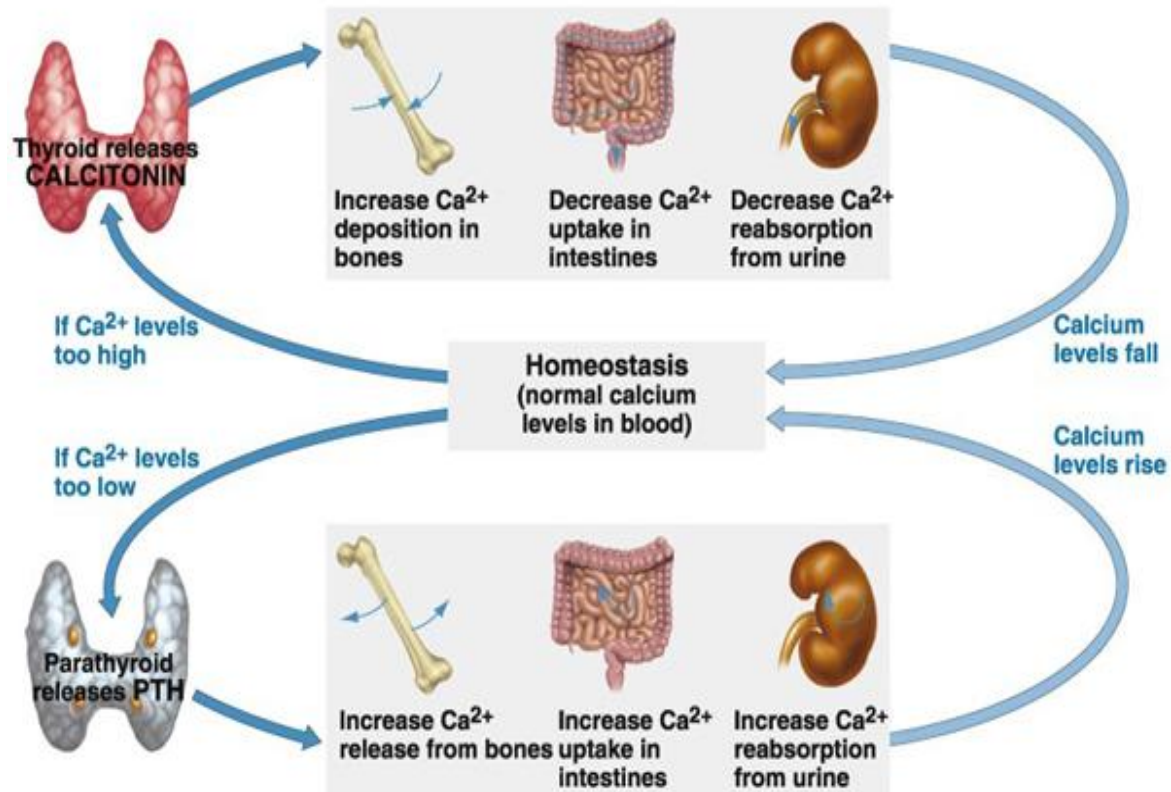
- Increase intestinal absorption (Calbindin-D9K, TRPV6)
- Promotes resorption by mobilizing bone calcium
- Reabsorption of calcium by renal tubules (Calbindin-D28K)

## □ Phosphorus balance

- ↑Alkaline phosphatase in small intestine
- Excretion by the kidney
- ↑ Hydrolytic enzymes in bone cell

# Vitamin D & Calcemic Role

Act as a hormone to maintain blood calcium levels at 8.5-10.5 mg/dl





# New Roles for Vitamin-D

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- ❑ Epi/experimental studies have found that low levels of 25(OH)D are associated with the risk of hypertension, CVDs, T2DM, cancers and other diseases
- ❑ VDR found in many organs-
- ❑ Many tissues have the capacity to make active Vit-D (powerful modulator of cell growth)

# Vitamin D & Non-Calceemic Role

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## □ Immune-related function

- Regulates immune system and prevents autoimmune disease (MS, RA, T1DM)
- Down-regulate production of inflammatory cytokines
- Production of antimicrobial peptides

## □ Insulin levels

- Stimulates secretion of insulin from pancreatic  $\beta$ -cells (T2DM)
- Positive insulin sensitivity

Adams et al 2010;95:471,  
Holick 2003;79:362

# Vitamin D & Non-Calceemic Role

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- Cell differentiation, proliferation & Apoptosis
  - 1,25(OH)<sub>2</sub>D can act on genes regulating normal cell growth, division & death in tissues (colon, prostate, breast)- protective against cancer
  - This ability to prevent abnormal cell proliferation assist in cancer prevention (basis of using vit D analogues to treat psoriasis)

# Vitamin D & Cancers

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- ❑ Type of cancers-breast, colon, prostate
- ❑ Reported in 1941 by Apperley
- ❑ People living in northern latitudes were more likely to die of cancer than adults living in southern states of USA (Grant,2002;94:1867)
- ❑ Various tissue cells have the enzymatic machinery to make 1,25(OH)<sub>2</sub>D
- ❑ Anti-proliferative activity of 1,25(OH)<sub>2</sub>D can inhibit tumor cells
- ❑ 30–50% ↓risk of developing and dying of colon, prostate, and breast cancers with ≥20 ng/mL of vit D (Ahonen et al, 2000;11:9)

# Vitamin D and Cardiovascular Health

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- ❑ Low vitamin D in Framingham offspring cohort was associated with ↑ CV and HTN events (Wang et al, 2008;117:503)
- ❑ Vitamin-D sufficiency results in ↓risk of CVD & congestive heart failure (Zitterman et al. 2003;41:105)
- ❑ Renin & angiotensin production is down regulated by  $1,25(\text{OH})_2\text{D}$  (Li et al. 2002;110:229)

# Vitamin D and Women's Health

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## □ Reproductive health<sub>1</sub>

- Lower 25(OH)D levels in women with preeclampsia compared with controls
- Potential mechanisms could be gene regulation, immunological response & hypertension

## □ Premenstrual syndrome<sub>2</sub>

- Research efforts are still in the early stages
- Women with high vitamin D intake had a lower risk of premenstrual syndrome

# Vitamin D and Obesity

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## □ Epi data:

- NHANES III data set- significant stepwise drop in the serum 25OHD with upward trend in BMI & % body fat
- Serum 25OHD rises significantly in extremely obese after intestinal bypass surgery

## □ Possible factors: limited mobility, ↑ vit-D need etc

## □ Proposed mechanism:

- Volume of distribution to fat of lipid soluble vitamin as it leaves general circulation after being synthesized in the skin/ or through diet
- Preferential retention of vitamin D in those fat stores
- Increase fat stores (VDR?, Leptin)

Yetley, 2008;88:558S  
deLuis et al,2008;53:234

# Vitamin D and Mortality

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- **Cross-sectional data** (Autier 2007;167:16)
  - Intake of ordinary doses of vitamin D supplements are associated with decreases in total mortality rates
- **Meta-analysis of prospective data** (Zitterman 2011 online)
  - RR for mortality for different 25(OH)D concentration
  - Nonlinear ↓ in mortality risk as 25(OH)D ↑ with optimal concentrations ~30–35 ng/ml
- **RCT UK based** (Avenell 2011online)
  - Daily vitamin D or calcium supplementation did not affect mortality, vascular disease, cancer mortality, or cancer incidence



# Vitamin D Requirements

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## Past Recommendations

(AI)

- Newborn -50 years old  
200 IU/day (5 µg)
- 51 – 70 years old  
400 IU (10 µg)
- >70 years old  
600 IU (15 µg)

## Current Recommendations

(AI)

- Newborn -1 years old  
400 IU/day (10 µg)

(RDA)

- 1– 70 years old  
600 IU (15 µg)
- >70 years old  
800 IU (20 µg)

# Vitamin D Status Assessment

25(OH) D Level	ng/ml	nmol/L
Deficient	<20	<50
Insufficient	20-30	50-75
Optimal	32 -60	80 - 150
High	60-90	150-225
Toxic	>90	>225

# Vitamin D Deficiency-Panademic

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- ❑ World wide >1 billion people are either vitamin D insufficient or deficient
- ❑ Prevalence study from 18 countries in South America, Europe, Middle East, Asia, and Australia reported 64% of women with vitamin D levels <30 ng/mL
- ❑ Common in US young adults (36%-42% had 25(OH)D<20ng/ml)

# Vitamin D Insufficiency & Chronic Disease

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- Association between 25(OH)D status and CVDs, obesity, and T2DM in migrant and ethnic minority population
  - **Method:** Systematic review from 1980 through 2010 on studies including immigrants from low- to high-income countries
  - **Result:** Significantly higher rates of vitamin D insufficiency : <20 ng/ml
    - children 43.6–48.7% versus 10%; adults 30.3–53% versus 13.7–26%
  - **Conclusion:** Vitamin D supplementation could be valuable in the prevention or treatment of obesity-related diseases in migrants & ethnic minorities

# Vitamin D Deficiency

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## Persons at greatest risk of deficiency:

- Elderly, 'shut-ins', dark skin people
- Persons in northern latitudes
- Those whose heads/bodies are covered by clothing
- Low intake from diet
- Persons with impaired fat absorption
- Persons with liver or renal disease
- People with genetic abnormalities

# Vitamin-D Deficiency

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Metabolic bone disease from Vit-D deficiency is called:

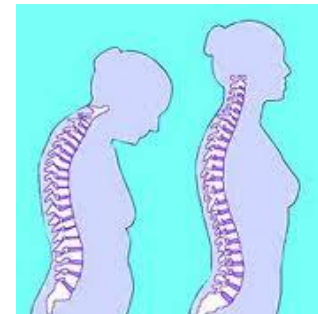
## □ Rickets in children

- Mineralization defect
- Short stature/bony deformities
- Bowed or knocked knees



## □ Osteomalacia in adults

- Mechanical insufficiency of the hip muscle
- Soft, porous & spongy bones
- Severe pain



# Treatment of Vitamin-D Deficiency

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## 500,000 IU

- Divided dose of 50,000
- Over 4-5 wks

## Gap of 4-5 wks

- For blood level to normalize & stabilize
- Blood test to see if 25(OH)D are >30ng/ml

## If yes.....

- 50,000 IU orally monthly for maintenance
- Monitor annually to ensure sufficiency

