

# Vitamin D deficiency in Children



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# Agenda

- Introduction.
- Vitamin D resources.
- Vitamin D Benefits.
  - Skeletal & 'extra-skeletal' benefits of vitamin D.
- Vitamin D Deficiency
  - Definition.
  - Causes.
  - Symptoms & signs.
  - Laboratory findings.
  - Radiological findings.
- Prevention & Treatment.

# Introduction

## Importance of Vitamin D:

- Essential vitamin with powerful effects on body systems
- Functions like a hormone; every cell has a vitamin D receptor
- Vital for bone health, immune function, and overall development in health

## Deficiency linked to:

- Rickets and impaired bone development
- Weakened immune system and higher risk of infections
- Potential future risk of chronic diseases (e.g., asthma, diabetes)

# Vitamin D Deficiency in Saudi Arabia

- High prevalence across all age groups
- **Estimated 80-90% of children and 90-95% of adults are deficient**

## Contributing factors:

- Limited sun exposure due to high temperatures
- Cultural practices covering most of the skin
- Low intake of vitamin D-rich foods

## Age-specific prevalence in Saudi Arabia:

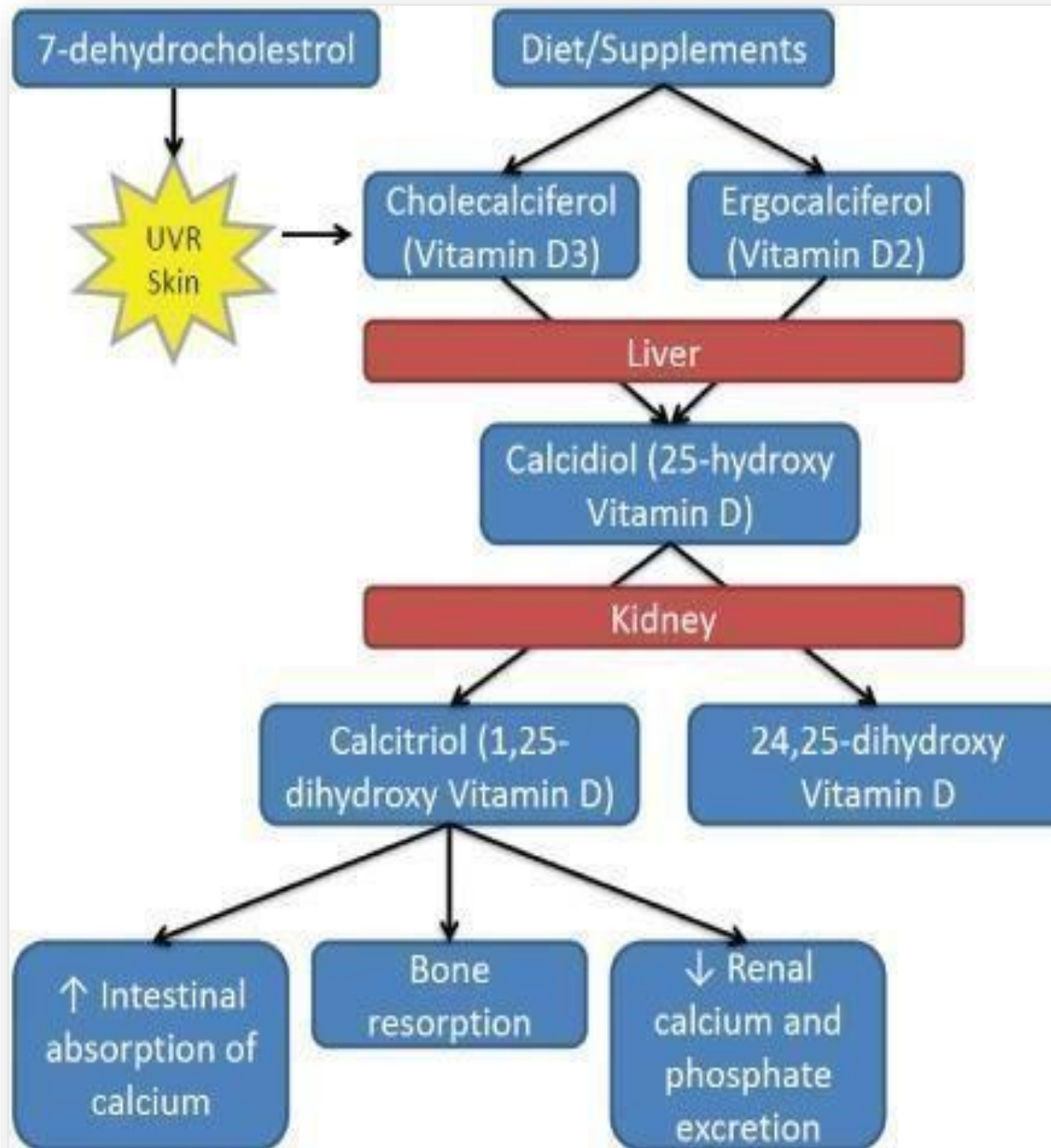
- **Infants & Young Children:** Over 80% deficient, especially if exclusively breastfed without supplementation
- **School-Aged Children:** Around 85% have low vitamin D due to limited outdoor play
- **Adolescents:** High deficiency rate at 90-95%, influenced by indoor lifestyles

# Vitamin D resources

- Both ergocalciferol (D2) & cholecalciferol (D3) are equivalent; both increase vitamin D stores.
- Recent evidence suggests that vitamin D3 increases vitamin D concentrations two to threefold more than D2.
- The commonest dietary resources of vitamin D3 are fish (e.g., salmon and tuna), cod liver oil, milk, and all fortified milk products, whereas vitamin D2 is found in plant sources like yeast and mushrooms.
- Vitamin D is available commercially as ergocalciferol, cholecalciferol, one alpha calcediol & calcitriol.

# Vitamin D resources

- Nearly 90% from sunlight (UVB exposure); 10% from diet.
- 18% of the body surface should be exposed to mid-day sun (10 am-3 pm) for 15-30 min/day.
- Barriers to Sunlight:
  - Pollution blocks UVB rays.
  - Urban overcrowding limits direct sunlight exposure.
- Dietary Factors:
  - High phytate (e.g., chapati bread) or low calcium diets can impair vitamin D absorption and cause deficiency.



# Vitamin D Benefits



**Vitamin D is not only just for skeletons!!**

# Vitamin D benefits on the skeleton

- Crucial for Skeletal and Non-Skeletal Health: Essential from conception through lifespan.
- Supports Bone Mass Accumulation:
  - 40-60% of total skeletal mass is developed during childhood and adolescence.
  - Vital for peak bone mass and strength.
- Promotes Growth and Development:
  - Essential for proper skeletal growth in early years.
  - Impacts physical development milestones.
- Regulates Calcium and Phosphorus Balance:
  - Key in bone mineralization & remodelling processes.
  - Helps maintain the calcium-phosphorus ratio necessary for strong bones and overall bone health.

# Vitamin D Benefits on Non-Skeletal Health

- **Powerful Antioxidant:**

- Protects against free radical damage and promotes cellular differentiation.
- Reduces risk of carcinogenesis.

- **Immune System Support:**

- Regulates T cell signaling and activation, helping combat serious infections.
- Lowers risk for multifactorial diseases even if not entirely preventive.

- **Protects Against Respiratory Infections:**

- Subclinical deficiency and non-exclusive breastfeeding in the first 6 months increase risks of:
  - Acute respiratory infections
  - Tuberculosis
  - Other respiratory illnesses.

- **Respiratory Disease Severity:**

- Studies show an inverse relationship between vitamin D levels and the severity of asthma and COPD (Chronic Obstructive Pulmonary Disease).

# When to say vitamin D is deficient??

**Deficiency:** Serum 25-hydroxyvitamin D (25(OH)D) levels < 20 ng/ml (or < 50 nmol/L)

- Low vitamin D levels can lead to rickets in young children and other bone-related issues, such as osteomalacia, in older children and adolescents.

**Insufficiency:** Serum 25(OH)D levels between 20–29 ng/ml (50–72 nmol/L)

- Insufficiency may not lead to overt clinical symptoms but can contribute to suboptimal bone health over time.

**Sufficiency (Normal):** Serum 25(OH)D levels between 30–100 ng/ml (75–250 nmol/L)

- This range is generally considered adequate for maintaining bone health and supporting overall health in children.

# Rickets / Osteomalacia

- Rickets is a disease of the growing bones in which defective mineralization occurs in both bone & cartilage of the epiphyseal growth plates.
- Is associated with growth retardation & skeletal deformities:
  - vitamin D deficiency causes muscle weakness.
- Osteomalacia is a disorder of the mature bone in which mineralization of new osteoid bone is inadequate or delayed.

# Types

- Hypocalcaemic Rickets (most typical type).
- Hypophosphatemic Rickets (not shared).
- Combined Rickets (combination of hypocalcemia & hypophosphatemia).

# Hypocalcaemic rickets

(with secondarily elevated parathyroid hormone levels)

- Nutritional Rickets due to:
  - Decreased sun exposure.
  - Dietary-deficient intake.
  - Malabsorption diseases that affect the absorption of vitamin D (e.g., celiac disease, CF, chronic diarrhea...etc)
- Chronic liver diseases (affects the conversion of cholecalciferol to calcidiol).
- Anticonvulsant drugs (phenytoin, phenobarbitone due to increased vitamin D metabolism by inducing cytochrome P450 activity).

- Celiac disease.
- Pancreatic insufficiency.
  - Cystic fibrosis.
- Hepato-biliary disease
  - Biliary Arteresia.
  - Cirrhosis.
  - neonatal hepatitis.
- Anti-convulsant.
  - Phenobarbitone.
  - Phenytoin.
- Diet
  - Excess of phytate in diet with impaired calcium absorption (chapati flour).



# Renal Rickets

## **Chronic renal failure (Renal Osteodystrophy):**

- Occurs due to lack of synthesis of active form (1,25-dihydroxy vitamin D) as consequences of 1- $\alpha$ - hydroxylase enzyme deficiency.

## **Renal Tubular acidosis:**

- Metabolic acidosis from proximal or distal tubular disease.
- Fanconi syndrome (generalized form of RTA)
  - associated with cystinosis, tyrosinemia & Wilson's disease
- Accompanied with other urinary loss:
  - Calcium.
  - Phosphate.
  - Glucose.
  - Protein.
- Isolated or generalized forms.
  - Hereditary hypophosphatemic rickets.

# Hereditary Rickets

- Hypophosphatemic rickets (Vit D resistant).
- Vitamin D dependent rickets.

# Vitamin D dependent rickets

## Type 1

- Rare, autosomal recessive.
- Lack of 1  $\alpha$  hydroxylase enzyme.
- Clinically & biochemically like nutritional rickets except it appears early at 3-4 months.

## Type 2

- Rare autosomal recessive disorder.
- 1  $\alpha$  hydroxylase enzyme is present.
- Lack of Calcitriol receptors.
- Common in Arabs.
- Baldness.
- Severely affected individuals.
- Unresponsive to treatment.

# Clinical Features







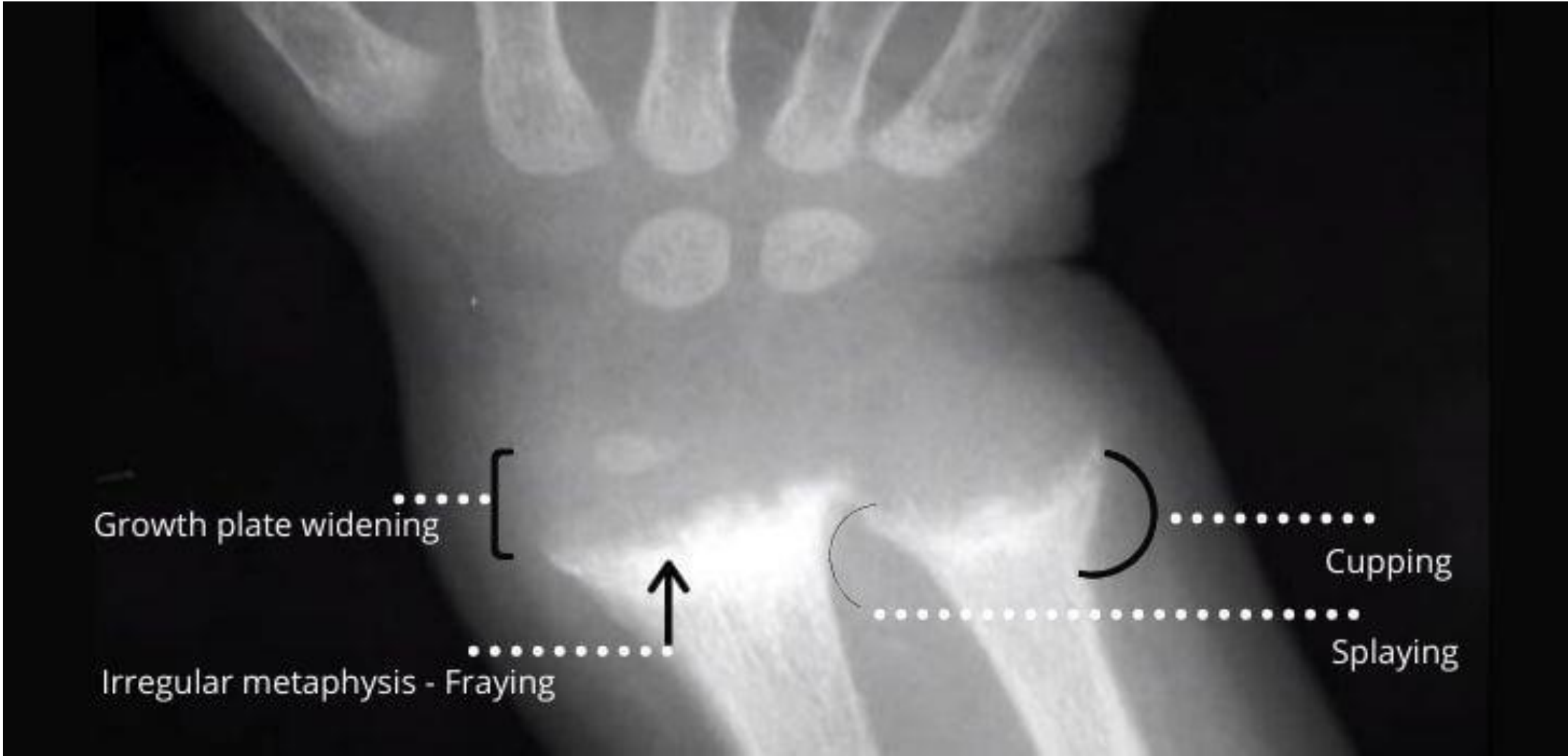




# Hypocalcaemic Tetany



# Radiological Features



Growth plate widening

Irregular metaphysis - Fraying

Cupping

Splaying

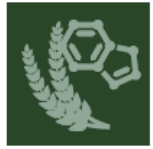
# Prevention & Treatment

# Prevention

## Recommended Interventions

- Encourage safe sun exposure: Promote morning outdoor activities
- Dietary improvements: Increase intake of vitamin D-rich foods (e.g., fortified milk, fish)
- Supplements: Educate families about the importance of vitamin D supplements, especially for children
- Public health strategies: Consider food fortification and awareness campaigns

Updated Doses 2021



*nutrients*



*Review*

# Vitamin D Dosing: Basic Principles and a Brief Algorithm (2021 Update)

Andrius Bleizgys

Andrius Bleizgys

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# PREVENTION

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Patient Age	Recommended Daily Dose (IU/d)	Recommended Intermittent Dose	Upper Tolerable Daily Dose (IU)
Infants < 6 months	<b>400-600</b>		1000
Infants 6-< 12 months	<b>600-800</b>		1000
Children 1-10 yrs.	<b>600-1000</b>		2000
Teens 11-<18 yrs.	<b>800-2000</b>	25,000 IU in 5-2 weeks	4000

IU-International unit

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# TREATMENT

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<b>Patient Age</b>	<b>Recommended Daily Dose &amp; Duration</b>	<b>Recommended Intermittent Dose &amp; Duration</b>
	<b>250H-D Levels &lt;25nmol/L</b>	
Infants < 1 month	1000 IU/d 3 months	
Infants 1-< 12 months	2000 IU/d 3 months	
Children 1-<11 yrs.	3000-6000IU/d 3 months	
Children 11-<18 yrs.	6000 IU/d 3 months	50,000 IU / week - 1.5 -2 months
IU-International unit		



# Conclusions

- ✓ Vitamin D deficiency is incredibly common & most people are unaware of it.
- ✓ Symptoms are often subtle & non-specific.
- ✓ Advisable, all age groups to screen for its deficiency.
- ✓ Fortunately, a vitamin D deficiency is usually easy to treat.
- ✓ It is highly advisable to increase people's awareness of vitamin D deficiency and broadcast preventive measures such as increasing sun exposure and consuming more vitamin D-fortified food/formulas, fish and salmon, or fortified dairy products.
- ✓ Encourage sun exposure (15 -30 minutes per day (longer with darker skin) or vitamin D supplements.

***Thank you***