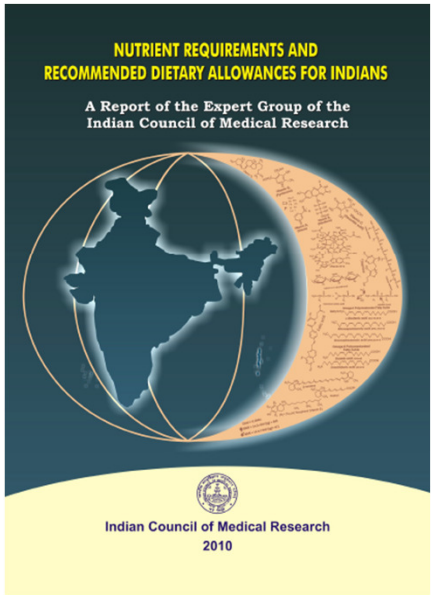
RDA levels of Vitamin D fortified milk



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ILSI-India Workshop on
Milk fortification as a strategy to address vitamin D deficiency
New Delhi, July 12, 2013

Contents Of Presentation

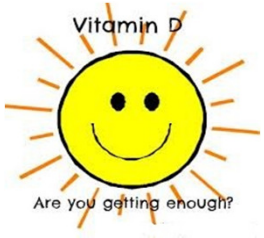
- Why different RDAs across the globe
- Basis for recommendations of DRI of vitamin D by IOM and ICMR
- Derivation of intake of vitamin D for achieving optimum vitamin D status in Indians
- Fortification of milk in India-level of vitamin D

RDAs- why different across globe?

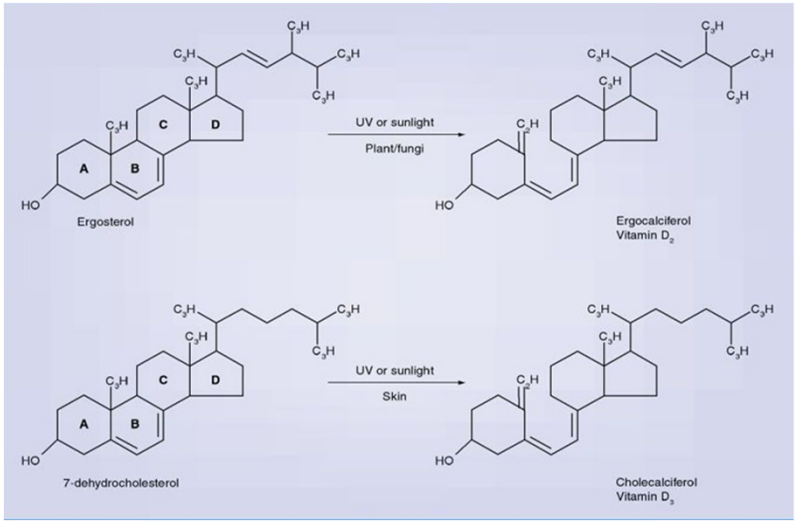
Ethnic environmental variations

- Genetic: Is there a genetic (ethnic) difference in the prevalence of **osteoporosis** between racial groups within a given society?
- Environmental-cultural (e.g., dietary): Is there a difference in the prevalence of osteoporosis between national groups of similar ethnic composition?
- Environmental-geographical (e.g., latitude, affluence, and lifestyle): Is there a difference in the prevalence of osteoporosis between countries regardless of ethnic composition?

Sources of vitamin D make it challenging to develop dietary reference intake values



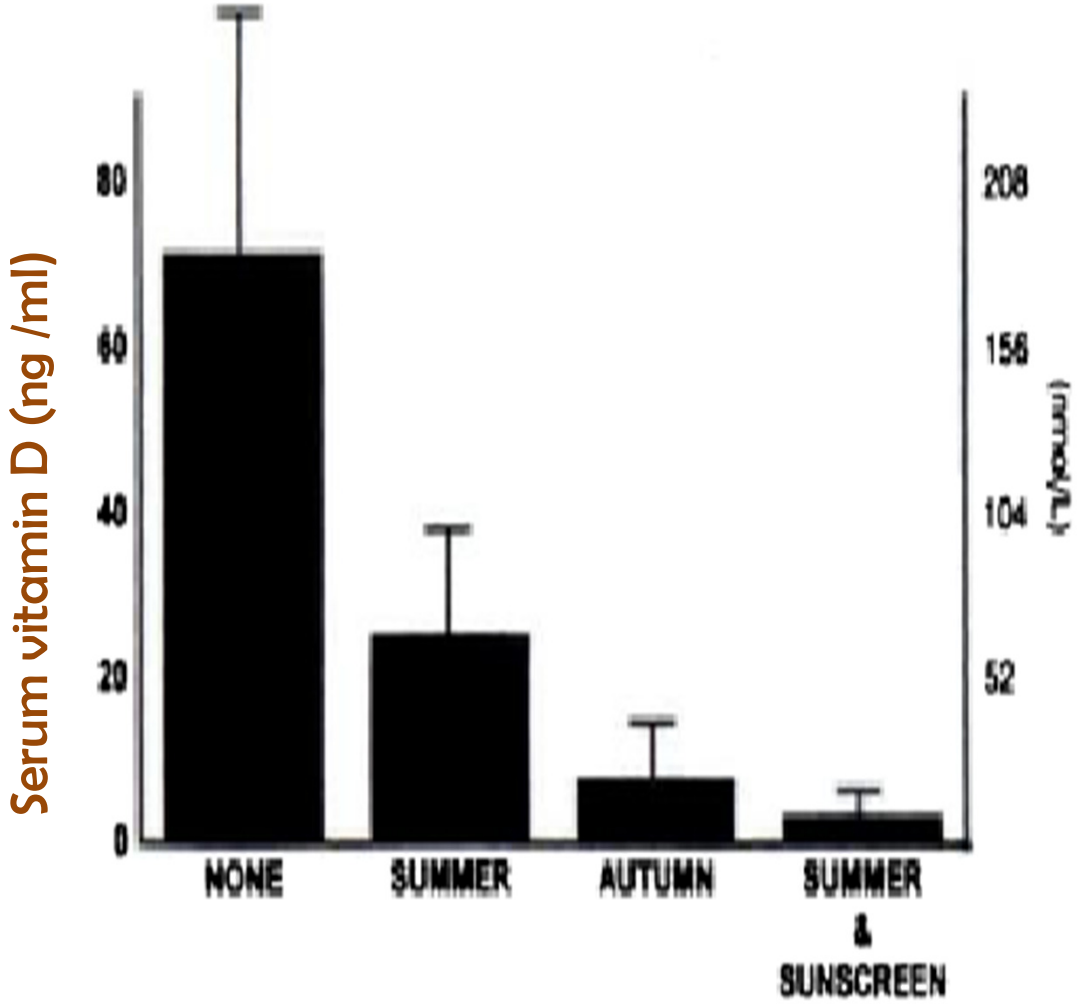
- Vitamin D3 – Irradiation at UVB wave length of 290-320 nm of 7-dehydrocholesterol in the skin of animals.



- Vitamin D2 - UV irradiation of ergosterol, found in some plants and fungi (phytoplankton, invertibrates, yeast and mushrooms)

- Fortified foods

Body Exposure to Sunlight
Type of clothing and circulating vitamin D in humans



Type clothing and sunscreen, 24 h after a whole body exposure to one minimal erythemal dose of UVB radiation.

Clothing absorbs most of the UV radiations. Covering skin with any type of clothing prevents cutaneous producation of cholecalciferol

Matsuoka. J Clin Endocrinol Metab 1992:75

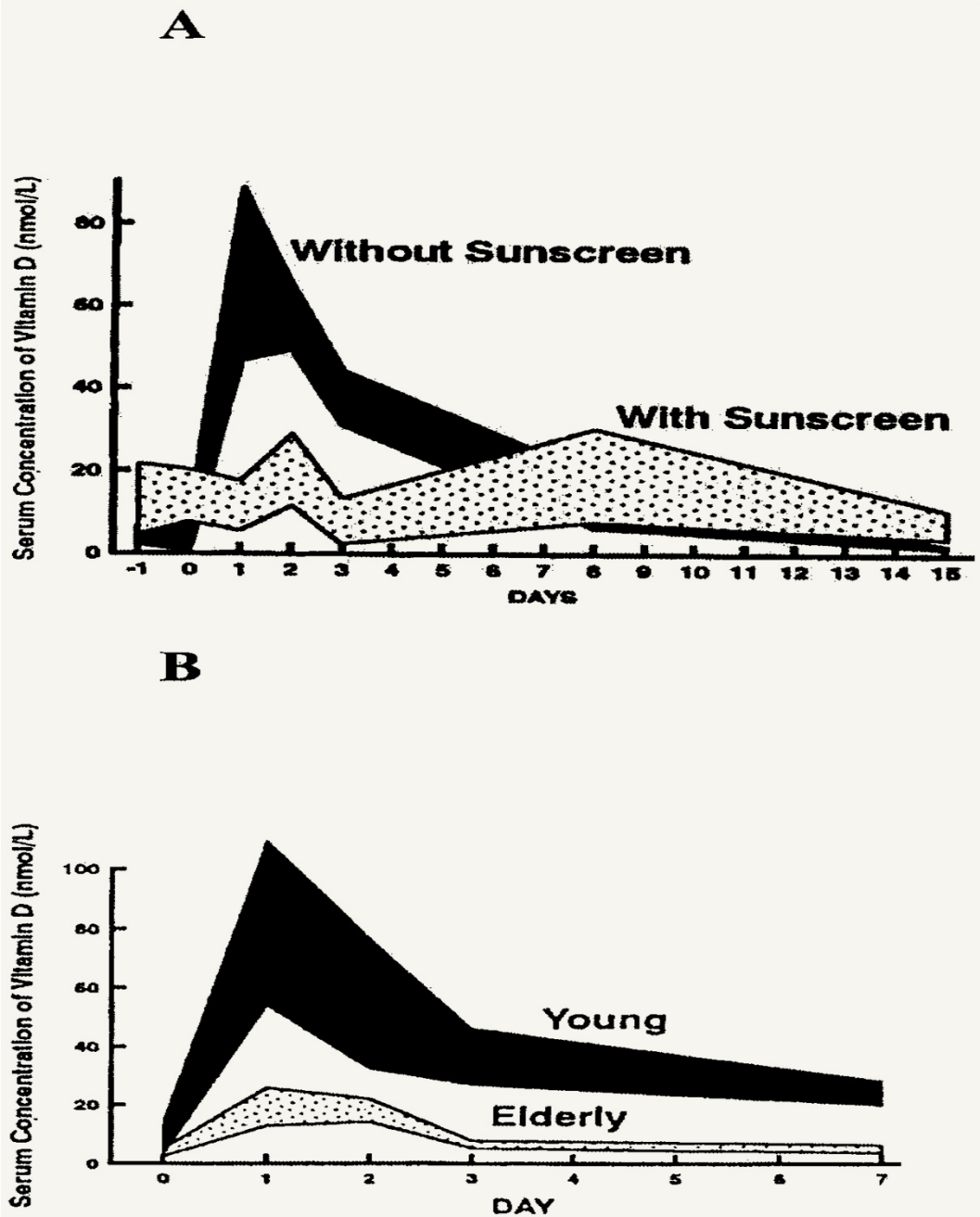


Fig A: Circulating concentrations of vitamin D after a single exposure to 1 MED of simulated sunlight, with a sunscreen (SPF 8) or a topical placebo cream.

Minimal erythemal dose

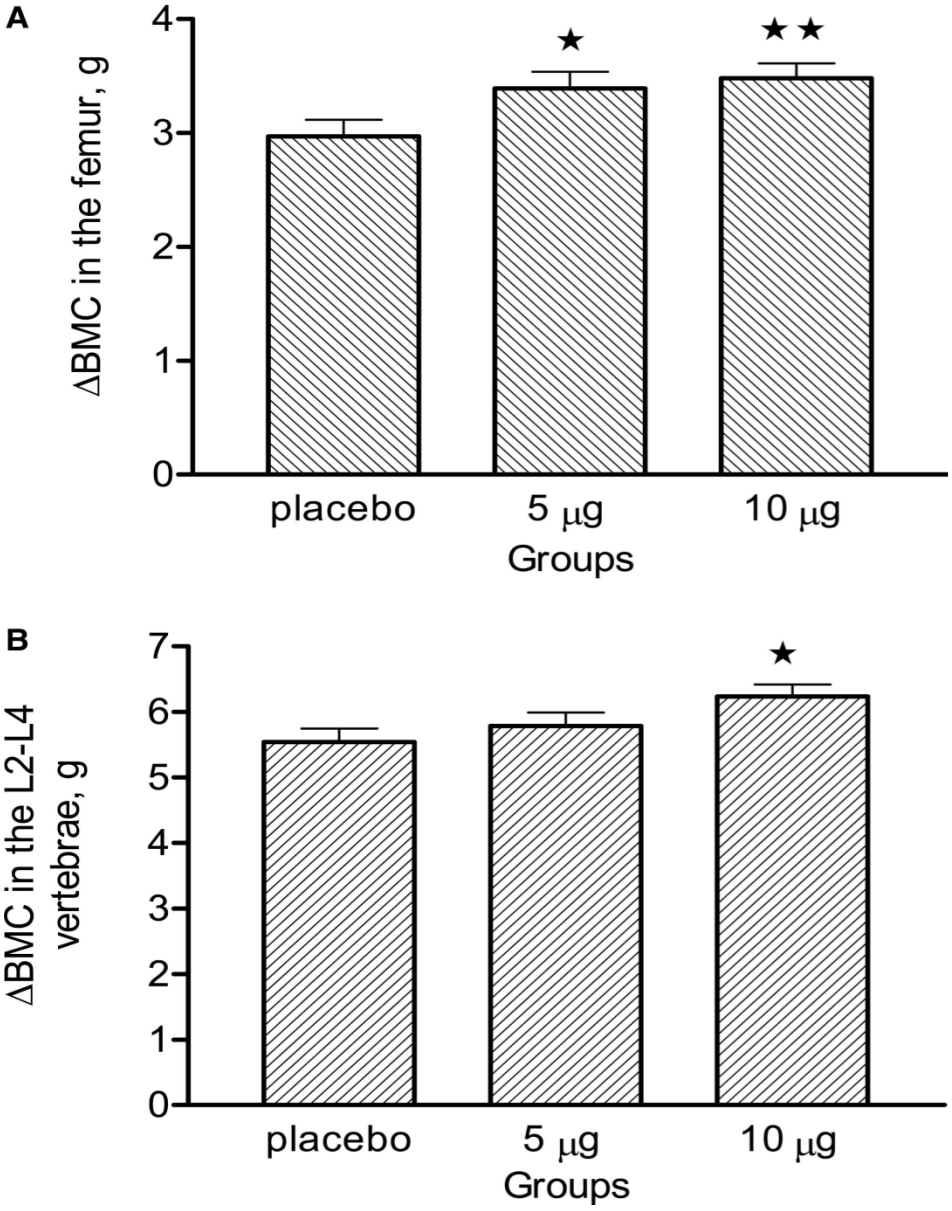
Fig B: Circulating concentrations of vitamin D in response to whole-body exposure to 1 MED among healthy young and elderly subjects.

-Holick MF. Am J Clin Nutr 1994; 60.

Basis of deriving DRI by IOM

- Bone and skeletal health studies (including bone mineral content and density, fracture risk,and rickets/osteomalacia).
- Calcium absorption and balance studies.
- Measures such as serum 25(OHD) and PTH dose response studies.
- Falls and physical performance studies.
- Cancer and site-specific neoplasms, cardiovascular disease, hypertension, diabetes, metabolic syndrome, autoimmune disorders, infectious diseases, neuropsychological functioning (including autism, cognition, and depression), and disorders of pregnancy studies.

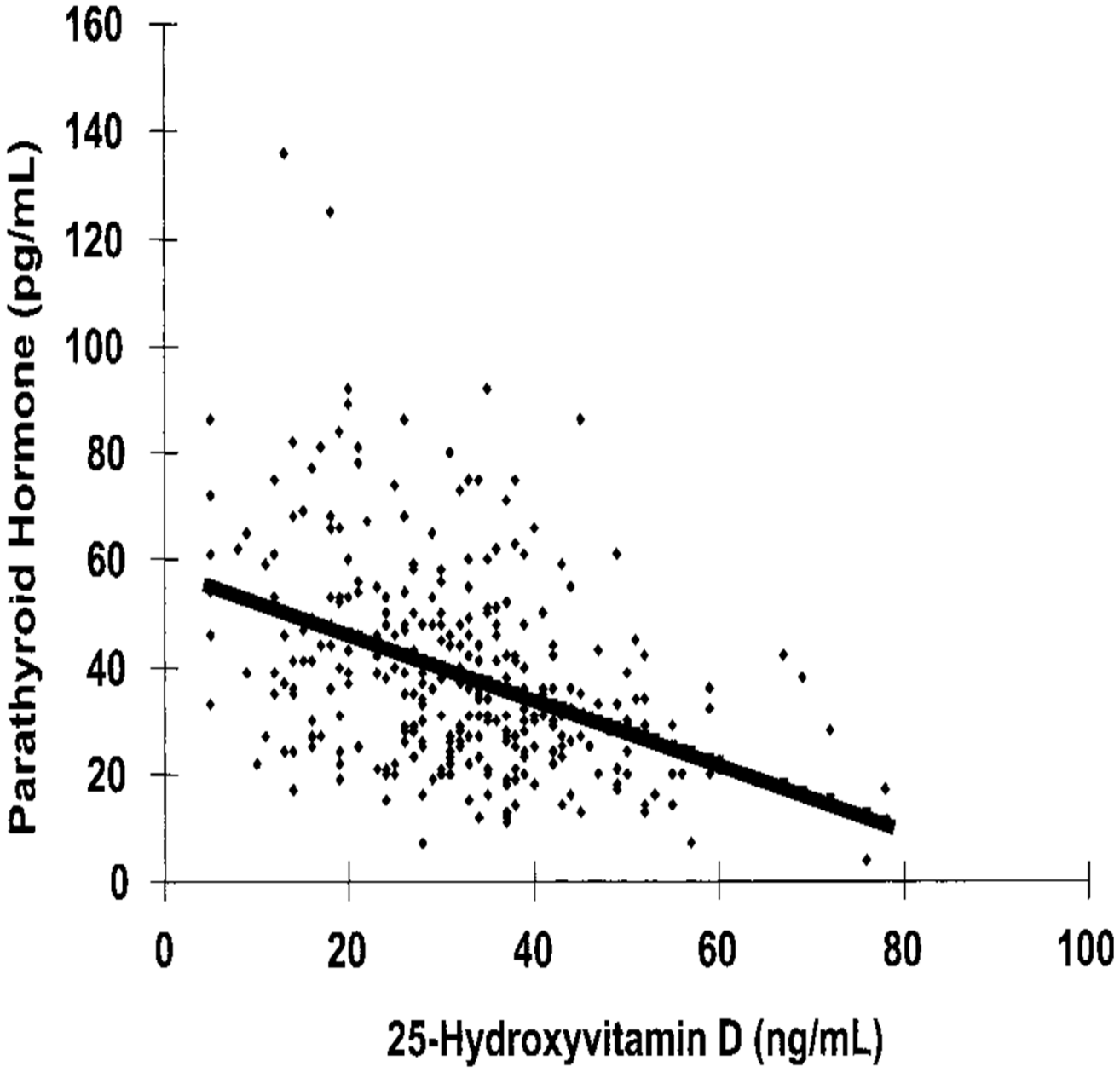
Dose–Response Effect of Vitamin D Supplementation on Site-Specific Bone Mineral Augmentation in Adolescent Girls: A double blinded RCT of 1 year



Bone mineral augmentation in the femur was 14.3% and 17.2% higher in the groups receiving 5 and 10 g of vitamin D, respectively, compared with the placebo group (Fig A).

In the lumbar vertebrae, the BMC augmentation did not differ among study groups When taking the compliance into account, the difference reach significance (p 0.039; N 185), and the BMC augment ation was 12.5% higher in group receiving 10 g of vitamin D than in the placebo (Fig B).

-Viljakainen J Bone Miner Res 2006;21

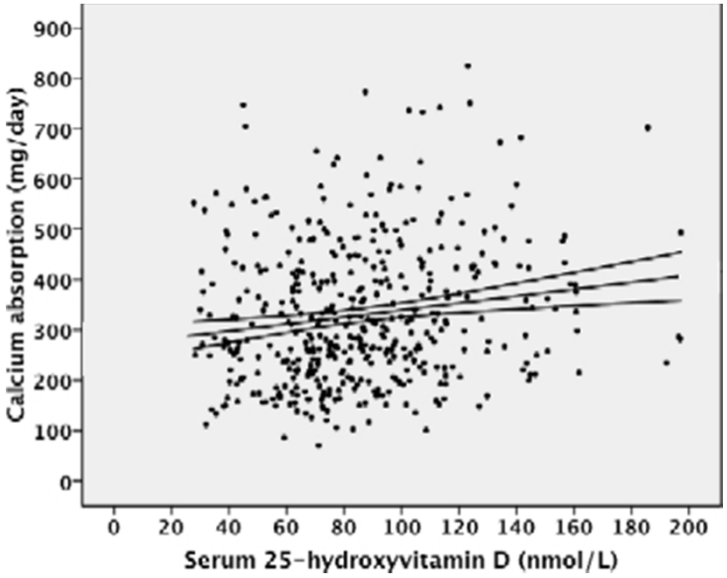


Relationship between 25(OH)D and PTH concentrations.

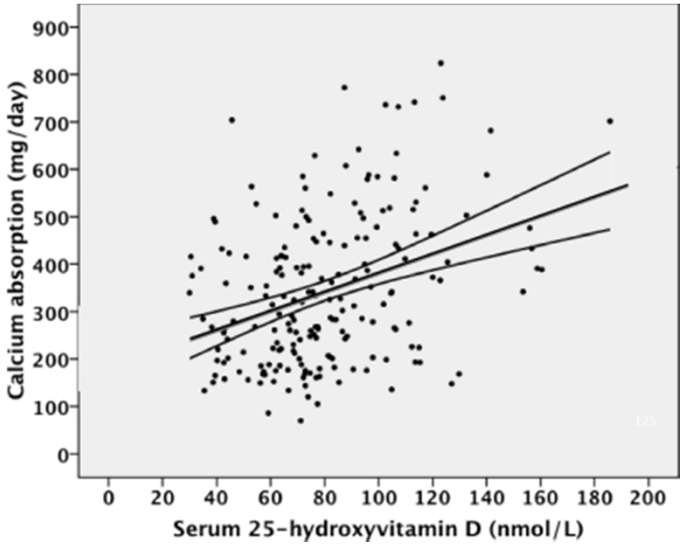
Serum concentrations of 25(OH)D were inversely correlated with PTH concentra tions (r = - 0.40, P 0.001).

-Tangpricha et al *Am J Med* 2002;112 (8)

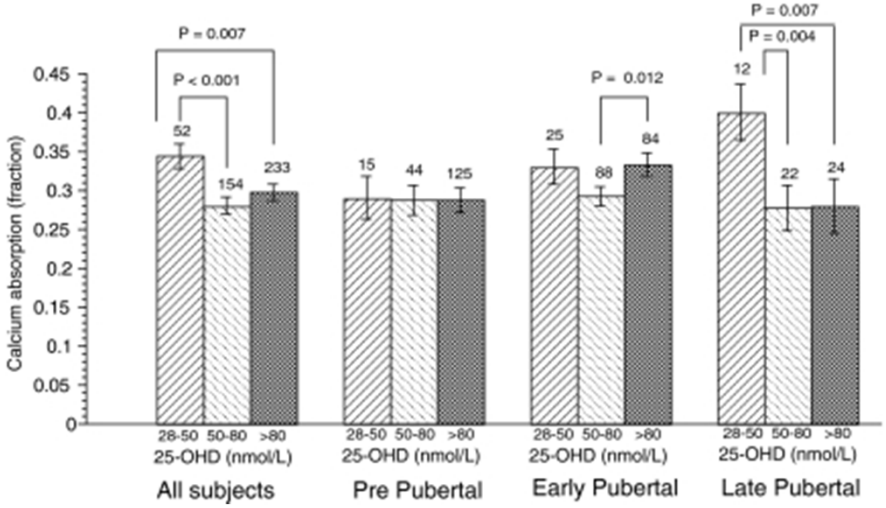
Higher serum 25-hydroxyvitamin D levels in school-age children are inconsistently associated with increased calcium absorption



Relationship between total Ca-abs and 25-OHD



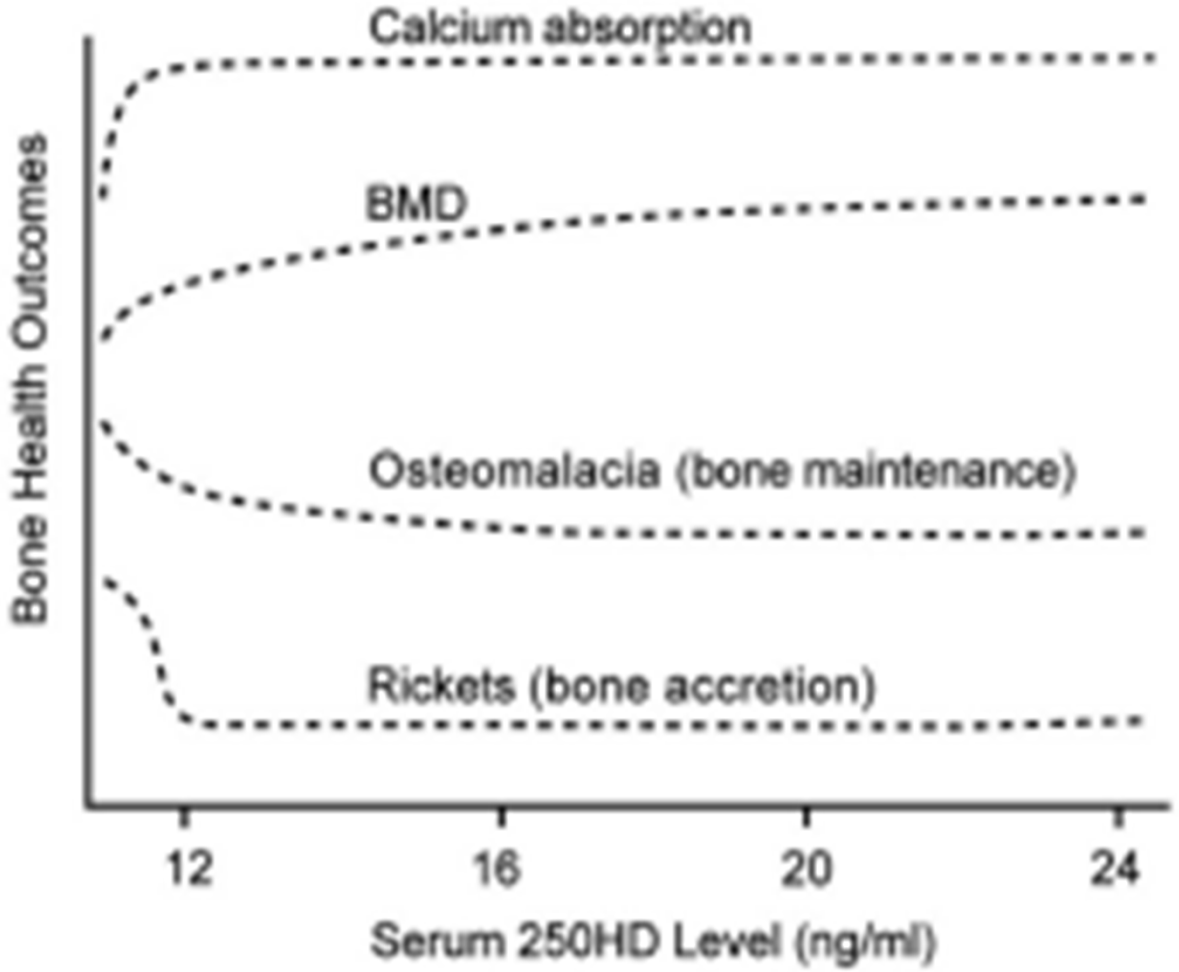
Relationship between total Ca-abs and 25-OHD for studies in early pubertal



Relationship between fractional Ca-abs and 25-OHD. Covariates in each analysis were gender, race, and calcium intake. Pubertal status was also included as a covariate in the analysis of all subjects. Overall differences were significant ($P < 0.05$) for all except prepubertal subjects.

Abrams et al J Clin Endocrinol Metab 2009; 94:2421-2427

Skeletal health indicators for vitamin D



IOM committee integration of optimal bone health outcomes and achieved serum 25OHD levels revealing congruence of benefit between 16 and 20 ng/ml.

-IOM, 2011

Recommendations of DRI of Vitamin D by IOM

- The amount of sun exposure one receives varies greatly from person to person, and people are advised against sun exposure to reduce the risk of skin cancer

- Therefore, the committee assumed minimal sun exposure when establishing the DRIs for vitamin D, and it determined that 600 IU of vitamin D per day meets the needs of males and females aged 1–70 y in the United States and Canada.

- People age 71 and older may need as much as 800 IU per day because of potential changes in people's bodies as they age.

Dietary Reference Intakes for Calcium and Vitamin D

	Calcium			Vitamin D		
Life Stage Group	Estimated Average Requirement (mg/day)	Recommended Dietary Allowance (mg/day)	Upper Level Intake (mg/day)	Estimated Average Requirement (IU/day)	Recommended Dietary Allowance (IU/day)	Upper Level Intake (IU/day)
Infants 0 to 6 months	*	*	1,000	**	**	1,000
Infants 6 to 12 months	*	*	1,500	**	**	1,500
1–3 years old	500	700	2,500	400	600	2,500
4–8 years old	800	1,000	2,500	400	600	3,000
9–13 years old	1,100	1,300	3,000	400	600	4,000
14–18 years old	1,100	1,300	3,000	400	600	4,000
19–30 years old	800	1,000	2,500	400	600	4,000
31–50 years old	800	1,000	2,500	400	600	4,000
51–70 year old males	800	1,000	2,000	400	600	4,000
51–70 year old females	1,000	1,200	2,000	400	600	4,000
>70 years old	1,000	1,200	2,000	400	800	4,000
14–18 years old, pregnant/lactating	1,100	1,300	3,000	400	600	4,000
19–50 years old, pregnant/lactating	800	1,000	2,500	400	600	4,000

*For infants, Adequate Intake is 200 mg/day for 0 to 6 months of age and 260 mg/day for 6 to 12 months of age.
**For infants, Adequate Intake is 400 IU/day for 0 to 6 months of age and 400 IU/day for 6 to 12 months of age.

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Relationship between blood levels of 25OH Vitamin D and intake -IOM

- In spite of the average total intake of vitamin D is below the median requirement, data show that average blood levels of vitamin D are above the 20 ng/mL

- These seemingly inconsistent data suggest that sun exposure currently contributes meaningful amounts of vitamin D to North Americans and indicates that a majority of the population is meeting its needs for vitamin D.

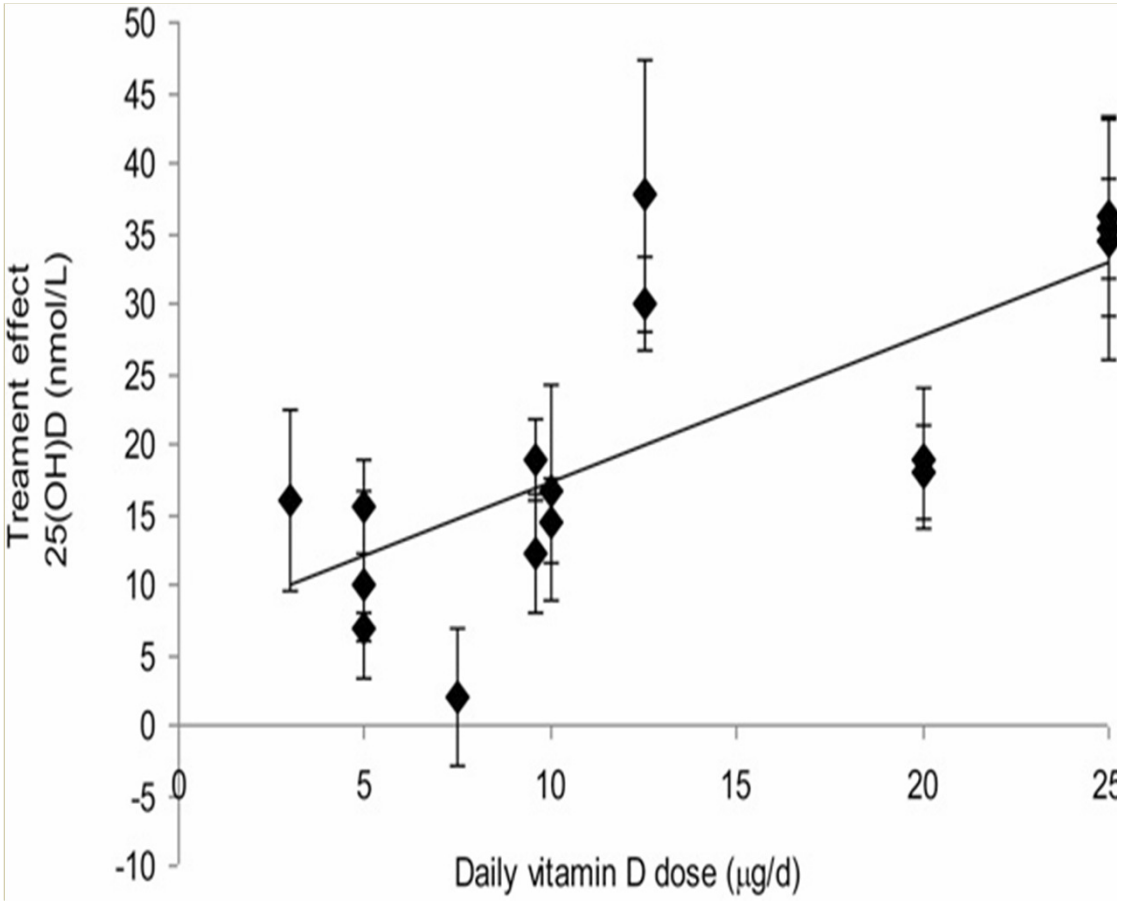
Reasons for recommending outdoor activity as a means of achieving adequate Vitamin D

- Tropical climate
- Adequate sunlight exposure
- Outdoor physical activities are more
- Lack of data on bone health
- Low intake of Calcium
- Under situations of minimal exposure to sunlight, like 1-2 y old children a specific recommendation of a daily supplement of 400 IU (10 µg).
- Data on vitamin D status is emerging
- Increased urbanization and poor outdoor activities
- Physical agents blocking UVB exposure such as clothing, skin pigmentation

Indian studies on mean 25(OH) Vitamin D concentrations

Location	Study population	Mean 25(OH)D level		Reference
		nmol/L	ng/mL	
Delhi	Pregnant women	21.9±10.73	8.8	Goswami *et al Am J Clin Nutr* 2000;72:472-5.
	New born	16.72±4.99	6.7	
Delhi	Toddlers	31	12.4±7	Agarwal *et al Arch Dis Child* 2002;87:111–13.
	Infants	70	28±7	
Kashmir	Men	37.7±30	15.1	Zargar *et al Post grad Med J* 2007;83:713-6
	Women	13.8±11	5.5	
Lucknow	controls	61±36	24.4	Balasubramanian *J Trop Pediatr.* 2003;49(4):201-6.
	Rickets/OSM	49±38	19.4	
Vellore	Postmenopausal w	52	20.8±8.6	Paul *et al Endocr Pract* 2008;14:665-
Lucknow	Cord blood (OSM)	30	12±8	Sachan *et al Am J Clin Nutr* 2005;81:1060-4.
	Cord blood (no)	35.8	14.3±9.5	
Hyderabad	Children 6-18 y	77.5	31.0	Sivakumar et al Nutrition 22 (2006) S9
Delhi	10-14 y	30	11.9±5.6	Khadgawat , Marwaha et al Osteoporos Int, 2013
Average (7)		**37.5**	**15**	

Efficacy of Vitamin D Fortification on serum 25(OH) D concentration- A meta-analysis of RCT



- 16 studies were included, of which 14 showed a significant effect of fortified foods on 25(OH)D.
- When combined in a random effects analysis (n = 1513; 767 treated, 746 controls), a mean individual intake of ~11 µg/d (440 IU/d) from fortified foods (range, 3-25 µg/d) increased 25(OH) D by 19.4 nmol/L corresponding to a 1.2nmol/L (95% CI: 0.72, 1.68) increase in 25(OH)D for each 1 µg ingested.

-Black J. Nutr. 2012; 142(6)

Vitamin D intake to achieve optimum of 50 nmol/L of 25(OH)D in Indians

Considering the following:

- Optimum 25(OH) D of 20 ng/mL or 50 nmol/L
- Increase in 25(OH)D of 1.2nmol/L for each 1 µg of vitamin D ingested
- Average circulating level of 15 ng/mL or 37.5 nmol/L of 25(OH)D
- Deficit in 25(OH)D is about 5 ng/mL or 12.5 nmol/L

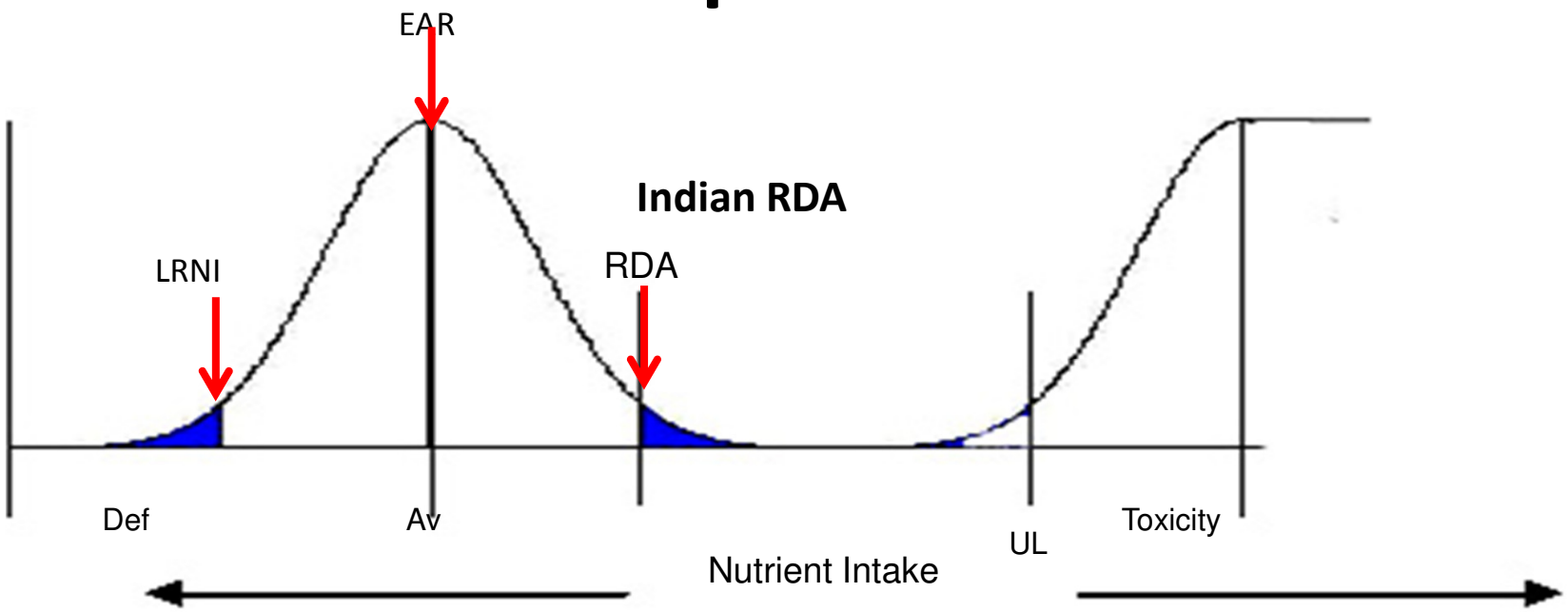
Intake of 10 µg/day or 400 IU/d

Level of Vitamin D for Fortification of Milk in India

- Monthly per capita quantity of consumption of milk is 4.1 L (rural) and 5.3 L (urban) in India.
- Consumption of milk and milk products is relatively concentrated in northern and western regions of India.
- The groups at greatest risk of vitamin D insufficiency consume less milk than do their other counterparts.
- Intake of milk is around 150 mL
- Fortification of milk with Vitamin D @ 70 µg/L or 2800 IU/L
- When multiple food sources are fortified level suggested is one third

Thank you

Concepts and Basis



Recommended Dietary Allowances (RDA), the daily dietary intake level of a nutrient considered sufficient to meet the requirements of 97.5% of healthy individuals in each life-stage and gender group.

Estimated Average Requirements (EAR), expected to satisfy the needs of 50% of the people in that age group.

Adequate Intake (AI), where no RDA has been established, adequate for everyone in the demographic group

Tolerable upper intake levels (UL), This is the highest level of daily consumption that current data have shown to cause no side effects in humans when used indefinitely without medical supervision.