Vitamin D Deficiency in Athletes

EMILY KRODEL, MD

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Franciscan HEALTH

Overview – Vitamin D

- Clear up confusion

- What is it?
- Why is it important?
  - Athletes
- How/why do you test it?
- Categorization – deficient, insufficient, etc
- How do you treat it?

What Is Vitamin D?

- “Vitamin” not the best term
- (Pre)Hormone
  - Levels regulated through biochemical feedback system
  - Produced by a secretory gland (skin)
  - Has its effect elsewhere in body
    - Globally… brain, thyroid, bones
- Fat soluble

Importance of Vitamin D

- Subclinical deficiency/insufficiency estimated to affect 1 billion people worldwide
  - CDC estimates 1/3 of US population has insufficient vitD
- Cells need vitD to carry out key processes
  - Many cellular responses impaired without it
    - >1000 vit D responsive genes have been identified
  - Every organ system involved
- Main role is to help regulate blood levels of calcium, phosphorus, and magnesium
  - Intestinal absorption
    - Deficiency leads to 85-90% decreased absorption of dietary Ca^{2+}
  - Suppresses release of PTH

Importance of Vitamin D

- Vital for growth and health of bone, muscle function
  - Rickets in children
  - Osteomalacia/porosis in adults
- Other potential CV and immune function benefits
- Deficiency associated with depression, anxiety, and increased risk of certain cancers and AI diseases

Different Forms

- **Vitamin D2 – ergocalciferol (plants)**
  - Found in fortified foods and most vitamin preps and supplements
  - Capsules, tablets, solutions
- **Vitamin D3 – cholecalciferol (animals)**
  - Produced in body, also in some supplements
  - Capsules, tablets, ODT, chewable, solution, spray
- Both are biologically inactive precursors
  - Slightly different chemical structures
  - Liver metabolizes differently
  - Both effectively absorbed into bloodstream, D3 seems to be more effectively utilized, may be less toxic
  - Cost similar

Vitamin D Sources

- Endogenous (D3)
  - Skin produces in response to sunlight
  - UVB → basal layers of epidermis produce D3
    - Make 10k – 20k units in 20 minutes of sunbathing
- Exogenous (D2 or D3)
  - Ingested in food and supplements

Food Sources

- Very few foods naturally contain vitD
  - Oily fish (salmon, mackerel, sardines)
  - Cod liver oil
  - Beef liver
  - Egg yolks (lesser extent)

- Artificially enriched
  - Milk*, fruit juices, breads, cereals, etc
    - *100 IU per 8oz

- Almost impossible to get what you need from food alone

TESTING

Who Gets Tested?

- Low trauma fracture
- Recurrent bone stress injury
- Trabecular fracture
  - Femoral neck
  - Sacrum
  - Pelvis
- Complete metabolic workup: CBC, CMP (with Ca2+), 25(OH)D, PTH, TSH
  - Consider free and total T in males and hormone levels in females if oligo/amenorrheic

Screening Athletes? PROS

- **Good screening test:**
- Disease has health consequences
- High prevalence in screened population
- Test is safe, affordable, and available
- Treatment exists and isn't risky

Screening Athletes? CONS

- No studies show improved sporting performance with supplementation
- Can't fully determine bioavailability by only checking vitD measures
- Potential risk of treating vitD deficiency w/o further investigation (if increased Ca2+, could have PTH tumor and supp could be hazardous)

What Test Is Ordered?

- 2 options for blood test:
  - 25-hydroxyvitamin D
  - 1,25-dihydroxyvitamin D
- **25(OH)vitD** - major form found in blood
  - Includes D2 + D3
  - Relatively inactive precursor to active hormone 1,25(OH)vitD
  - Measured due to longer half life & higher concentration
  - Ng/ml
- Check 1,25(OH)vitD if renal impairment or concern about ability to convert 25(OH) form to 1,25(OH)

Serum 25(OH)VitD Levels

- Differences of opinion
  - Definitions of deficiency, insufficiency, normal
- Pretty much everyone agrees that <20 is too low
  - Many labs have normal range from 30-74 ng/mL
  - Average person shoots for 20-50 ng/mL

- **Classify deficiency as <20**
- **Classify insufficiency as 20-29**
- **Classify normal as >30**

- **40-80** ng/mL typical targeted range for athletes
  - Target low end if h/o bone spurs or hypercalcemia

Terminology & Ranges

	Vitamin D Council	Endocrine Society	Food & Nutrition Board	Testing Laboratories
Deficient	0-30	0-20	0-11	0-31
Insufficient	31-39	21-29	12-20	
Sufficient	40-80	30-100	>20	32-100*
Toxic	>150			

*Franciscan normal range 30-100 ng/mL

What Does It Mean If Level Is Low?

- **Not getting enough exposure to sunlight**
- **Not getting enough dietary sources**
- Problem with absorption from intestines
  - Crohn's, celiac, CF, gastric bypass
- Drugs (phenytoin) could be interfering with production of it in liver
- Kidney or liver disease
  - Causing decreased levels of enzymes that change vitD to its biologically active form

Other Factors

- Race
  - Decreased vitD binding protein in African Americans
    - Due to polymorphism in vitD binding protein gene
  - May often have decreased 25(OH)vitD level BUT have similar levels of estimated *bioavailable* vitD…
    - Same pts actually had increased BMD compared to white cohort
- Fat
  - 25(OH)D is lipophilic
  - Adipose tissue is storage site for it and its precursors
  - May decrease circulating vitD and lead to lower levels in obese people

ATHLETES

NFL Studies

- 2015 AJSM – Pittsburg Steelers
  - VitD deficiency might increase risk of injury
  - Levels significantly lower in players with at least 1 fx
  - Players with h/o fx at some point or released during preseason (injury OR poor performance) had significantly lower levels
  - Black athletes had increased rate of deficiency
- 2011 AOSSM – NY Giants
  - Association b/w low vitD levels and injuries. Specifically looked at soft tissue injuries like muscle strains
- Plans for a larger study with approx 320 NFL players

Maroon JC, et al. Vitamin D profile in national football league players. AJSM. Vol 43, issue 5, 2015.

Other Studies

- UCLA study: Serum vitamin D levels are inversely associated with *time lost* to bone stress injury in a cohort of NCAA Div 1 distance runners
  - 25(OH)D level not associated with *incidence* of injury
    - Most levels were in "normal" range
- Case reports
- Larger studies of military populations
  - Female Navy recruits 2x risk of tib/fib stress fx if vitD<20 compared to if it was >40
  - 2000mg Ca2+/day and 800 IU/d vitD x8wks associated with reduction of stress fx

Who's Checking?

- Millions of $$ at stake – want athletes to keep playing – tracking player health
  - Emphasizing wellness: sleep, nutrition, etc
- Many teams in NFL, NBA, MLB, NHL monitoring levels and intake
- USMNT and USWNT
- Some college athletic departments
  - Screen everyone each fall?
  - Only high risk athletes?
    - High impact athletes at risk for stress fx
    - Indoor sports in winter - basketball
    - Athletes with stress fx, MSK pain, and recurrent infections

TREATMENT

What Some Places Are Doing

- Some sports dietitians recommend athletes get 1000-2000 IU daily through food, supplements, or both
- UVA – 2000 IU vitD supplements available to all athletes
- USC (sunny) – check annual vitD levels
  - 2015 study: >1/3 of 223 athletes had insufficient levels, lower in black athletes
  - Added fortified Frosted Flakes + milk
- GSW in 2007-2009… 9-12 of 16 players were insufficient and given 5000 IU supplements daily
- Evidence of injury prevention isn't overwhelming, but treat deficiency b/c minimal/no harm; may be helpful
- UC Berkley started supplementing – only 2 stress fx since 2006… But hard to get HS/college kids to take

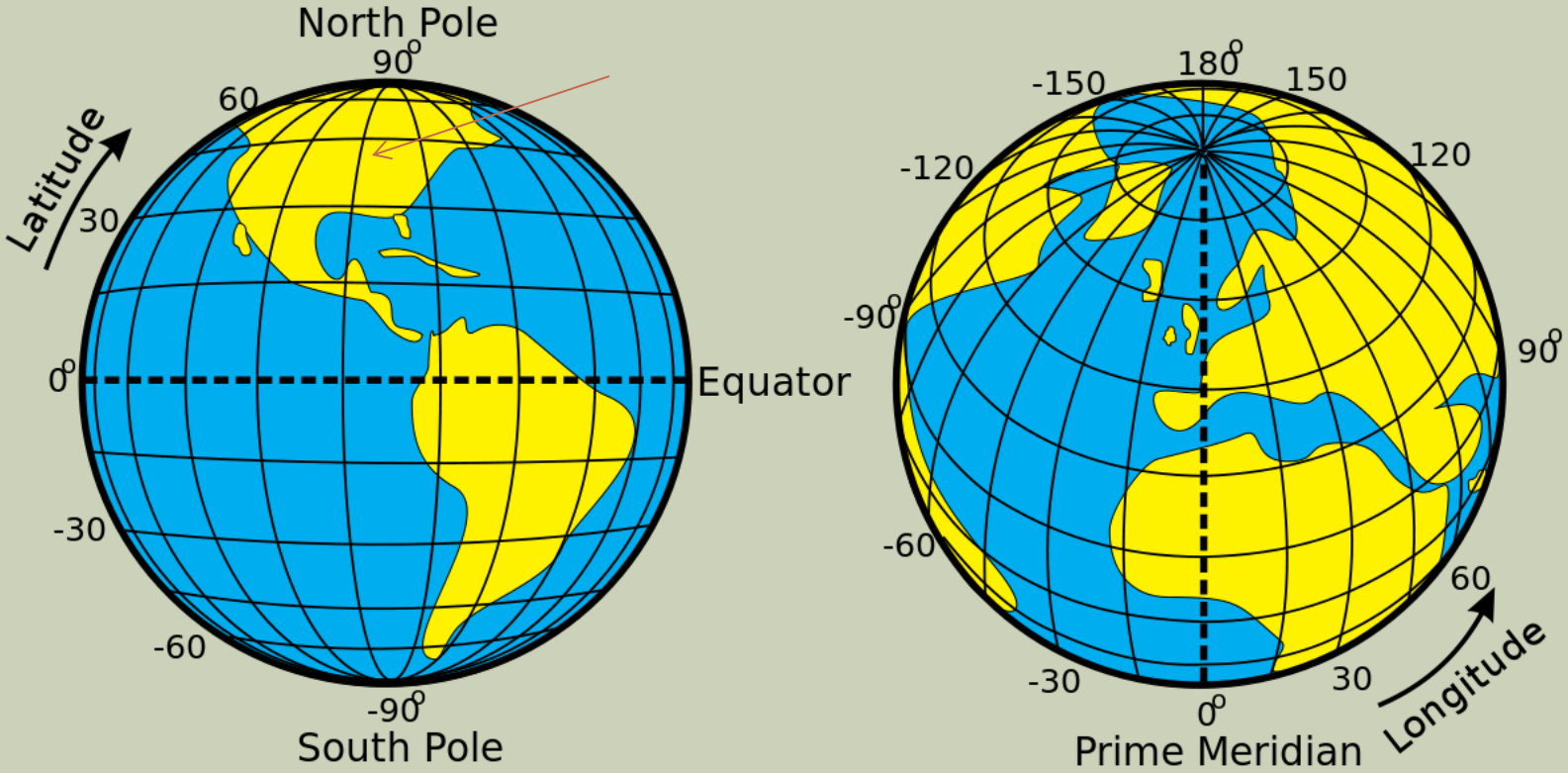
Sunshine/Heliotherapy

- Best source + FREE
- Drawbacks: sun**B**urn, premature **A**ging, skin cancer
- Dependent on season and latitude
- Also regulates serotonin levels

Heliotherapy Recs

- Sooooo many variables… location, season, skin color, age, altitude, clouds, pollution, etc
- 10-20min **outdoors** *without sunscreen* 2-3x/wk*
  - Based on skin tone and sensitivity
    - Avoid burn!
  - 10a-3p is highest yield… spring, summer, fall
  - Nov-Feb, # of UVB photons that reach Earth are greatly reduced above 37° latitude
  - Most glass blocks UVB rays
- Expose as much skin as possible
- Don't shower right away
- Make sure you're not on a sun sensitive medication

*These recs do not apply to babies ☺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South Pole
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120
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90°
-60
60
-30
30
0°
Prime Meridian
Longitude

Alternatives To Natural Sunlight

- Short-term visits to tanning salon
  - Not long enough to get tan/burn
  - Use beds with UVB light (not high intensity UVA)
- UVB lights/light therapy boxes

Dosing of Vitamin D

- Depends on nature and severity of deficiency
- Also if person has problems with absorption
- **If <10**: 50k IU of D2 or D3 PO weekly x6-8wks, then 800-1000 or more D3 daily after
- **If 10-20**: 1-5k IU of D3 daily x3mo, possibly more
  - "ideal dose" determined by testing levels, increasing it prn
  - Once normal level achieved, cont with 800/d
- **If 20-30**: 600-800 IU of D3 daily

Supplementation Pearls

- Increase dose 2-3 fold if obese, malabsorption syndrome, or drug-induced deficiency
- Better absorbed with vitK2 (not K1)
- If taking regularly and not seeing levels increase, try taking sublingually, getting more sun/UVB, increase dose

- Avoid high dose supplementation if on certain meds like digoxin, thiazides

Labeling Changes

- New FDA rule for OTC supplements
  - Jan 2021
- No more IU… changing to metric units
- Convert to micrograms by ÷ 40
  - 1000 IU is now 25mcg
- Ask pharmacist for help

Follow Up

- After high dose supplementation, **recheck @3mo**
- Recheck after 3mo of maintenance dose
- Then check q6-12mo
- Almost always need 1500-2000 IU/d if h/o deficiency

Too Much Vitamin D?

- Side effects uncommon unless 25(OH)D >100
- National Academy of Medicine says if supplementing with >4000 IU/d, run the risk of:
  - Renal impairment
  - Hypercalcemia
  - Calcified vessels
- Usually don't see toxicity unless taking 40k IU/d for a couple of months
- Vitamin D council doesn't recommend taking more than 10k/d for adults

How Can We Test Our Athletes?

- Order for blood test
  - Technically could do a test from home
- PCP
- **YMCA clinic – Dr Rowdon or Dr Krodel**

- At high school level would probably just do if concern for stress fracture, fracture, concerns about absorption, possibly depression, concussion, etc

THANK YOU