Vitamin D in the UK

Rufus Greenbaum

- A private individual - interested in preventive health
- I understand the difference between *Hypothesis* & *RCT Evidence*
- Correspondence with UK government about Vitamin D
  - DoH, SACN, NICE, BNF & others
  - since December 2009
- Involved with 5 hospitals in NW London, since July 2010
- Organised 4 conferences about Vitamin D, since December 2010
- Now commercially involved:
  - *Ddrops Company* , Canada
  - *Bio-Tech Pharmacal* , USA

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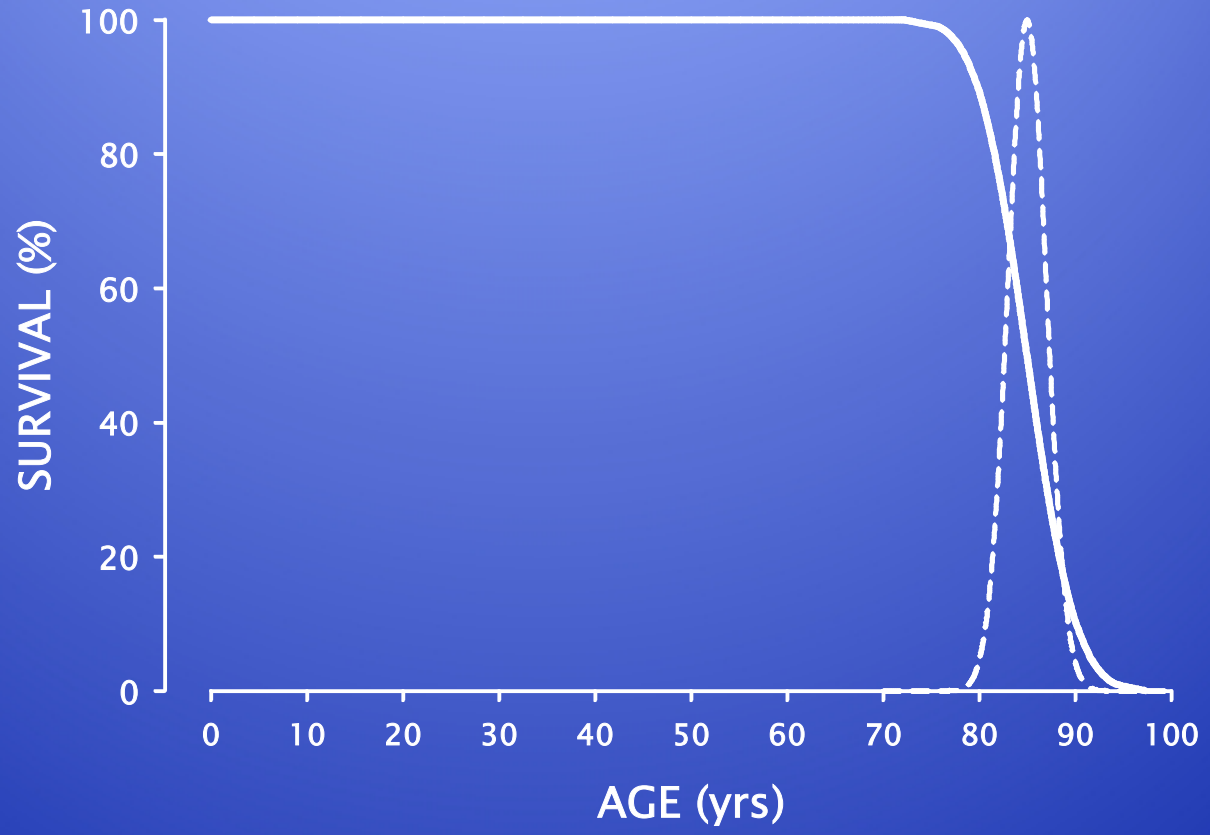
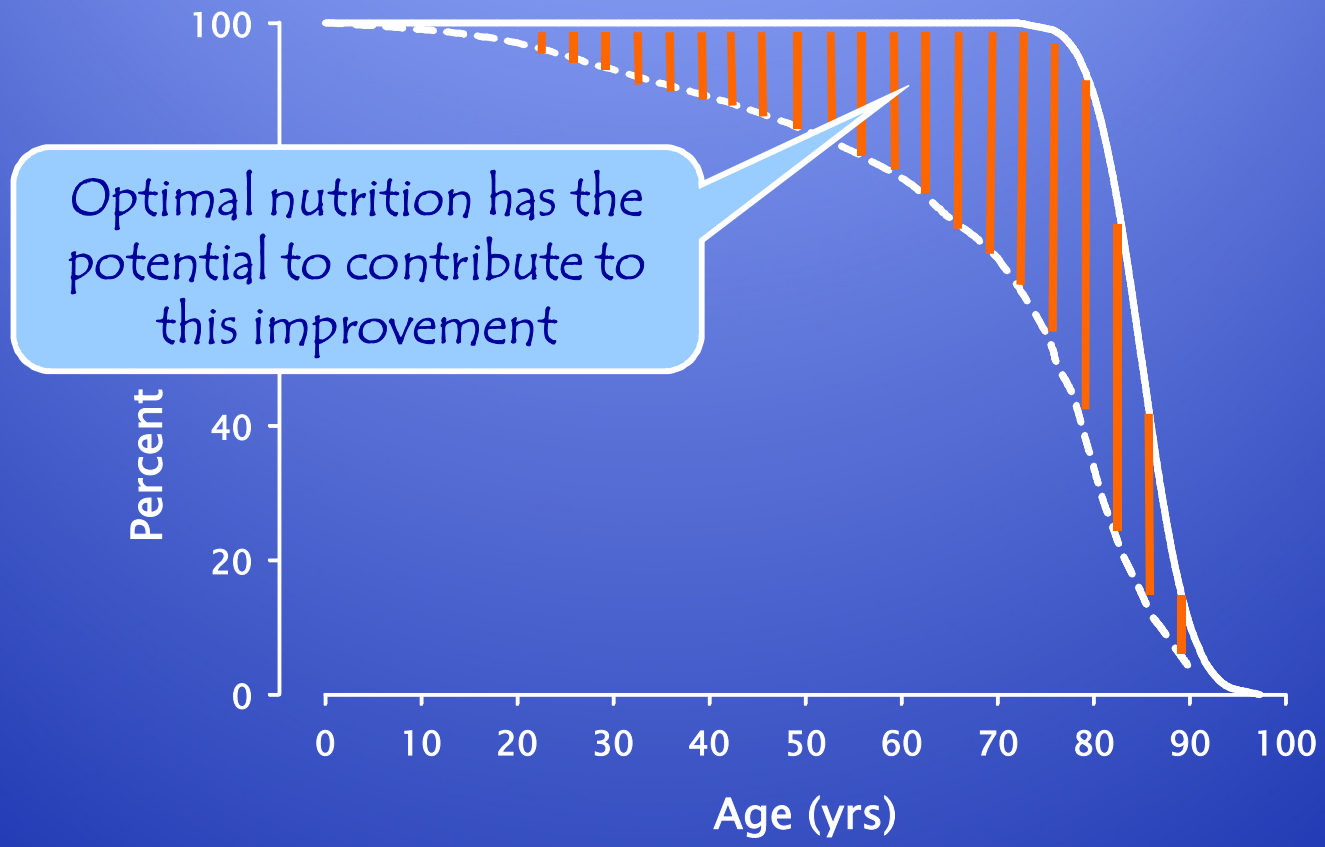
THEORETICAL MORTALITY CURVE



SQUARING THE MORTALITY CURVE



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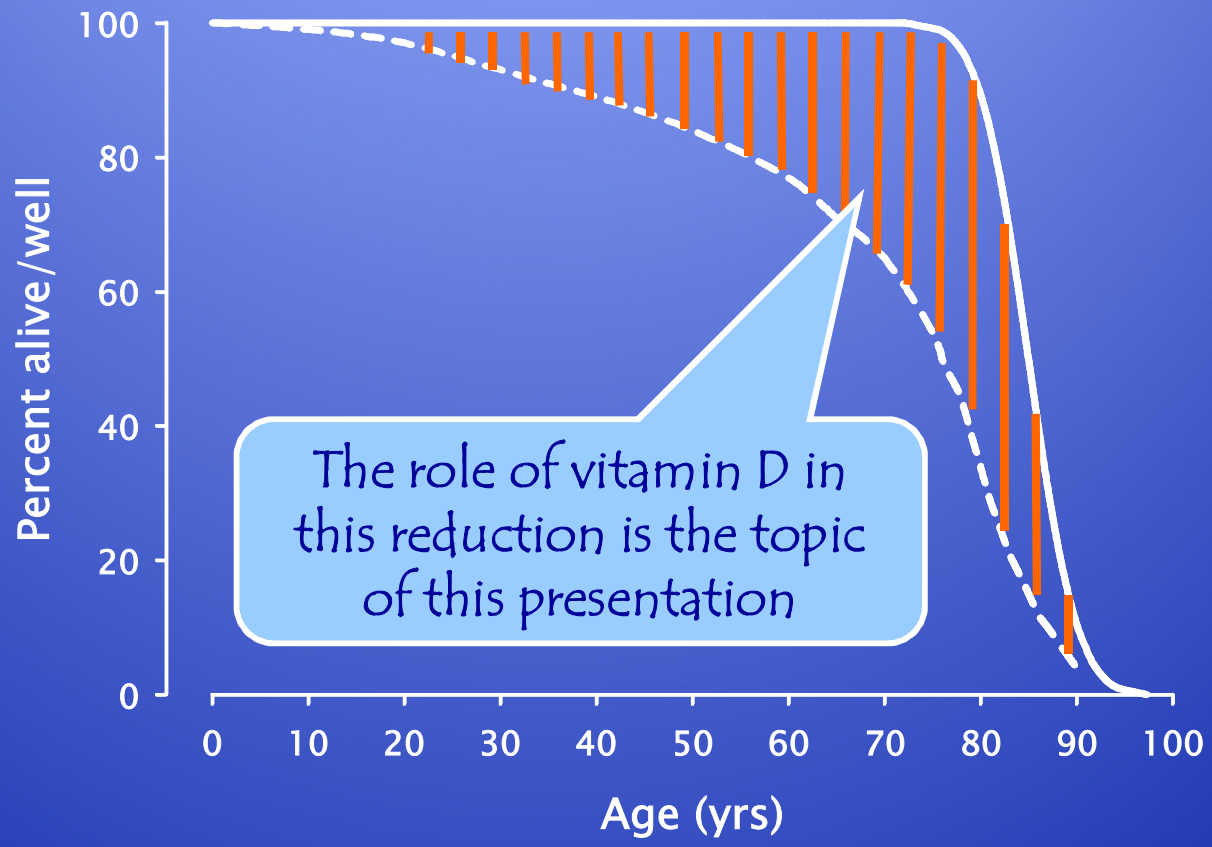

UK Data – England (50-55°N)

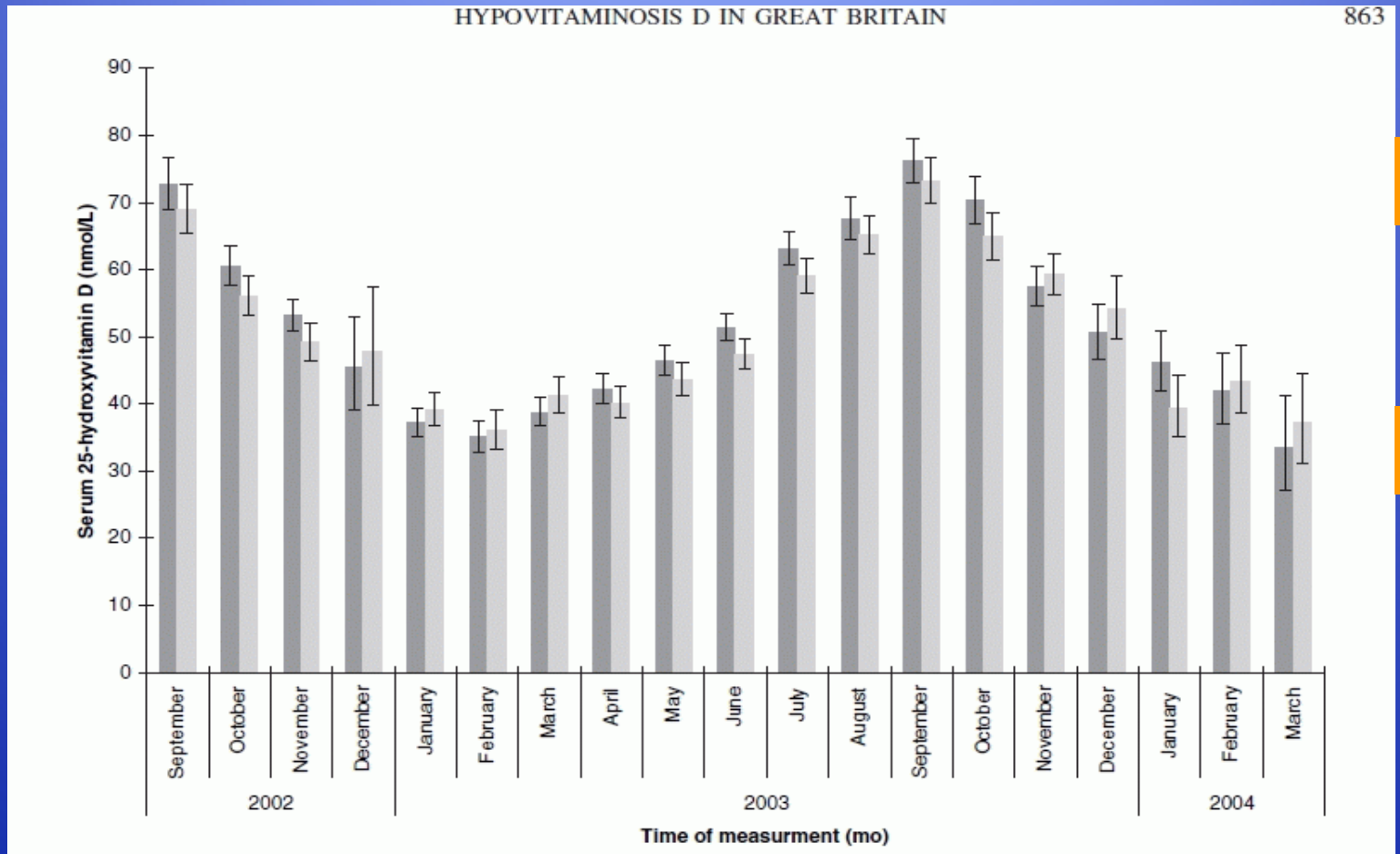

FIGURE 1. Geometric mean (95% CI) monthly variation in serum 25-hydroxyvitamin D [25(OH)D] concentrations in men (■; $n = 3725$) and women (▤; $n = 3712$) in the 1958 British birth cohort at age 45 y. The interaction between sex and month was significant [$P = 0.02$, linear regression analyses on log 25(OH)D]. n per sex and month ranged from 17 to 340: 98 in December 2003 for women and <100 for both sexes in December 2002 ($n = 40$ M, 37 F), January 2004 ($n = 95$ M, 75 F), February 2004 ($n = 58$ M, 70 F), and March 2004 ($n = 22$ M, 17 F).

<- 75nmol/L Summer

<- 35 nmol/L Winter

Source: Hypponen & Powers, Hypovitaminosis D in British adults at age 45 yrs: Nationwide cohort study, 2006

Actions depend on the definition !

If Target is:	*Action required:*
25 nmol/L *	(Current UK definition of *Deficient*) *No perceived national problem !* No preventive action required
50 nmol/L	(Current UK definition of *Adequate*) Minor Deficiency for a few months No preventive action required
75 nmol/L	Everyone is deficient all year round - now what action is required ?
100-150 nmol/L	Everyone is *very* deficient all year round - now what action is required ?

*** 25-hydroxyvitamin-D in blood test = 25(OH)D**

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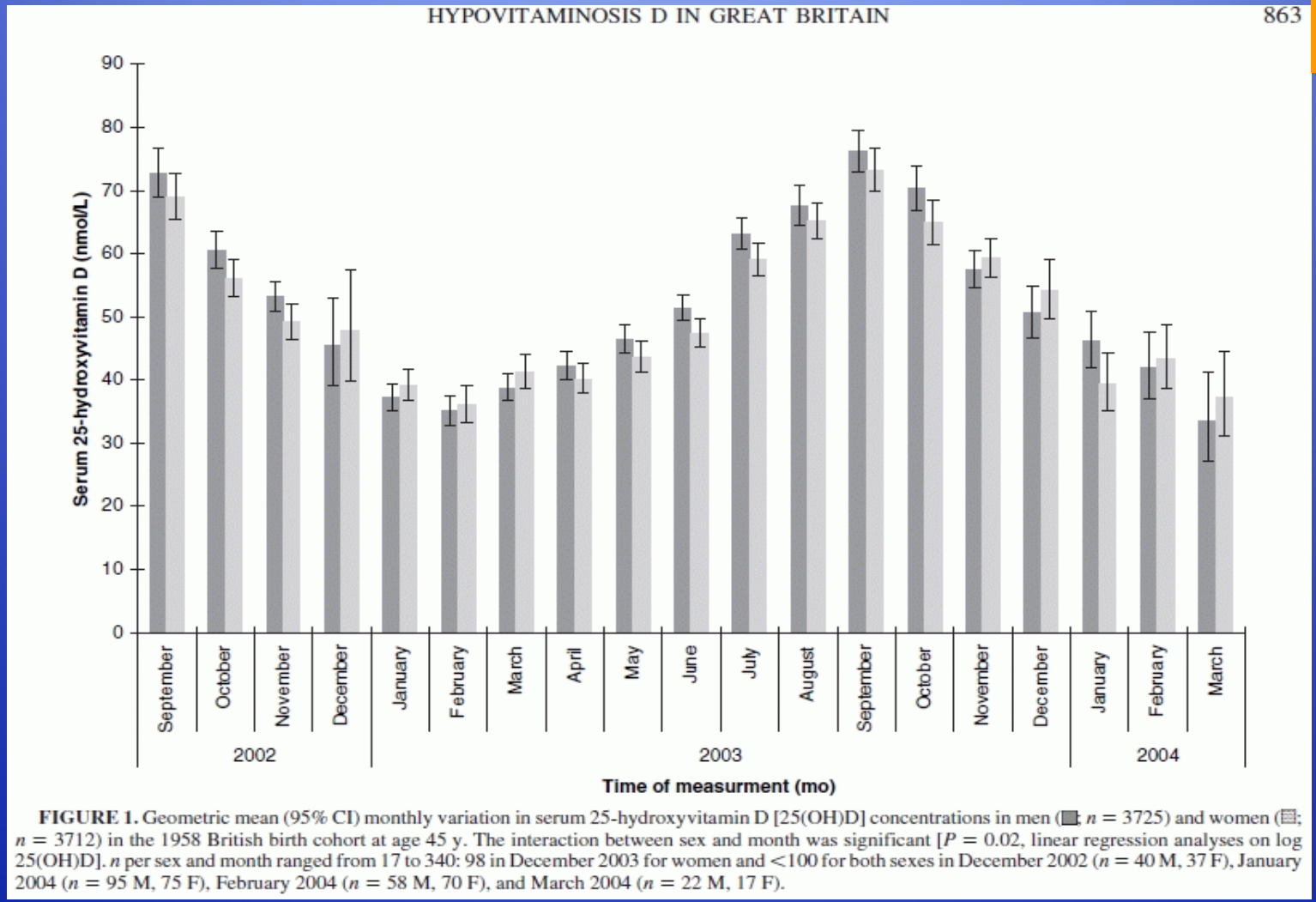
UK Data – England (50-55°N)

>100 nmol/L Target



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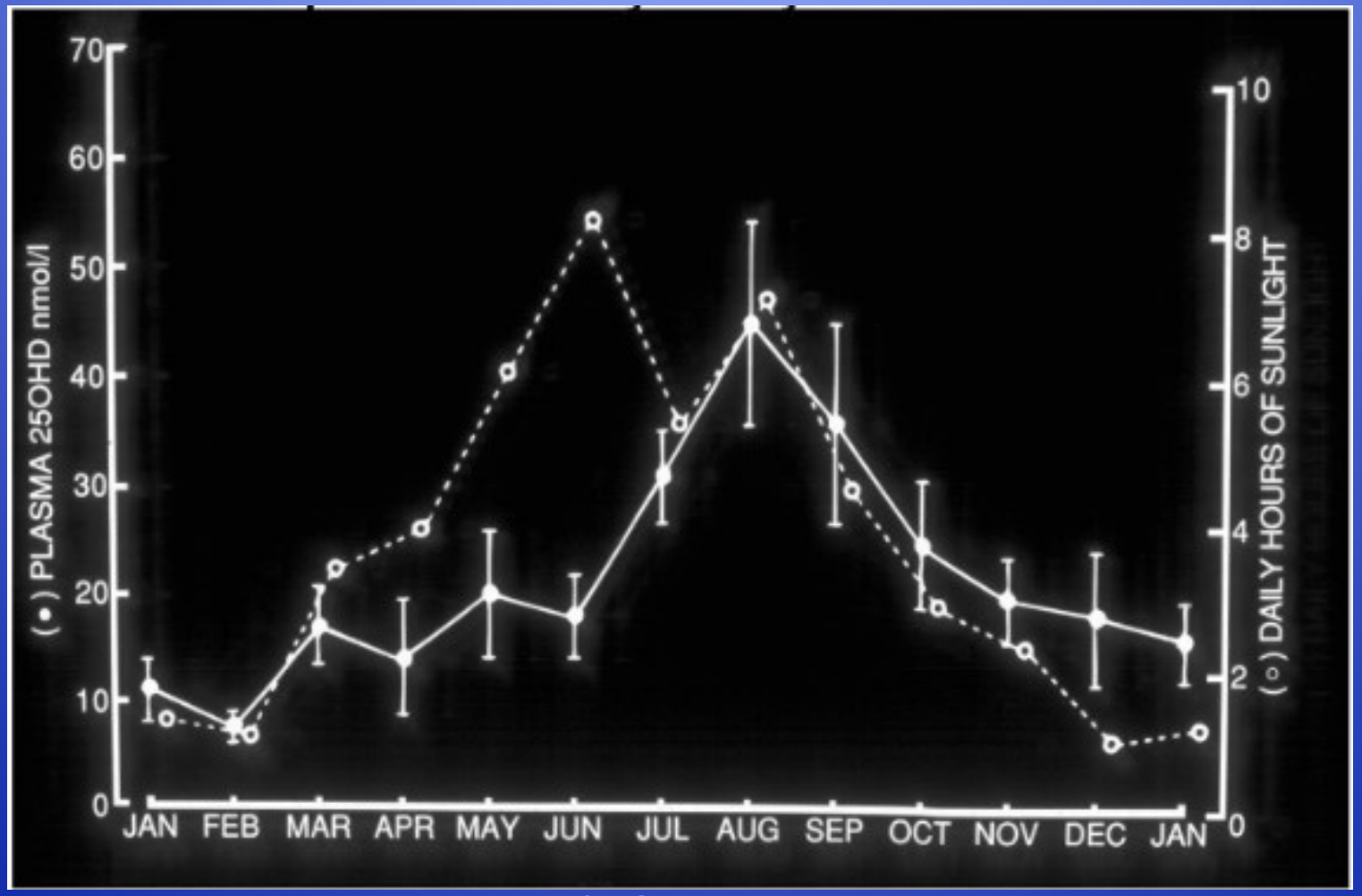
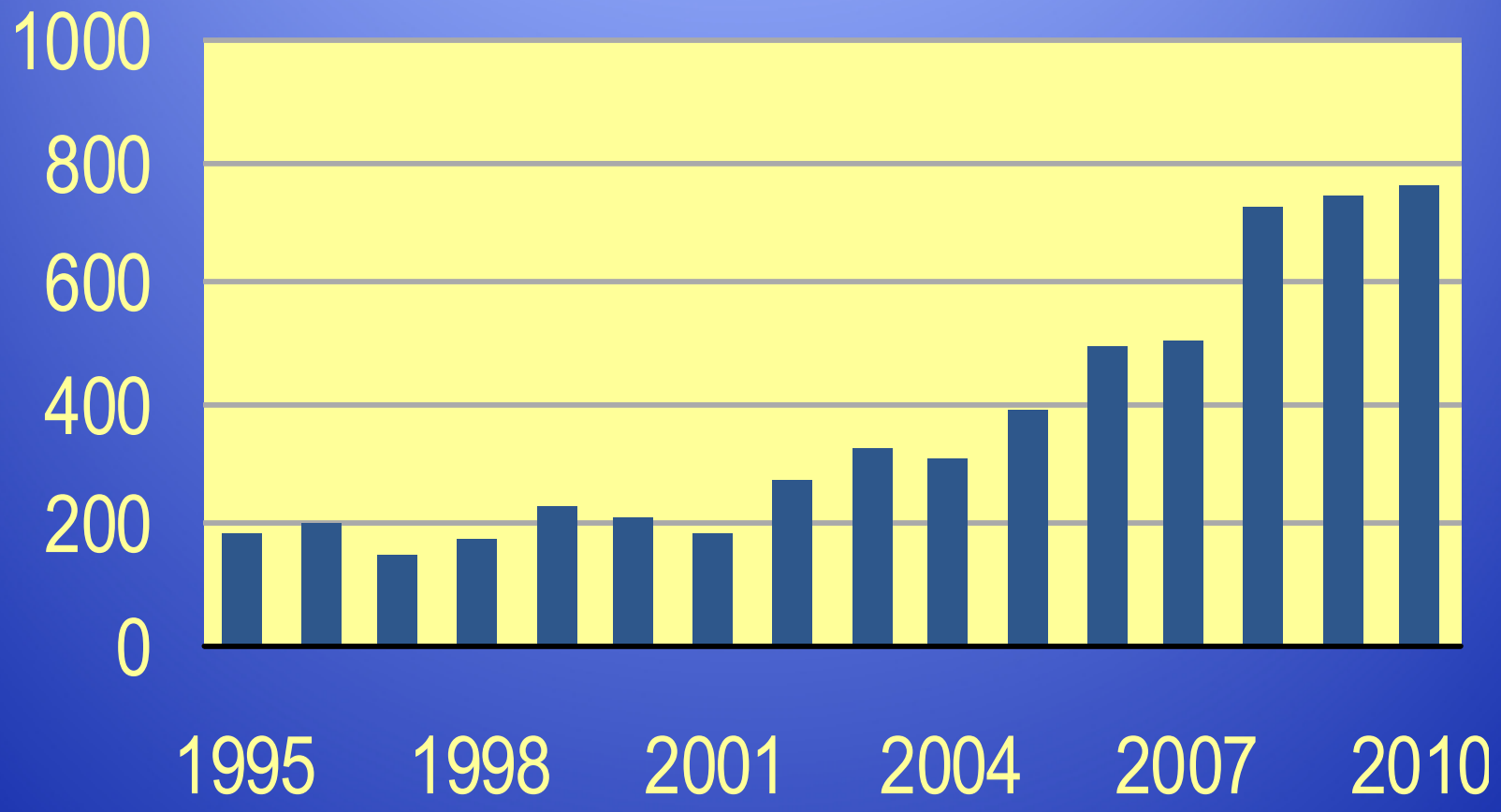
UK Data – Scotland (56-57°N)



UK Rickets – new cases each year – *Scandal !*



Source: Minister of State for Health, Simon Burns, Written Answer, Hansard, 2011-11-09

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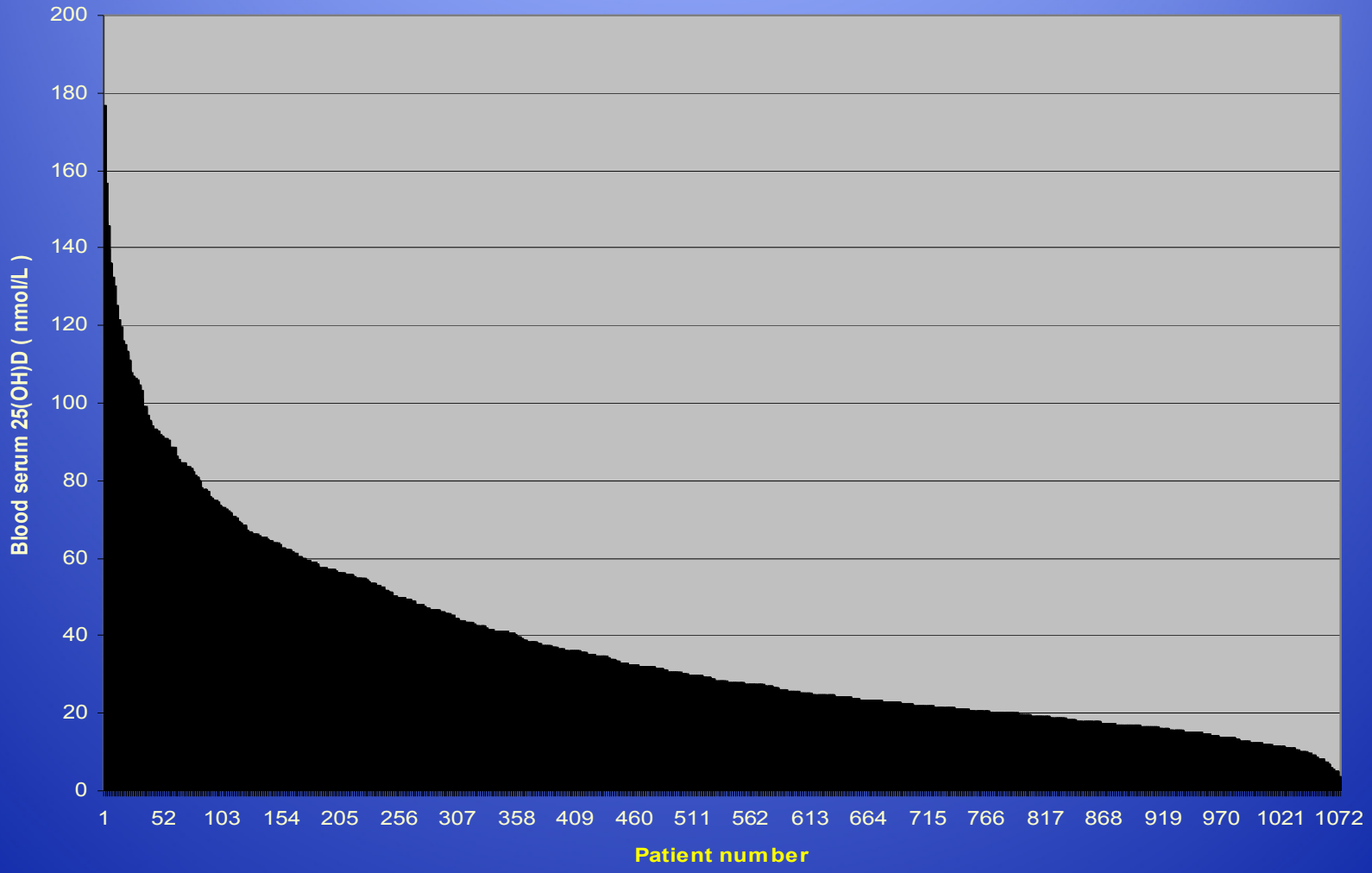
UK Hospitals – Blackburn



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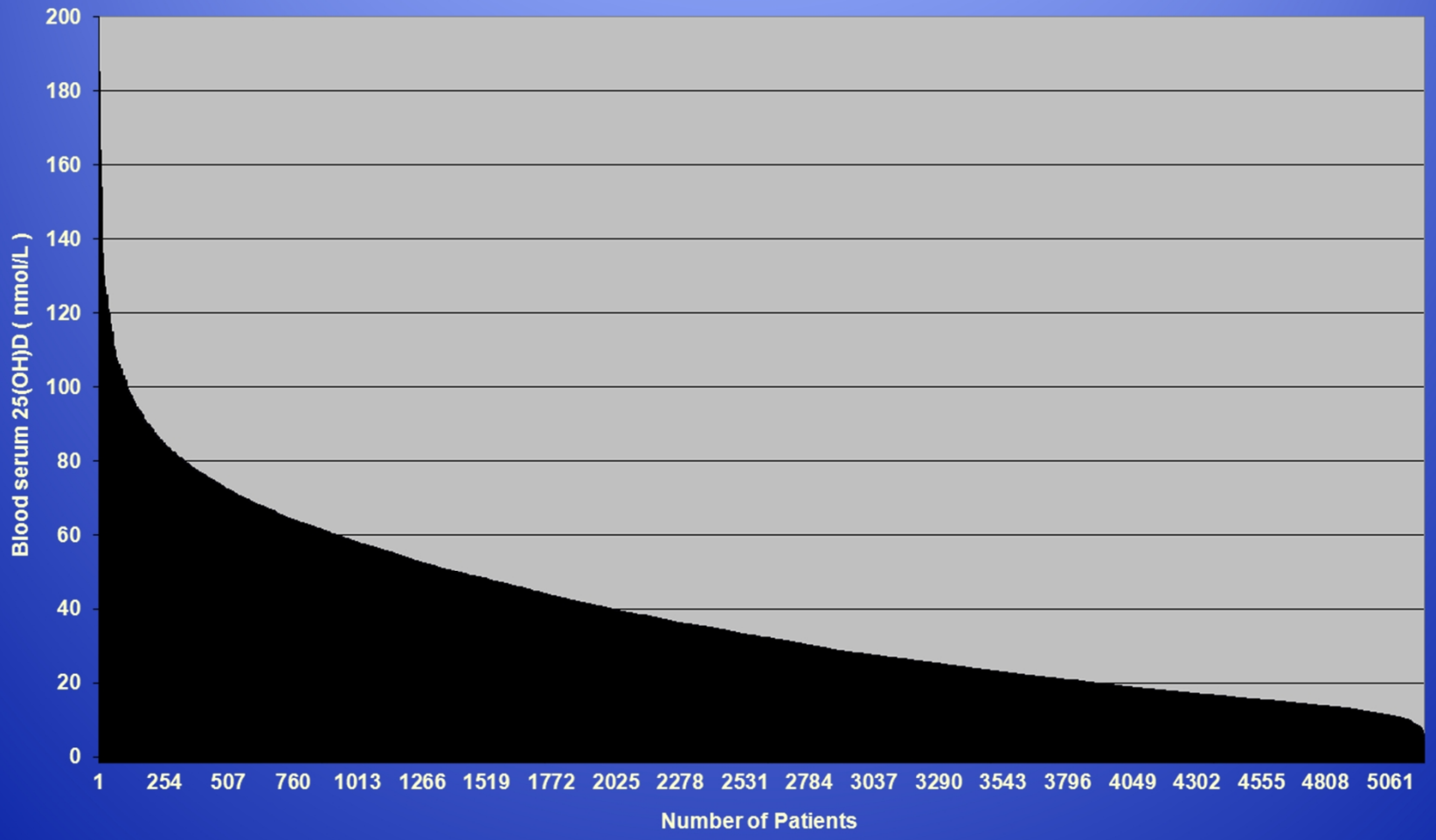
UK Hospitals – Ealing



UK Hospitals – Ealing

17 infants admitted from 2006 to 2008
- hypocalcaemic seizures, secondary to vitamin D deficiency
- majority had raised alkaline phosphatase and parathyroid hormone levels
- many had delays in achieving gross motor milestones especially in walking, as was reported in Victorian times.

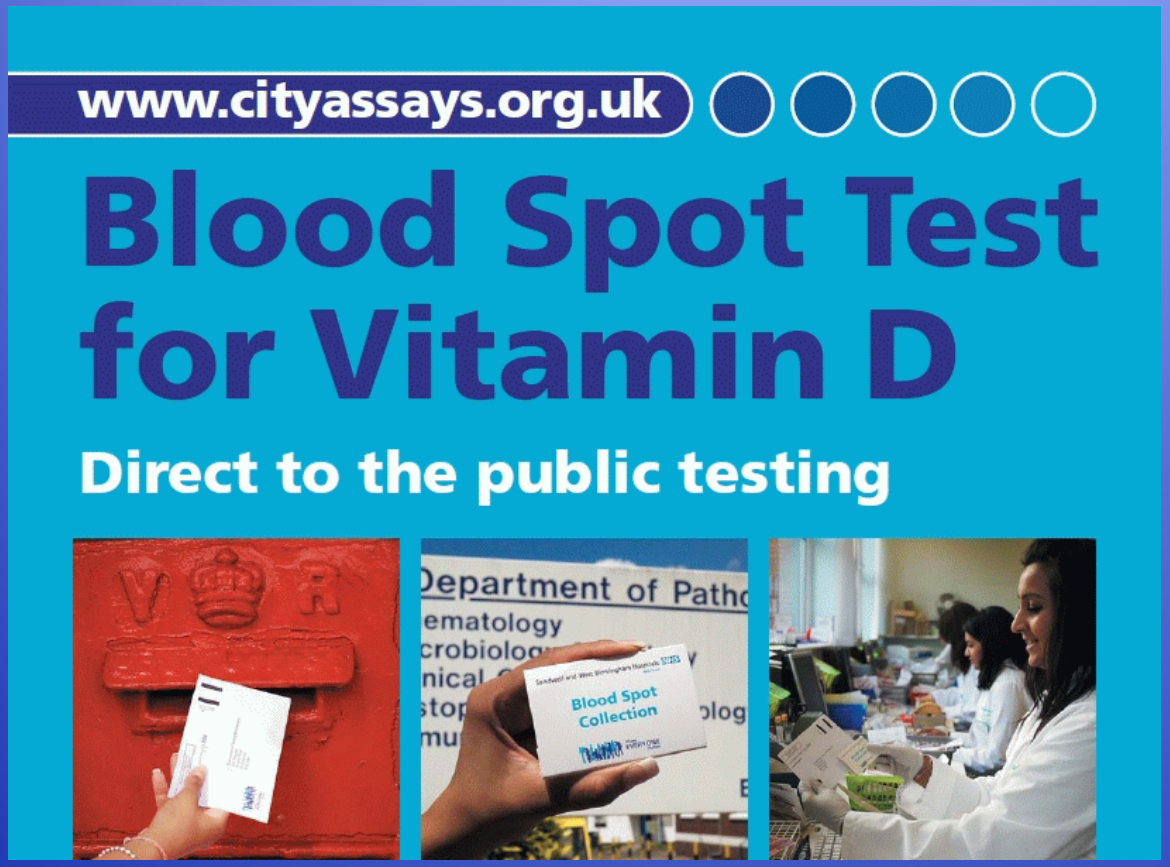
Small numbers of cases presented with cardiac failure, clinical rickets, tuberculosis, fractures and respiratory complications including wheezing in infancy.

Dr Colin Michie
Consultant Paediatrician
Ealing Hospital

Short, Medium & Long-term problems

Short (weeks)	Muscle pain
Medium (months)	Rickets, Psoriasis, Hypertension, Depression, Insulin resistance, Influenza, Falls in elderly, Infertility, Diabetes, Pre-Eclampsia Crohn's, Asthma +++ ???
Long (years)	Cancers, Multiple Sclerosis, Osteoporosis Alzheimer's, Parkinson's

Vitamin D – public testing for £25



Phone: 0121 507 4278 (Sandwell & West Birmingham Hospitals - NHS)

My Vitamin D test results:

I take 5,000 IU of Vitamin D3 each day:

Your Results:

Total vitamin D: 143.5 nmol/L

Status: Adequate 

25-hydroxyvitamin D_3: 140.7 nmol/L
25-hydroxyvitamin D_2: less than 2.8 nmol/L

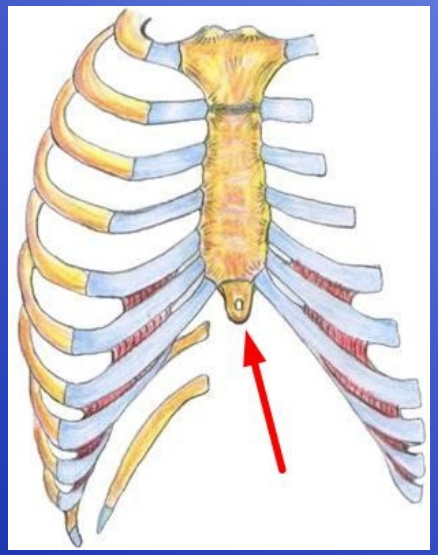
Interpretive Guide:

Reference Interval (nmol/L)	Vitamin D status
Less than 15	Severe Deficiency
15 – 30	Deficiency
30.1 – 50	Insufficiency
Greater than 50	Adequate

<- ???

Vitamin D – self-test

- *Quick, free, self test of vitamin D deficiency*
- *Not a quantitative test, but FREE*
- *Press as hard as you can on your sternum and your tibia*
- *Are your bones painful when you press them ?*



If you feel pain: Mayo Clinic says 93% chance that you are Vitamin D deficient

Vitamin D – Call to Action - 1

Vitamin D*action

A Consortium of Scientists, Institutions, and Individuals
Committed to Solving the Worldwide Vitamin D Deficiency Epidemic

University of California Scientists Panel

University of California Davis
Bruce D. Hammock, Ph.D.
Hari A. Reddy, Ph.D.
Ray Rodriguez, Ph.D.
University of California Los Angeles
John Adams, M.D.
Martin Hewison, Ph.D.
H. Phillip Koeffler, M.D.
Keith C. Norris, M.D.
University of California Riverside
Mathew Mizwicki, Ph.D.
Anthony W. Norman, Ph.D.
Laura P. Zanello, Ph.D.
University of California San Diego
Richard L. Gallo, M.D., Ph.D.
Cedric F. Garland, Dr. P.H.
Frank C. Garland, Ph.D. †
Edward D. Gorham, Ph.D.
Tissa Hata, M.D.
University of California San Francisco
David Gardner, M.S., M.D.
Bernard P. Halloran, Ph.D.

International Scientists Panel

Scientists' Call to D*action

The Vitamin D Deficiency Epidemic

40-75% of the world's population is vitamin D deficient.

The causal link between severe vitamin D deficiency and rickets or the bone disease of osteomalacia is overwhelming, while the link between vitamin D insuffiency and osteoporosis with associated decreased muscle strength and increased risk of falls in osteoporotic humans is well documented by evidence-based intervention studies.

There are newly appreciated associations between vitamin D insufficiency and many other diseases, including tuberculosis, psoriasis, multiple sclerosis, inflammatory bowel disease, type-1 diabetes, high blood pressure, increased heart failure, myopathy, breast and other cancers which are believed to be linked to the non-calcemic actions of the parent vitamin D and its daughter steroid hormone. Based on the evidence we now have at hand, action is urgent.

Vitamin D – Call to Action - 2

Atascadero State Hospital
John J. Cannell, M.D.
Boston University School of Medicine
Michael F. Holick, Ph.D., M.D.
Creighton University
Robert P. Heaney, M.D.
Joan M. Lappe, Ph.D., R.N.
Emory University
Vin Tangpricha, M.D., Ph.D.
Harvard School of Public Health
Edward Giovannucci, M.D., ScD.
Walter C. Willett, Dr. P.H., M.D.
International Medical Center of Japan
Tetsuya Mizoue, M.D., Ph.D.
Linus Pauling Institute
Adrian F. Gombart, Ph.D.
Massachusetts General Hospital
Carlos A. Camargo, Jr., M.D., Dr. P.H.
McGill University
John H. White, Ph.D.
Medical University of Graz, Austria
Stefan Pilz, M.D.
Medical University of South Carolina
Bruce W. Hollis, Ph.D.
Carol L. Wagner, M.D.
Roswell Park Cancer Institute
Candace Johnson, Ph.D.
Donald L. Trump, M.D.
Society For Medical Information and Prevention
Joerg Spitz, M.D.
Sunlight, Nutrition and Health Research Center
William B. Grant, Ph.D.
University of Albany - SUNY
JoEllen Welsh, Ph.D.
University of Alberta
Gerry Schwalfenberg, M.D., CCFP
University of Saskatchewan
Susan J. Whiting, Ph.D.
University of Toronto, Mt Sinai Hospital
Reinhold Vieth, Ph.D.

It is projected that the incidence of many of these diseases could be reduced by 20%-50% or more, if the occurrence of vitamin D deficiency and insufficiency were eradicated by increasing vitamin D intakes through increased UVB exposure, fortified foods or supplements. The appropriate intake of vitamin D required to effect a significant disease reduction depends on the individual's age, race, lifestyle, and latitude of residence. The latest Institute of Medicine (IOM) report, 2010, indicates 10,000 IU/day is considered the NOAEL (no observed adverse effect level). 4000 IU/day can be considered a safe upper intake level for adults aged 19 and older.

It is well documented that the darker the skin, the greater the probability of a vitamin D deficiency. Even in southern climates, 55% of African Americans and 22% of Caucasians are deficient.

More than 1 billion people worldwide are affected at a tremendous cost to society.

A Scientists' Call to Action has been issued to alert the public to the importance to have **vitamin D serum levels between 40 and 60 nanograms/milliliter (100-150 nanomoles/liter)** to prevent these diseases. Implementing this level is safe and inexpensive.

The benefit of an adequate vitamin D level to each individual will be better overall health and a reduction in illnesses and, ultimately, a significant reduction in health care costs. The benefit of adequate vitamin D levels to society/businesses is a more productive workforce and, lower health care costs.

The D*action project has as its purpose to serve as a model for public health action on vitamin D. It is a test bed for techniques, and for providing outcome evaluation at a community level.

Revised 1/12/11

GrassrootsHealth, A Public Health Promotion Organization
119 N. El Camino Real, Suite E-127, Encinitas, CA 92024 www.grassrootshealth.net

Vitamin D in Pregnancy & Lactation

- **Review** by Katie Bolland & Rufus Greenbaum
  Published in *The Nutrition Practitioner*, Summer 2011

- **Adverse consequences for mother & baby if mother is deficient**
- **Adverse consequences if children are deficient**

- ***There is ample epidemiological, ecological and anthropological evidence for every pregnant woman to require levels of 120-200 nmol/L, since the foetus takes the primary supply of nutrients***

- ***Evidence*** **that increased Vitamin D reduces:**
  pre-eclampsia, gestational diabetes, emergency C-sections, anaemia, bacterial vaginosis, pre-term delivery, miscarriages & post-natal depression

- **Randomised Controlled Trial by Hollis & Wagner**
  *** Gave 4,000 IU / day to pregnant women**
  *** *Safe* and *effective***
  *** Babies were bigger & healthier**

Vitamin D - UK - National

Department of Health	September 2012
Secretary of State for Health	Jeremy Hunt
Minister of State	Norman Lamb
Under Secretary of State	Anne Soubry
Under Secretary of State	Dr Daniel Poulter
Under Secretary of State	Lord Howe
Chief Medical Officer (CMO)	Dame Sally Davies

National Institute for Health & Clinical Excellence (NICE)

- *Review underway since October 2012*

Scientific Advisory Committee on Nutrition (SACN)

– will issue report in mid-2014 (Risk Assessment only)

Medicines & Health Regulation Agency (MHRA)

British National Formulary (BNF)

Timescales ?

Government & researchers will take years before they recommend changes

Health Professionals and patients can take action in days !

My submission to SACN - 1

- Evidence from biomarkers that deficiency = 25(OH)D < 100 nmol/L
  - Circulating 25-hydroxyvitamin-D levels indicative of Vitamin D sufficiency
    (Dr Bruce Hollis, 2005, American Society for Nutritional Sciences)
  - Vitamin D in preventive medicine – are we ignoring the evidence ?
    (Dr Armin Zittermann, 2003, British Journal of Nutrition)
  - Why minimum 25-hydroxyvitamin D should be >75 nmol/L
    (Dr Reinhold Vieth, 2011, JBEEM 25 681-691)
- 3 Biomarkers:
  - Parathyroid Hormone (PTH)
  - Calcium Absorption
  - Bone Mineral Density (BMD)
- My reading of these 3 papers is that below 100 nmol/L:
  - The body uses up stores of Vitamin D – *required by many genes*
  - Muscle strength is reduced
  - BMD is reduced by withdrawal of Calcium from the bones

* Copy of full submission available on request

My submission to SACN - 2

Estimation of optimal serum concentrations of 25-hydroxyvitamin D for multiple health outcomes

(Dr Heike Bischoff-Ferrari, 2006, American Society for Nutrition)

- **Lower Extremity Functions – *for older people*:**
  - **"8-foot walk time" showed major improvements above 60 nmol/L**
  - **"Sit-to-stand time" showed major improvements above 40 nmol/L, (with continued minor improvements up to 120 nmol/L)**
- **Periodontal Disease**
  - **Improvements were seen as 25(OH)D increased from 71-112 nmol/L**
  - **Dental "Attachment Loss" reduced when 25(OH)D was 90-100 nmol/L**
- **Colorectal Cancer**
  - **Less Colorectal Cancer when 25(OH)D is higher**

* Copy of full submission available on request

* My submission to SACN - 3

The amount of colecalciferol required to raise the 25(OH)D levels of the average UK person to the lower limit of 100 nmol/L:

Season	Dose (micrograms)	Dose (IU)
Winter	100 micrograms/day	4,000 IU/day
Summer	50 micrograms/day	2,000 IU/day

- *Compliance may be better with a weekly supplement of 20,000 IU*
- *Obese people should increase the dose (maybe double required)*
- *People who cover their bodies should take the full winter dose all year long*
- *Without a "Loading Dose", 25(OH)D takes 90-120 days to stabilise*
- *The dose / response varies for about 10% of the population*
- *Study of 3,500 people taking large doses at: www.grassrootshealth.net*
- *Supplementation required for life (not a 1-off top-up like iron)*
- *Whole family should be tested or supplemented*

* Copy of full submission available on request

rufus@greenbaum.com

How much Vitamin D do I need ?

Rough Guide:

25 micrograms per day raises your blood level by 25 nmol/L
- in about 3 months

Examples:

Start	Target	Dose required – per day
25 nmol/L	50 nmol/L	25 micrograms (1,000 IU)
25	75	50 micrograms (2,000 IU)
25	100	75 micrograms (3,000 IU)
25	125	100 micrograms (4,000 IU)
25	150	125 micrograms (5,000 IU)

Vitamin D Co-factors

If you take more than 2,000 IU of Vitamin D each day consider taking co-factors such as:

- *Vitamin K*
- *Magnesium*
- *Zinc*
- *Boron*

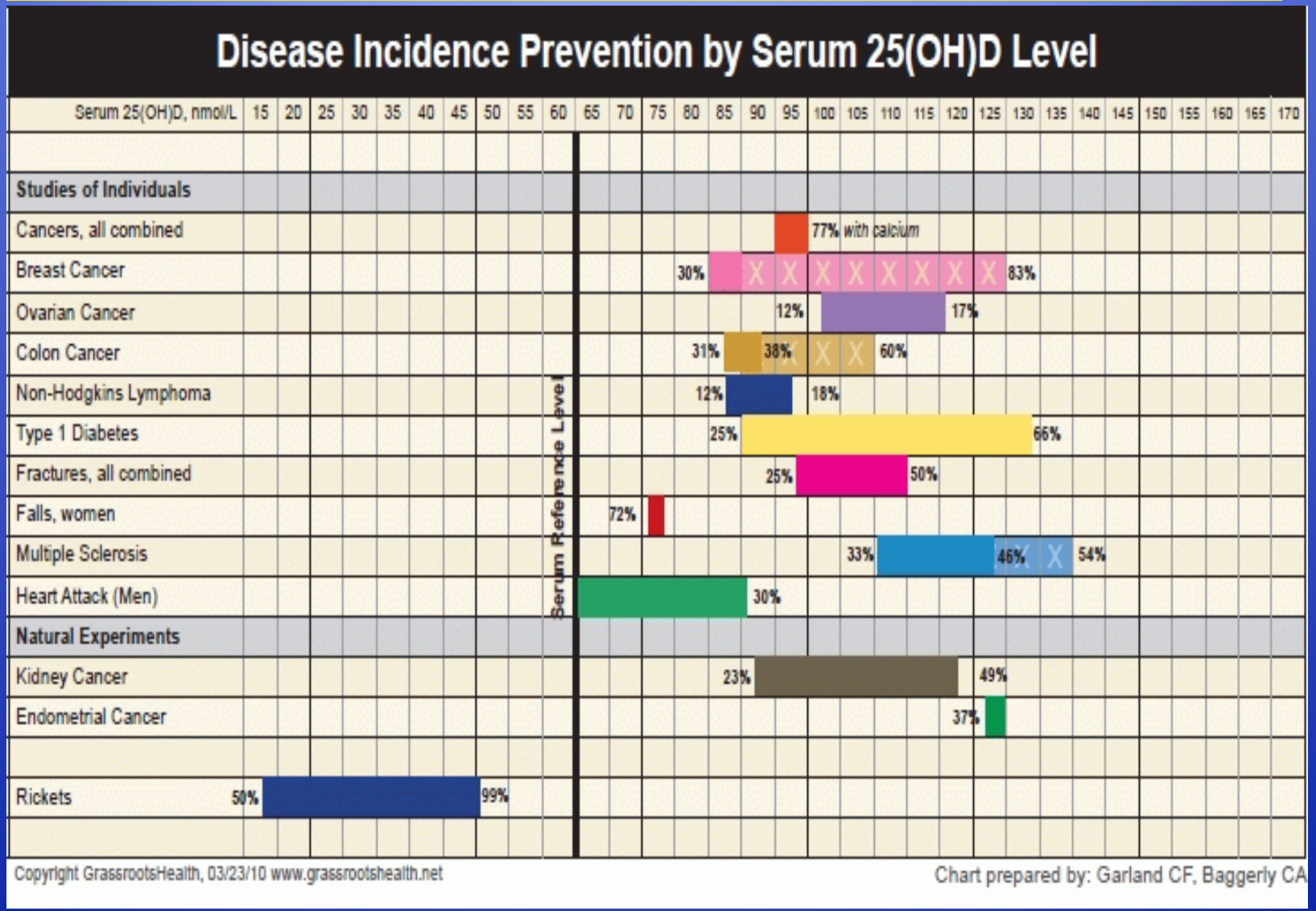
Directs more calcium into the bones
Reduces calcium in the arteries

Example: D3Plus from www.biotechpharmacal.com
Read more at: www.vitamindwiki.com

Vitamin D - UK Local Action

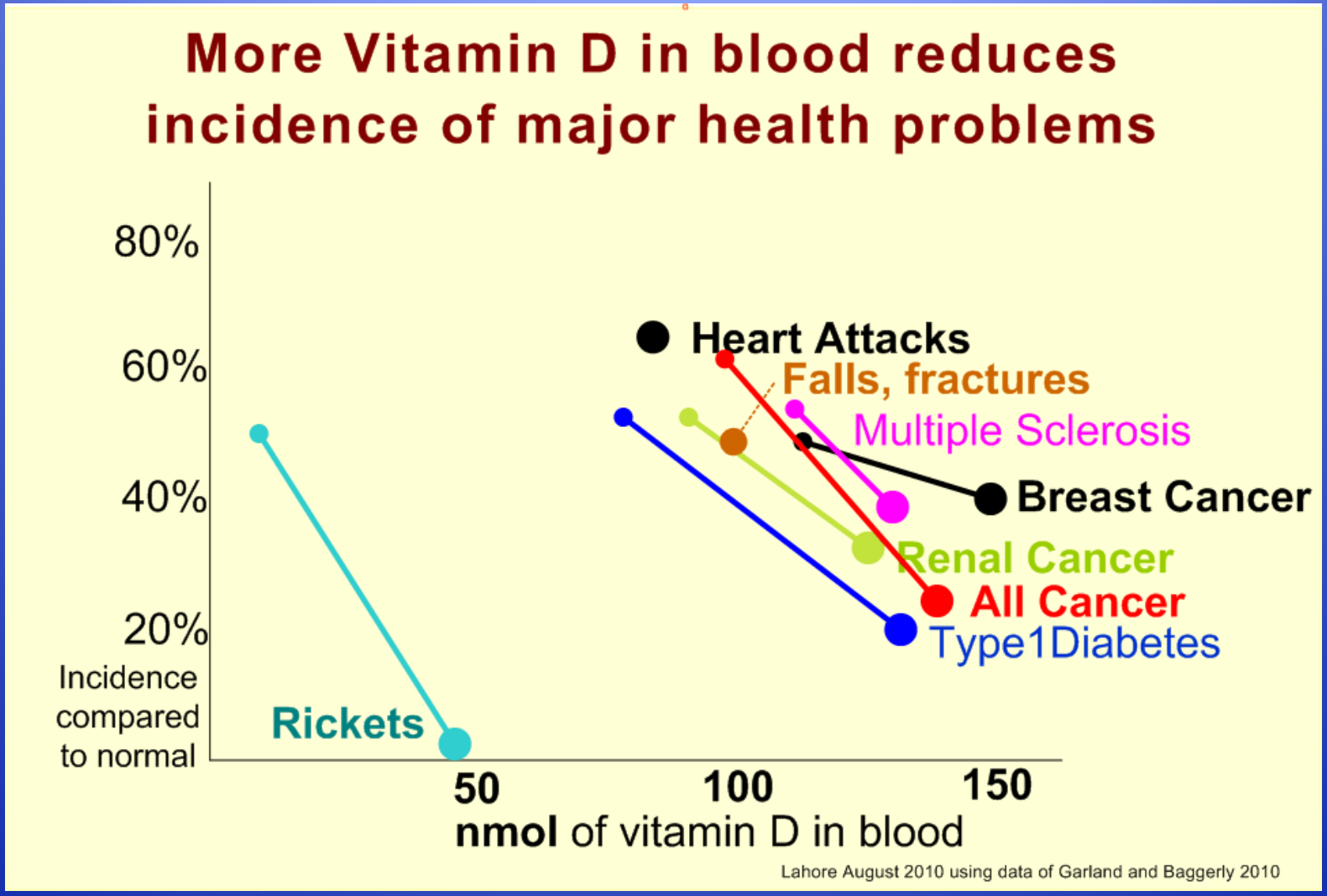
- *Monitor and supplement Vitamin D levels to > 100 nmol/L*
  - ** Cost / Benefit is massive for the people at risk*
  - ** This is an "Easy/Hard" challenge*
  - ** Each step is easy - making it happen everywhere is hard !*
- *Local Action ?*
  - ** Hospital doctors & specialists to take the lead ?*
  - * Public Health Directors & Doctors
  - * Paediatric Endocrinology
  - * Community Paediatrics & Dietetics
  - * Health Visitors & Midwives
  - * Doctors & Nurses in General Practice
  - * Pharmacists
- *Health Insurance Companies ?*
  - * BUPA / PPP / WPA would benefit from wide supplementation

Disease Prevention



Source: Vitamin D for Cancer Prevention (Professor Cedric Garland et.al www.ucsd.edu 2009)

Vitamin D – Overview 1



Vitamin D – Overview 2

Hypothesis: Reduced sun exposure over past 40 years has resulted in more disease

Less sun => Less Vitamin D => More disease

Less time outdoors
- Air Conditioning
- TV & internet & video games
- Live in smoggy cities
  or in suburbs with little walking
- Less work outdoors
- Fear skin cancer and wrinkles

Less sun when outdoors
- Sunscreen
- Protective clothing

Additional reasons at:
http://is.gd/lowvitamind

Henry Lahore 5/12 VitaminDWiki
details at is.gd/sundisease

More disease

Breast Cancer, Diabetes*, Rickets, Pregnancy problems, MS*, Influenza, Falls/fractures*, Osteopenia*, Osteoporosis*, Cognitive Decline

Strong Proof
that increase in Vit D decreases incidence

* = TREAT too

Allergy, ALS, Anemia, Asthma, Autism, Bone, Cancers, Celiac, Chronic Fatigue, Chronic Pain, COPD, Dental, Depression, Headache, Heart Disease, Hypertension, HIV, IBD, Kidney, Metabolic Syndrome, MRSA, Myopathy, Overweight, Psorasis, RA, Sepsis, Thyroid, TB

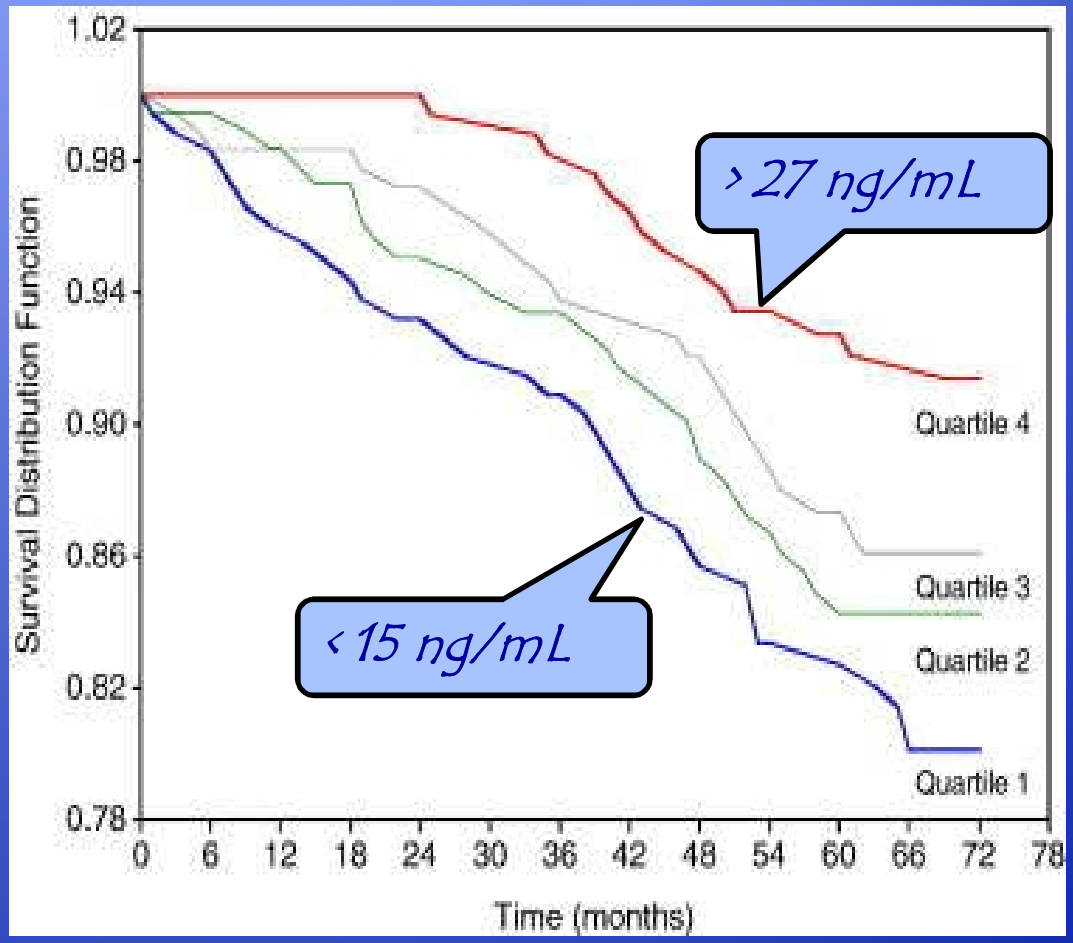
Associated
with low Vit D for most people with the disease

Cystic Fibrosis, Liver, Lupus, Osteoarthritis, Rosecea, Vision

Suspected
relationship with low Vitamin D

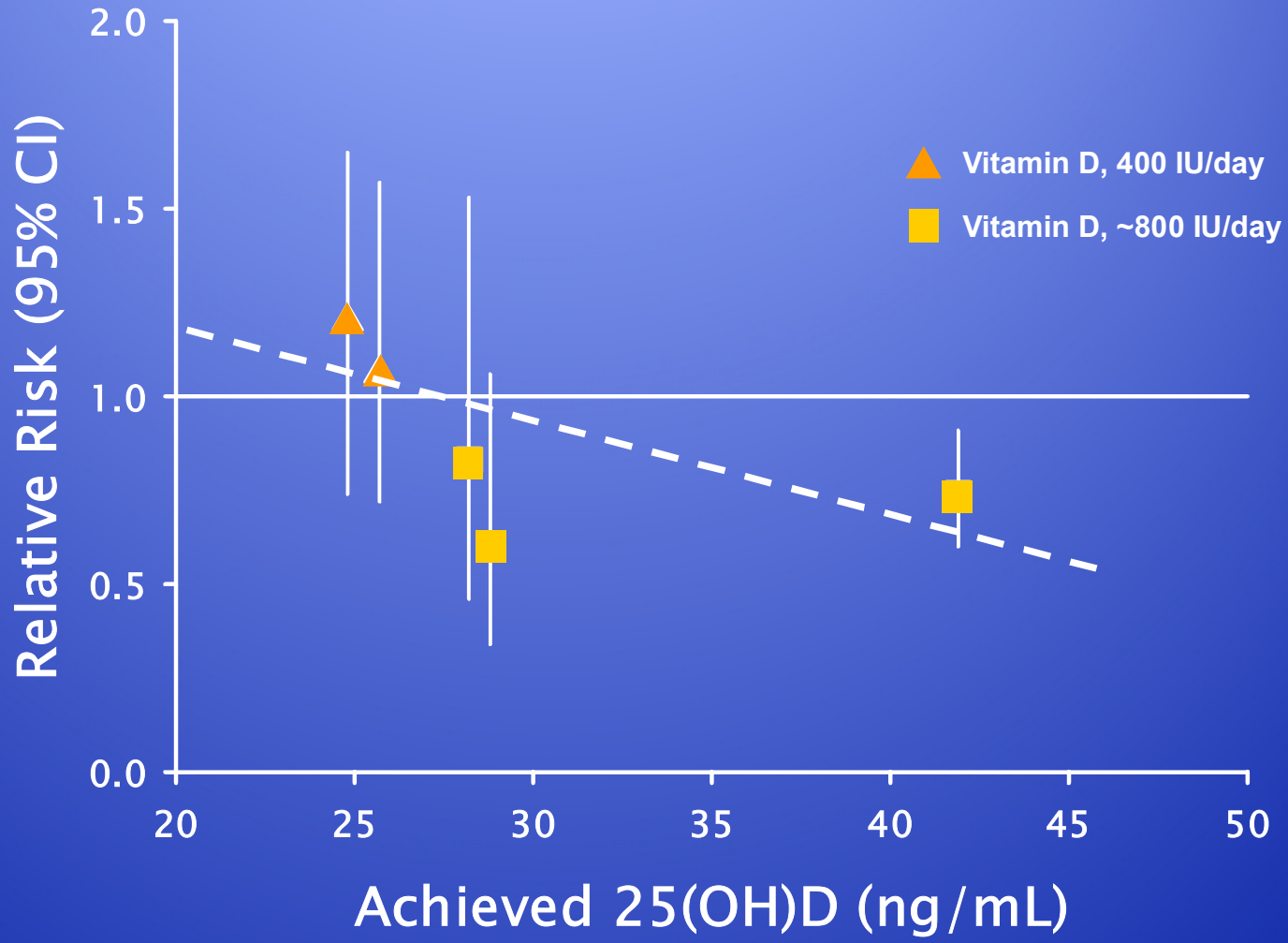
ALL-CAUSE MORTALITY*

- 714 community dwelling women
- aged 70–79
- Baltimore Women's Health & Aging Studies I & II
- median follow-up: 72 months
- risk adjusted for age, race, BMI, & other factors associated with mortality



* Semba et al. (2009) Nutr Res 29:525–530

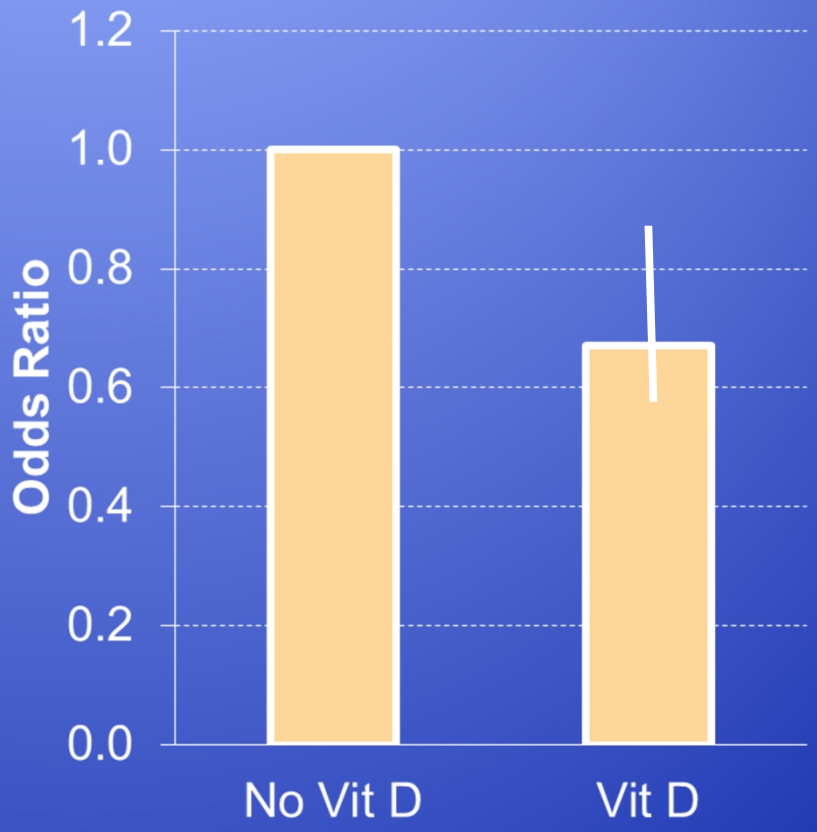
Fracture Risk*



*Redrawn from Bischoff-Ferrari et al. *JAMA*. 2005;293:2257–2264

Neonatal Vitamin D & Diabetes

- EURODIAB Study
- 7 European countries
- Case control = 820 cases (~80 % eligible population)
- Vitamin D supplements given in infancy
- ***Risk of Type 1 diabetes at age 15 reduced by 30%***



*Diabetologia 1999; 42:51-54

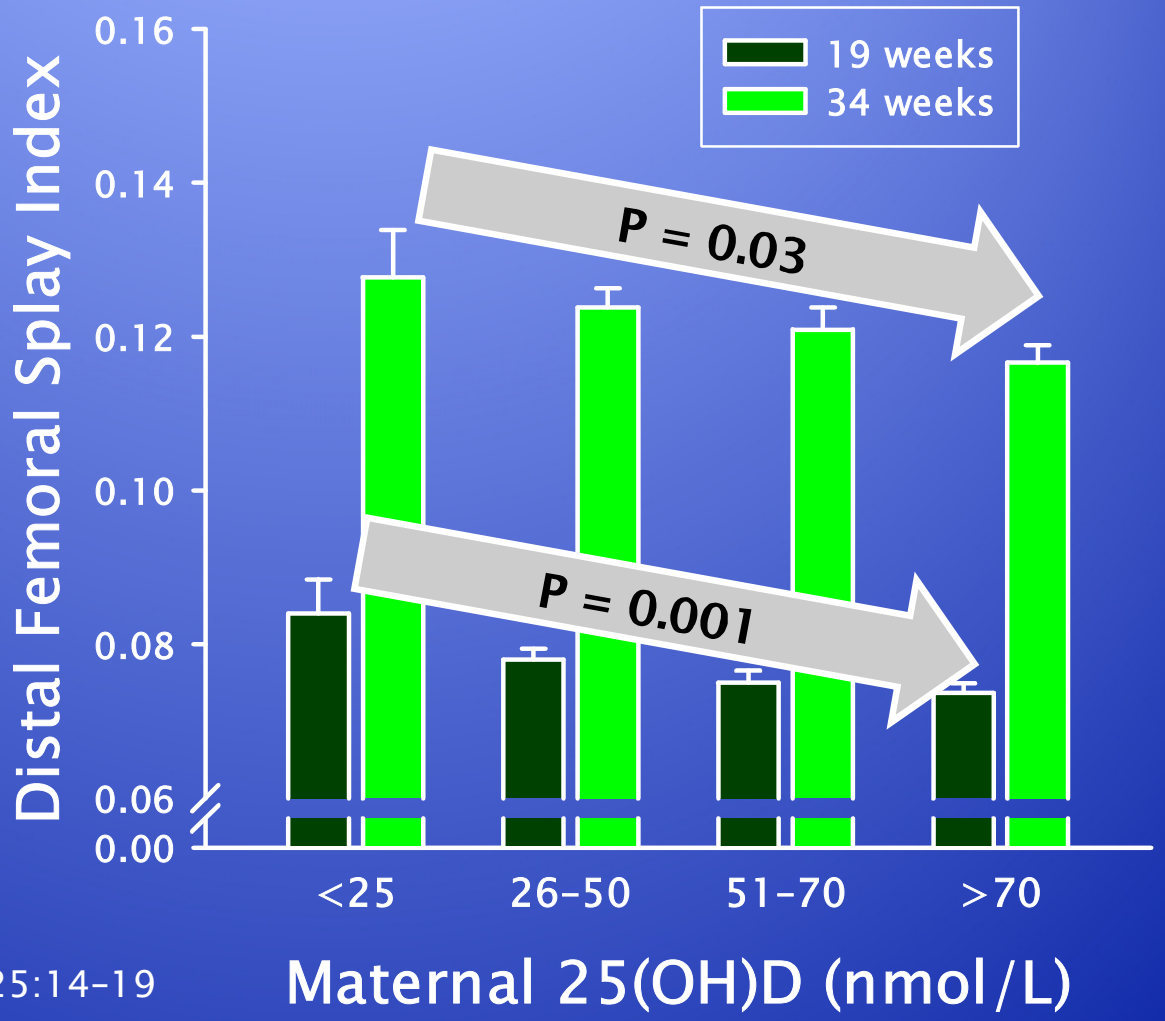
Rickets in the Foetus -1

- n = 424
- 3D Ultrasound
- Splay Index at distal femur at 19 & 34 weeks
- (metaphyseal X-sectional area divided by femoral length)
- High ≈ Rickets

*Mahon et al., (2010) JBMR 25:14–19

Rickets in the Foetus - 2

- n = 424
- 3D Ultrasound
- Splay Index at distal femur



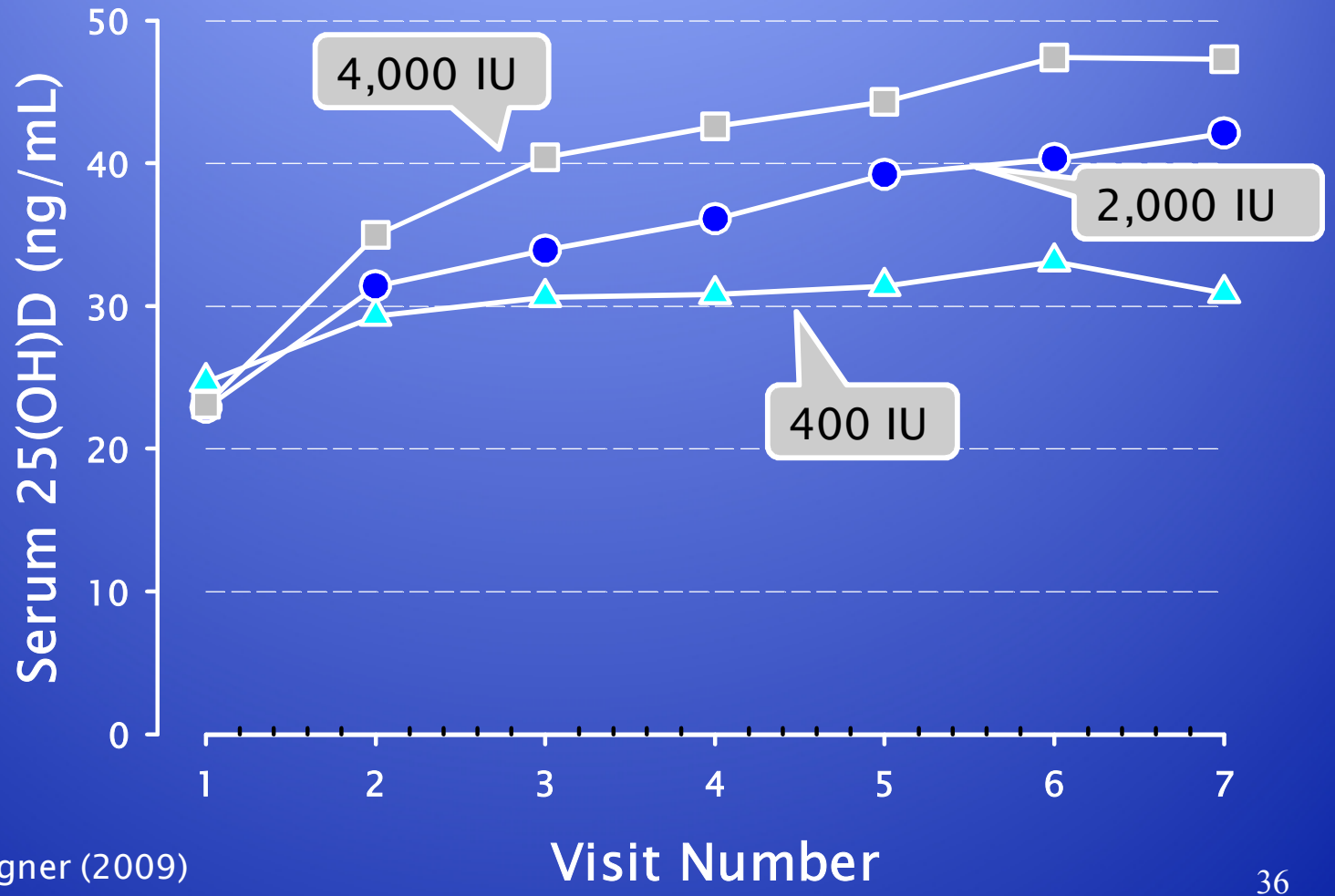
*Mahon et al., (2010) JBMR 25:14-19

Vitamin D & Pregnancy Outcomes - 1

- Double-Blind Randomised Control Trial
- N = 690 pregnant women
- Dosed with 400, 2000, & 4000 IU/d from week 12 to delivery
- With 4,000 IU/d - risk of untoward outcomes reduced by half:
  - pre-term delivery ($P < 0.01$)
  - gestational diabetes ($P < 0.01$)
  - pre-eclampsia, hypertension ($P < 0.01$)
  - periodontal disease ($P < 0.05$)
  - neonatal infection ($P < 0.05$)

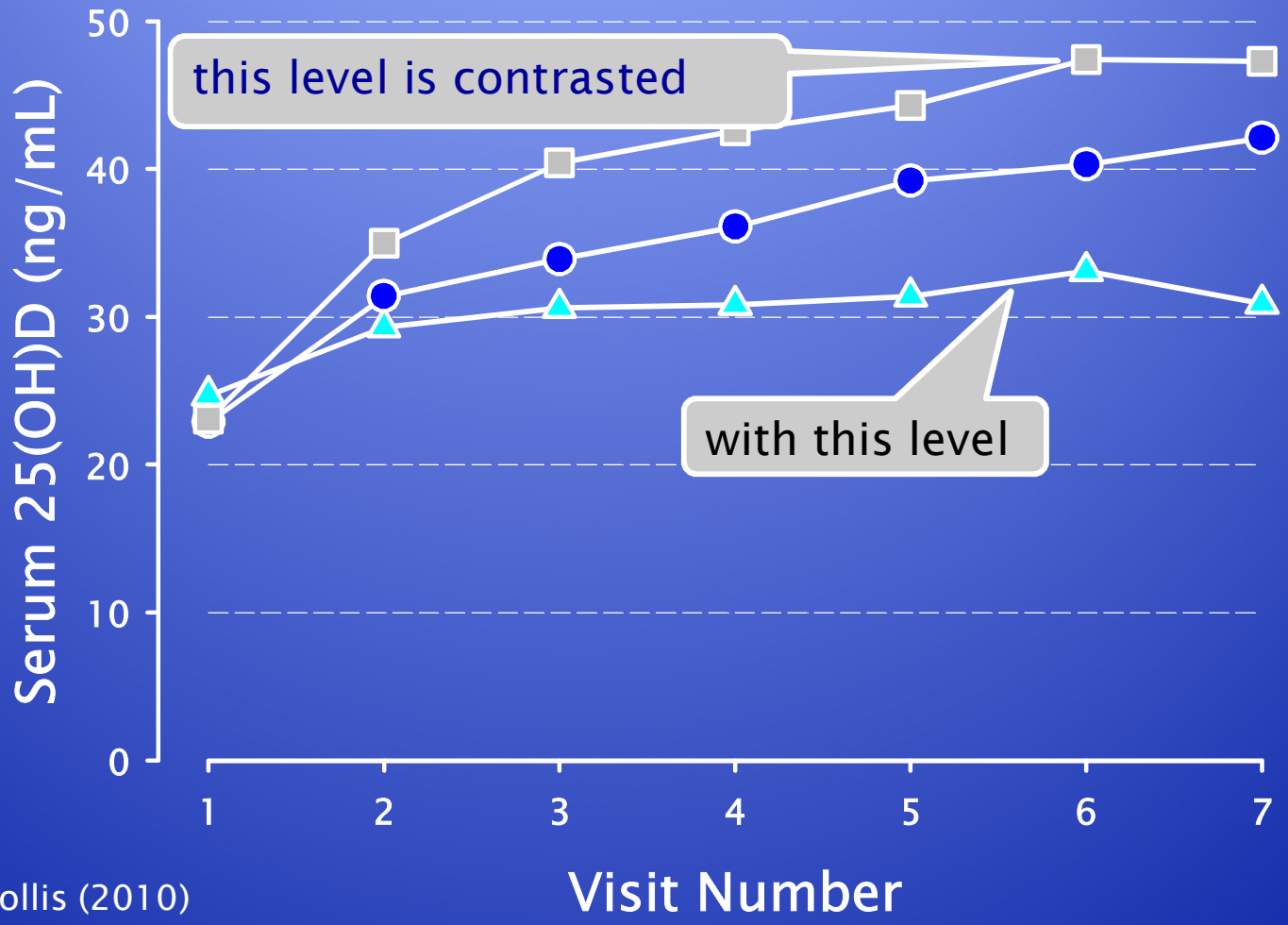
*Wagner & Hollis (2010)

Vitamin D & Pregnancy Outcomes - 2



*Hollis & Wagner (2009)

Vitamin D & Pregnancy Outcomes - 3



*Wagner & Hollis (2010)

Vitamin D & Pregnancy Outcomes - 4

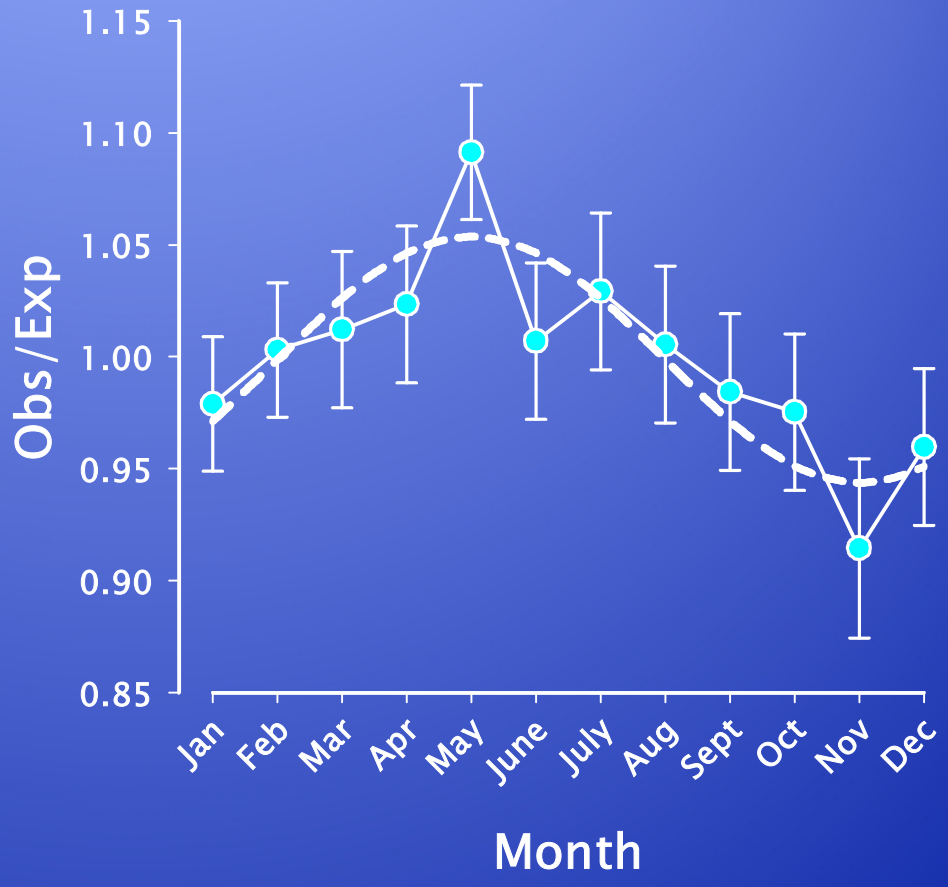
- Double-Blind Randomised Control Trial
- N = 690 pregnant women
- Dosed with 400, 2000, & 4000 IU/d from week 12 to delivery

- With 4,000 IU/d - risk of untoward outcomes *reduced by half:*
  - pre-term delivery ($P < 0.01$)
  - gestational diabetes ($P < 0.01$)
  - pre-eclampsia, hypertension ($P < 0.01$)
  - periodontal disease ($P < 0.05$)
  - neonatal infection ($P < 0.05$)

*Wagner & Hollis (2010)

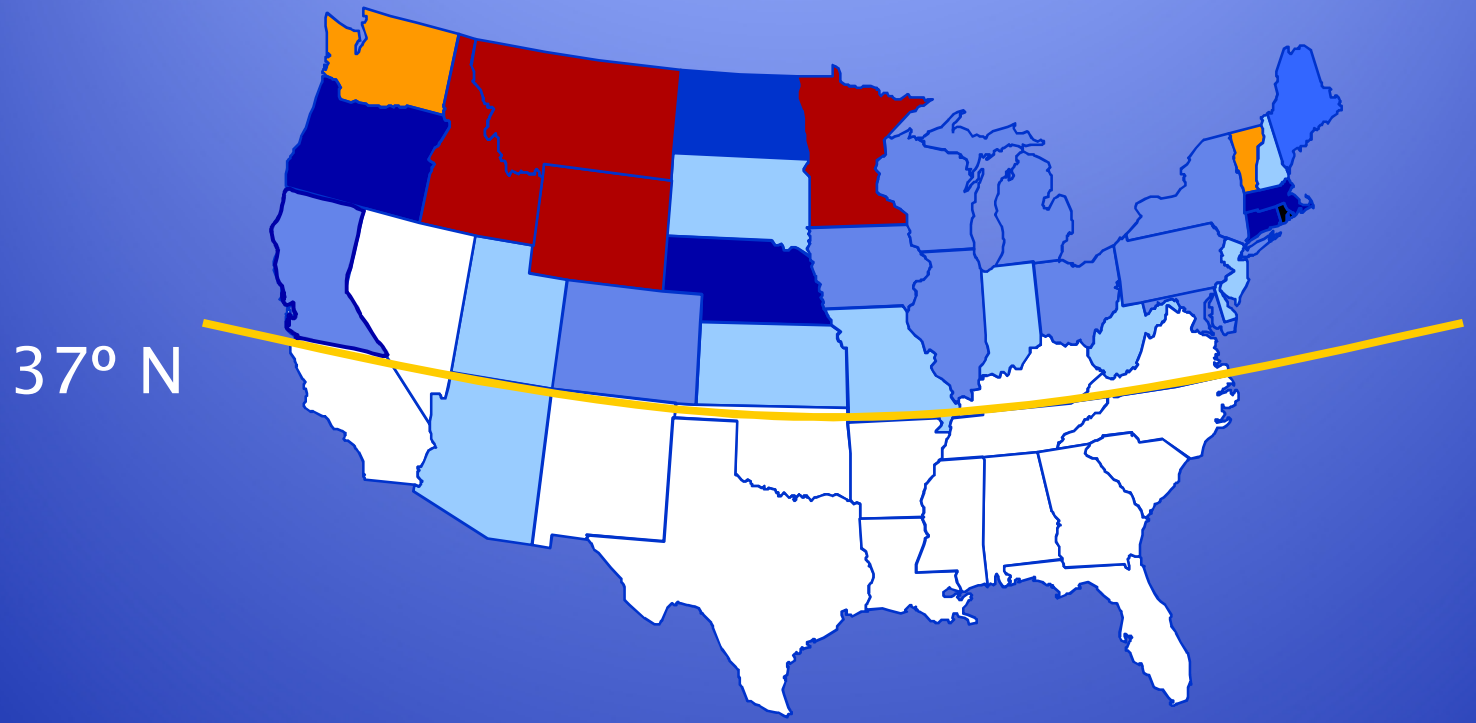
Multiple Sclerosis Risk & Birth Month

- 44,045 patients with MS
- Populations of Canada, UK, Denmark,& Sweden
- Cases by birth month
- Observed-vs-Expected



*Willer et al., (2004) BMJ

Incidence of Multiple Sclerosis in USA



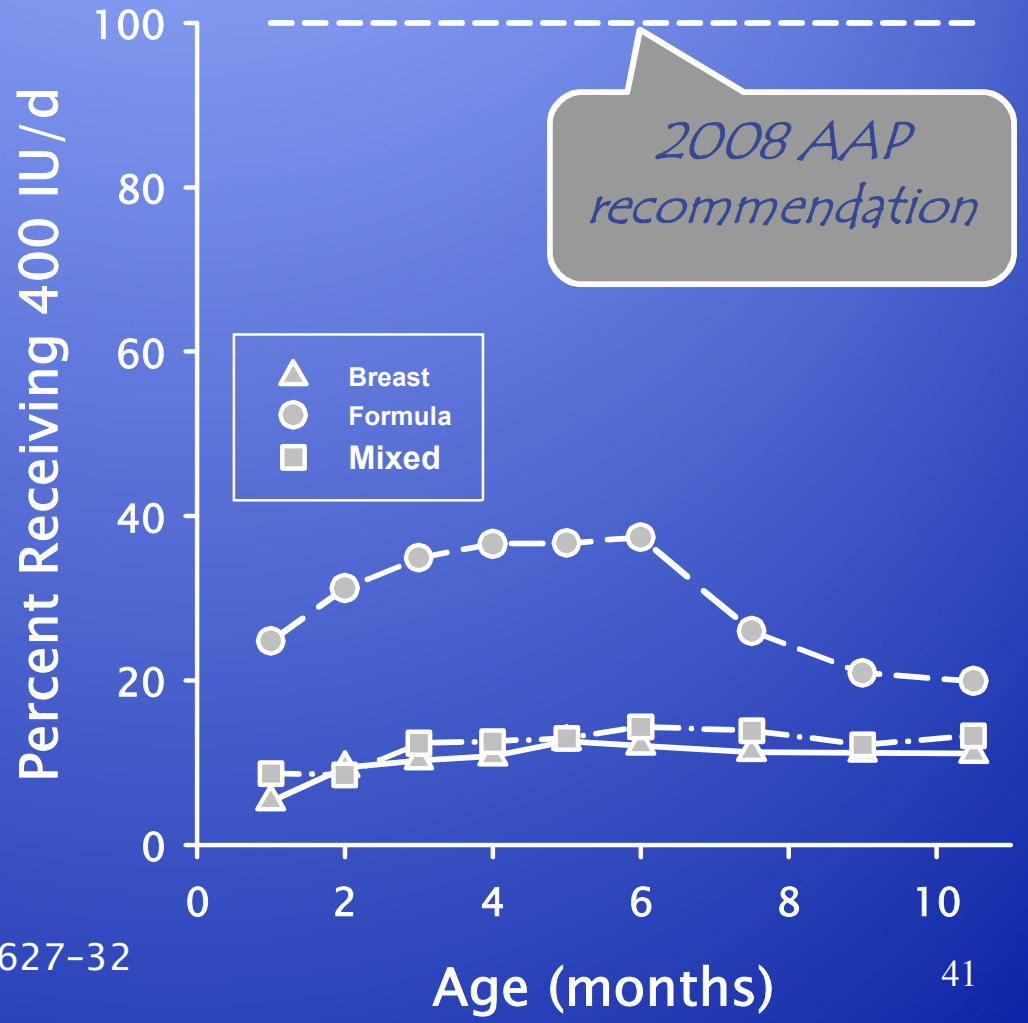
Percent national average incidence:

40–70% | 70–100% | 100–130% | 130–160% | 160–190% | 190–220%

*modified from: http://mscenter.ucsf.edu/

Infant Vitamin D Intake

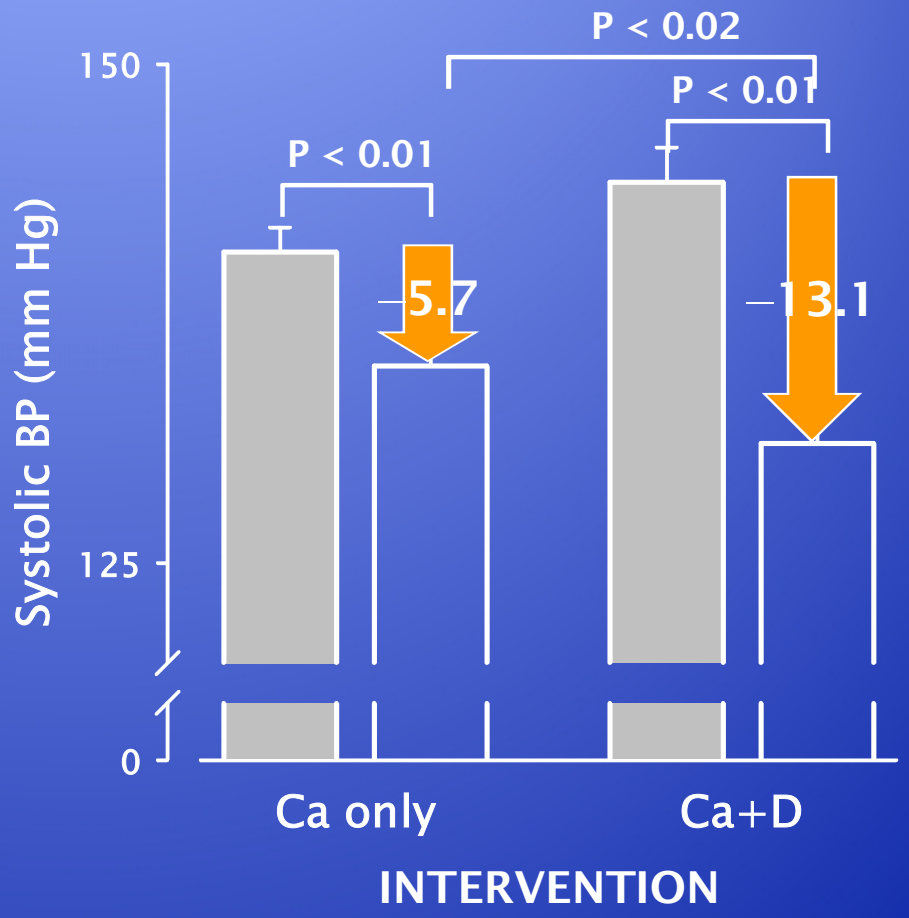
- *Infant Feeding Practices Study*
- > 33,000 infants
- 2005–2007
- Sources (1 mo):
  - breast – 43%
  - formula – 26%
  - mixed – 32%
- Check out: www.ddrops.co.uk



* Perrine et al. 2010, *Pediatrics* 125:627–32

Vitamin D & Blood Pressure

- 148 women, aged 74 ± 1
- DB–RCT
- Baseline 25(OH)D < 50 nmol/L
- Treated for 8 wks with:
  Ca 1200 mg/d or
  Ca + 800 IU Vit D/day

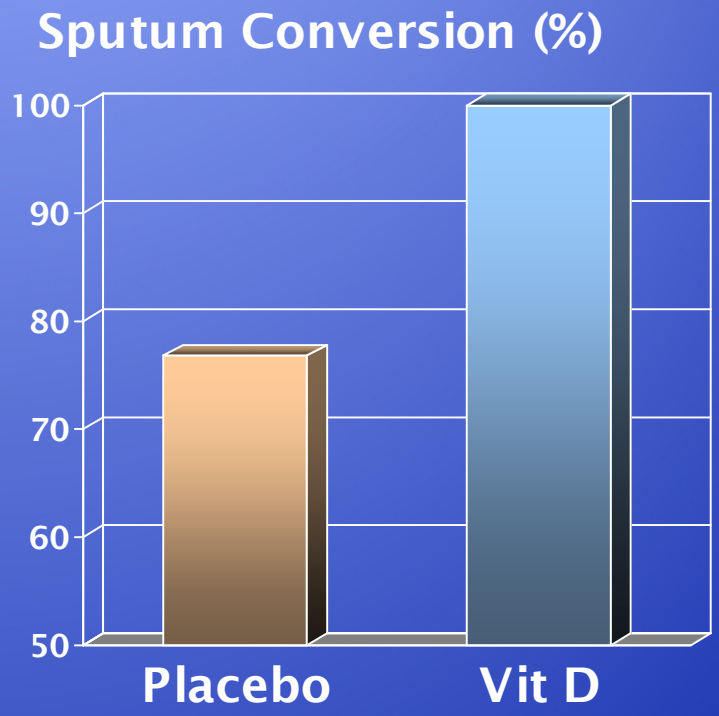


*Pfeifer et al., JCEM 2001; 86:1633–37

Vitamin D & Tuberculosis

- 67 patients with pulmonary TB
- Standard treatment for all
- In addition, randomized to either Vitamin D 10,000 IU/d or placebo

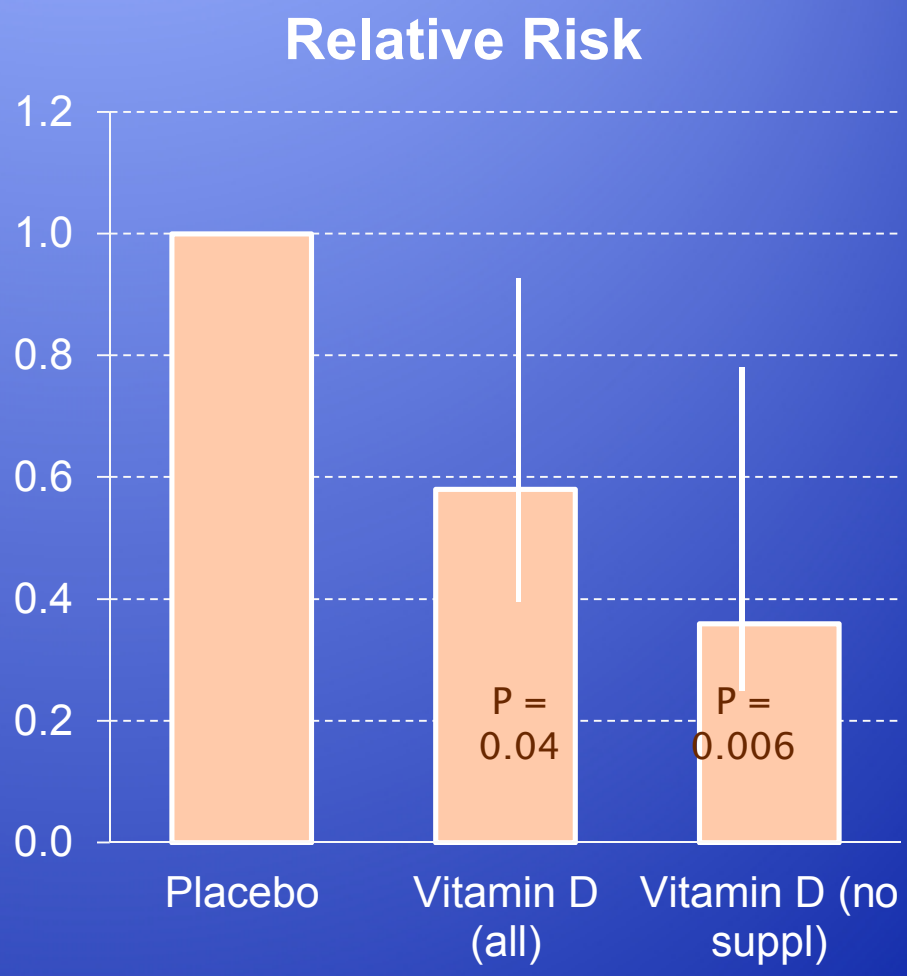
- P = 0.002



*Nursyam et al., Acta Med Indones 2006

Vitamin D Influenza

- DB–RCT
- Winter 2008–2009
- 334 Japanese school children, aged 6–15
- Mean weight: 35.5 kg
- 1200 IU D_3/d in addition to self-supplementation



*Urashima et al., AJCN 2010

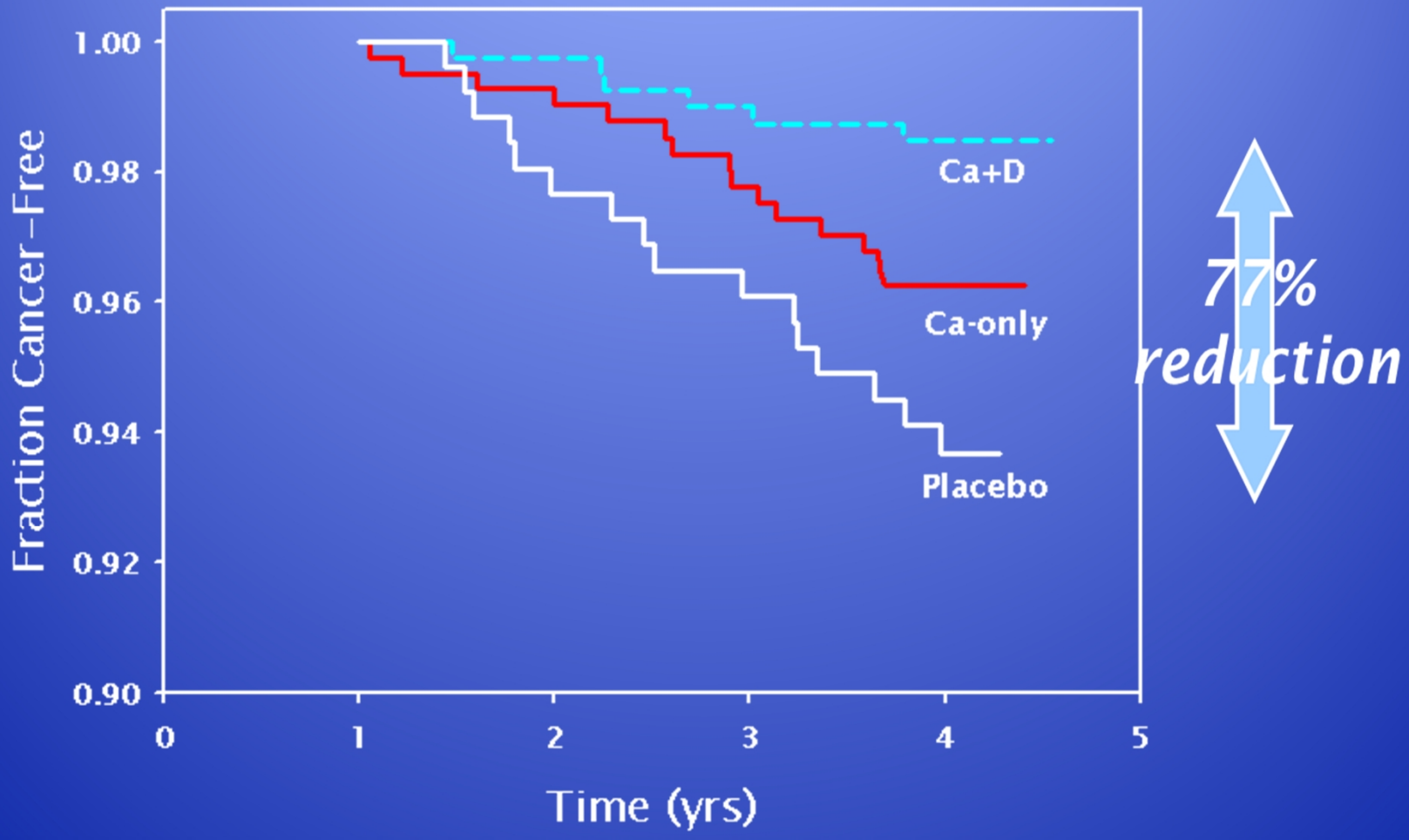
Vitamin D & Cancer

- 1179 healthy women
- aged 66.7 ± 7.3
- four year trial
- 1032 finished (87.5%)
- baseline 25(OH)D: 71.8 nmol/L ± 20.3
- three treatment groups:
  - control
  - Ca (1400–1500 mg/d)
  - Ca plus D_3 (1100 IU/d) <- 77% reduction in cancer
- achieved 25(OH)D: 96 nmol/L ± 21.4

*Lappe et al. AJCN 2007

Slide from R.P. Heaney, MD

Vitamin D & Cancer



Vitamin D & Haemodialysis

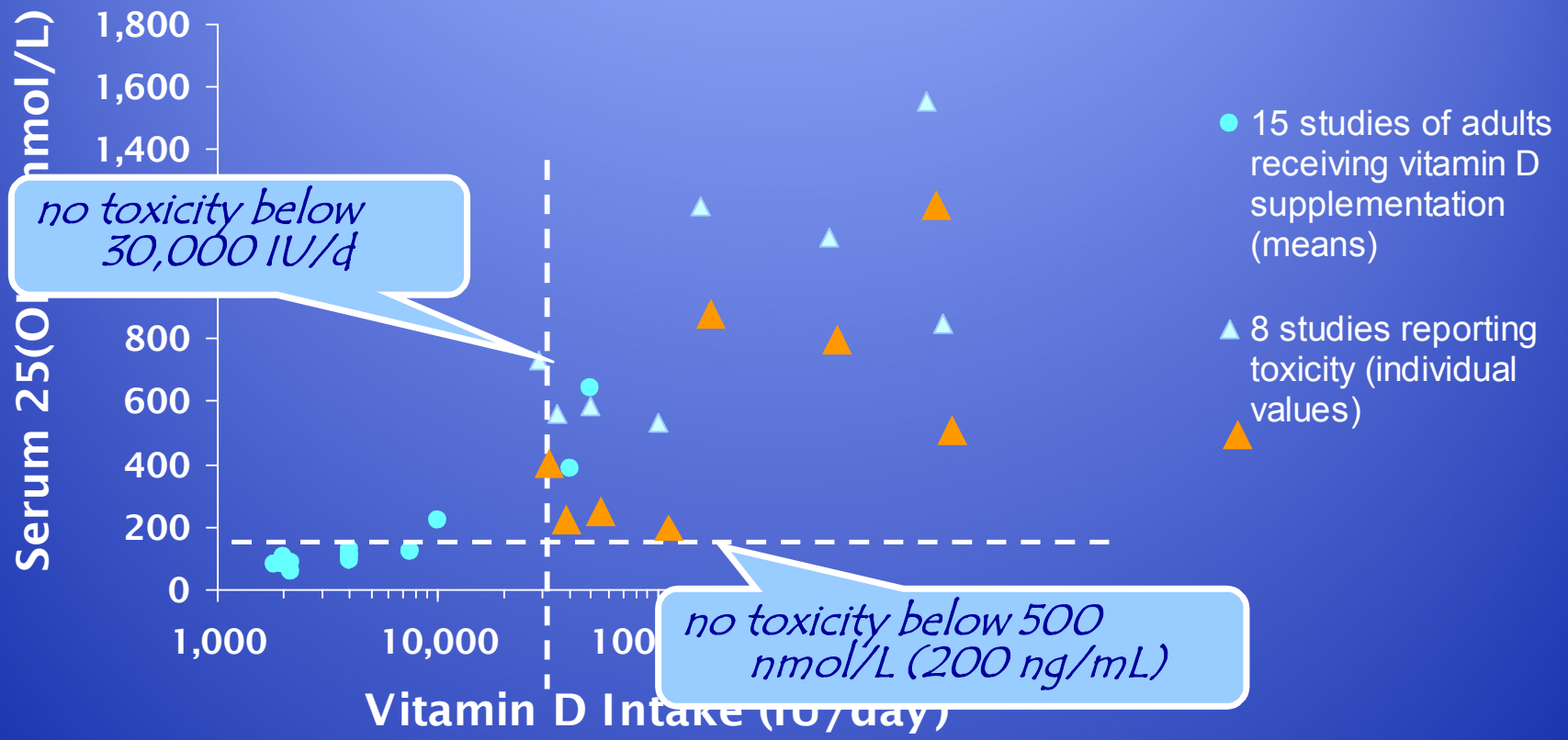
- Very recent studies have shown that, when serum 25(OH)D is normalized in patients on haemodialysis, serum $1,25(OH)_2D$ is "normalized" as well.

- Bikle showed many years ago that the skin was able to synthesize physiologically meaningful quantities of $1,25(OH)_2D$.

HOW MUCH IS ENOUGH?

▪ Rickets & osteomalacia	
➢ clinical	25 nmol/L
➢ histological	80 nmol/L
▪ Ca absorption	80 nmol/L
▪ Fracture risk	100 nmol/L
▪ Cancer prevention	100 nmol/L
▪ Pregnancy outcomes	120 nmol/L
▪ other	????

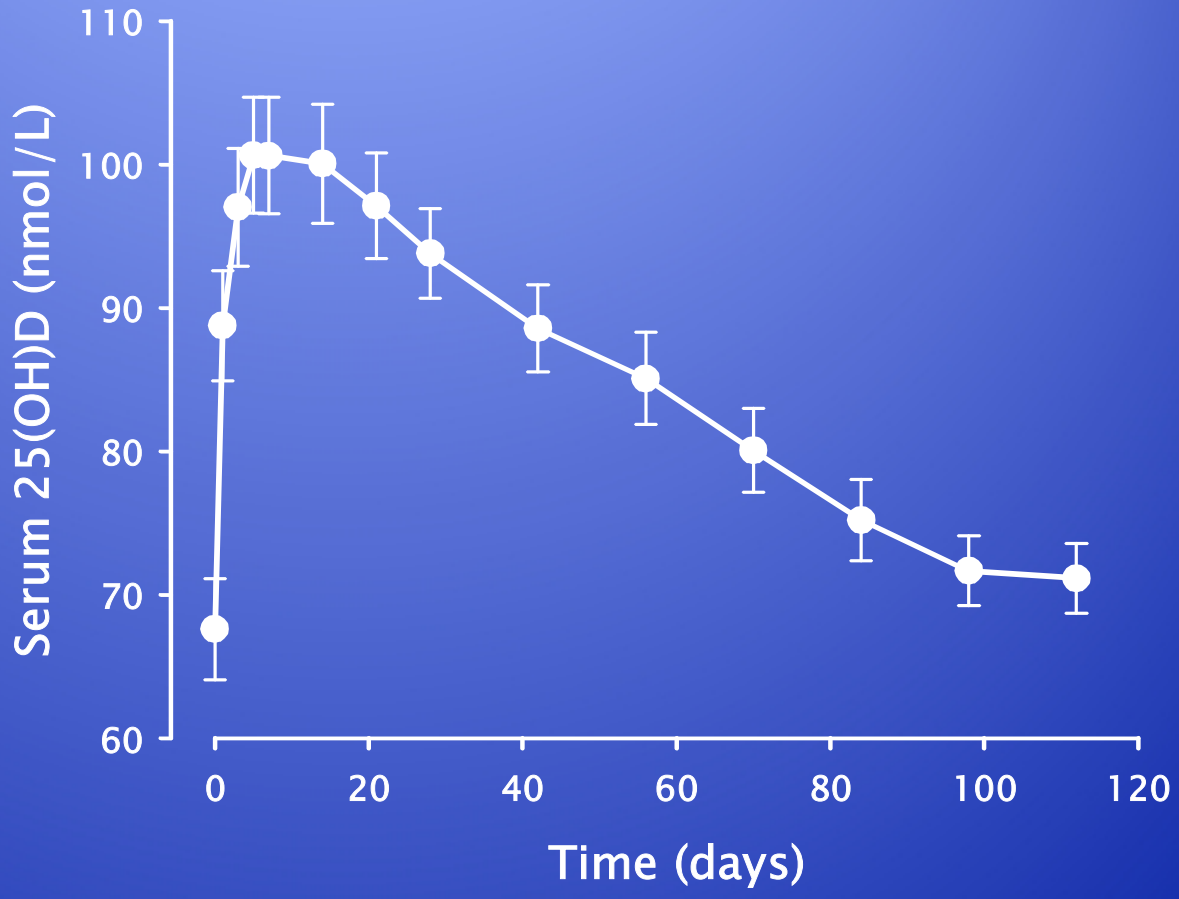
Vitamin D Intake & Toxicity



* Hathcock JN et al. *Am J Clin Nutr*. 2007;85:6–18.

Response to Large Doses

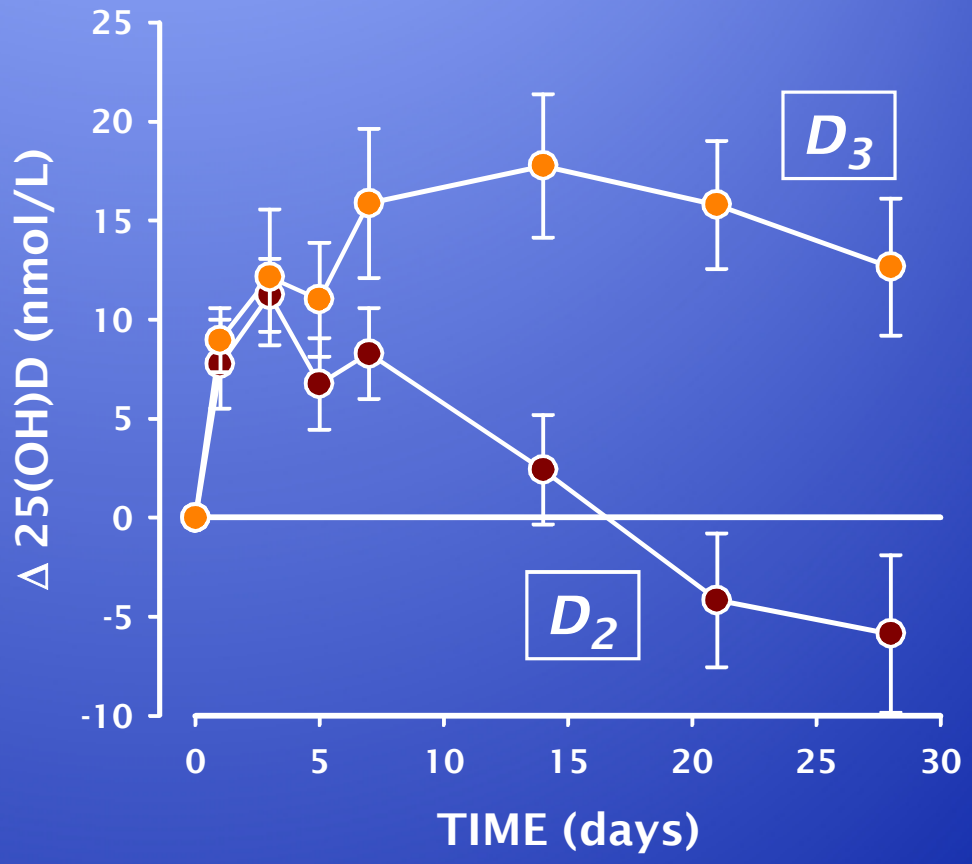
- **100,000 IU D_3, by mouth, once**



*Ilahi, Armas, & Heaney

D_2 vs. D_3*

- single oral dose
- 50,000 IU
- D_2 or D_3
- n = 10 in each group



*Armas et al., 2004

Vitamin D & Calcium

Vitamin D ***enables*** Calcium absorption

It does not cause it

Professor Robert Heaney
Creighton University, USA

Status of the Evidence

- There are now more than 30 randomised controlled trials evaluating a causal connection between serum 25(OH)D levels and various health benefits
  - 13+ osteoporotic fractures
  - 5+ falls
  - 2 hypertension
  - 1 cancer
  - 1 adjuvant tuberculosis therapy
  - 3 respiratory infection/influenza risk
  - 3 pregnancy outcomes
  - 1 periodontal disease
  - 3 insulin sensitivity & diabetes

Status of the Evidence

- Out of this total there are several null trials
- In general these failed trials either –
  - used too low a dose
  - had poor compliance
  - failed to achieve a therapeutic blood level of 25(OH)D
  - failed to optimize co-nutrition

Summary

- For some endpoints (e.g., pregnancy, cancer) the data suggest that 80 nmol/L is not high enough
- There is huge variability in individual response
- The emphasis must be on the achieved serum level, not on the oral dose

Summary

- Levels of 100 – 200 nmol/L are physiological
- Given the manifest safety of such levels, we should strive to achieve at least 100 nmol/L in ourselves & all our friends & family
- Whatever their primary condition, most will be vitamin D-deficient as well
- Their health, and recovery from any illness, will be aided by treating any Vitamin D deficiency

Programming the Immune System

"These perinatal and early life associations are probably epigenetic in character and are believed to involve the programming of the immune system to distinguish self and non-self – a process in which Vitamin D plays a role"

Professor Robert Heaney
Creighton University, USA

For more information:

www.vitamindcouncil.org	Data on 100+ illnesses
www.vitamindassociation.org	Videos from 4 conferences
www.vitamindwiki.com	Searchable in 50 languages
www.grassrootshealth.net	Public intervention project
www.ucsd.tv	Videos of scientific lectures (Search for “Vitamin D”)
www.healthresearchforum.org.uk	UK specific
www.vitaminduk.com	UK specific

Chronic Disease Perspective

- chronic disease is the breakdown of structure and/or function of a body system
- its origin is usually multi-factorial
  - genes
  - environment
    - ✓ nutrition
    - ✓ infection
    - ✓ toxins
    - ✓ injury

The body has mechanisms to repair this damage or to fight it at its origin

Vitamin D is an essential component of many of these mechanisms

Low Vitamin D status impairs this protective/ reparative activity

The Preventive Maintenance Model

Foundational premises:

- all tissues need all nutrients
- shortages impair the functioning of *all* body systems
- premature organ/system "wearing out", as a consequence of nutrient deficiency, will vary from person to person, depending on variable genetic composition

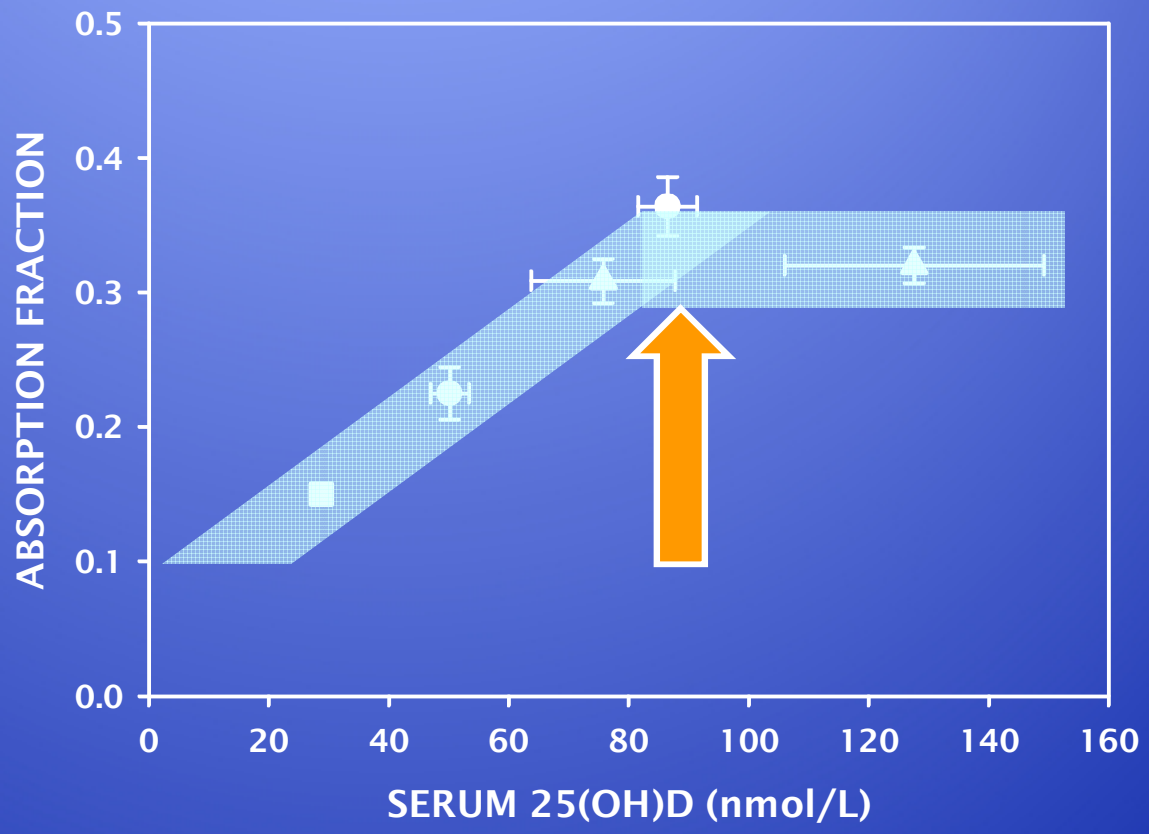
The Preventive Maintenance Model

- *also recognizes that:*
  - the organism will work perfectly well without maintenance – *for a while . . .*
- it thus reconciles the seeming paradox that an organism can be "deficient" without being clinically "sick"
  - *for a while . . .*
- it's also about squaring the morbidity/ mortality curve

Vitamin D shortage

- When vitamin D is in short supply, the various tissues and cells of our bodies cannot make enough calcitriol to open up their DNA libraries adequately
- Their functioning is thus impaired
- ***This is the basis for the multi-system manifestations of Vitamin D deficiency***

A VITAMIN D THRESHOLD



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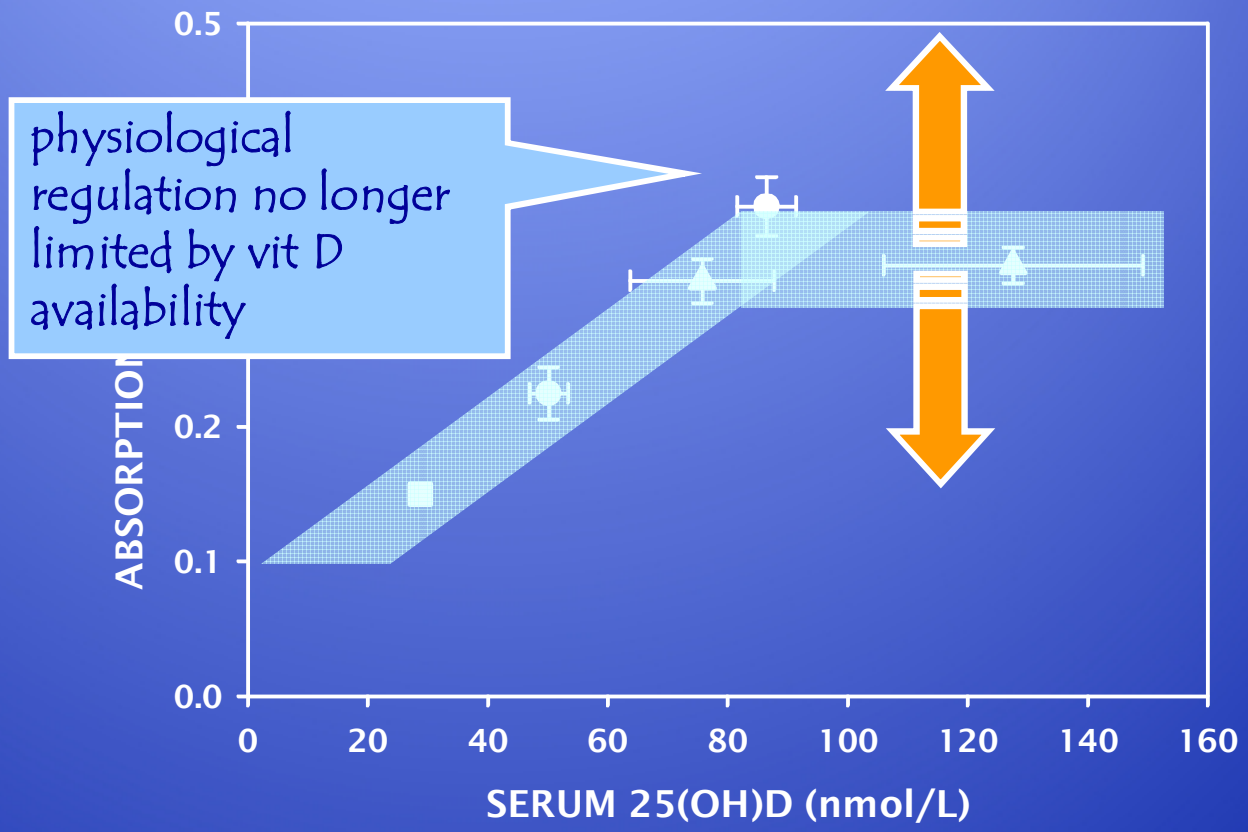

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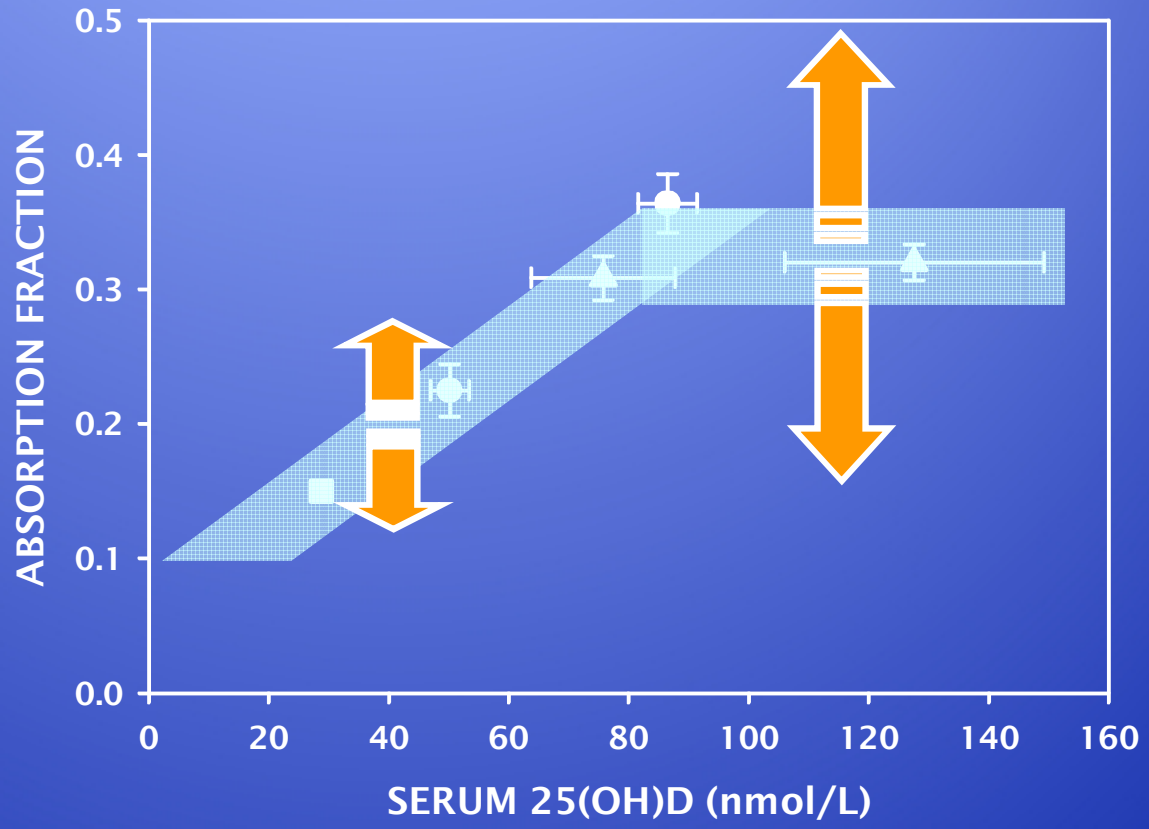

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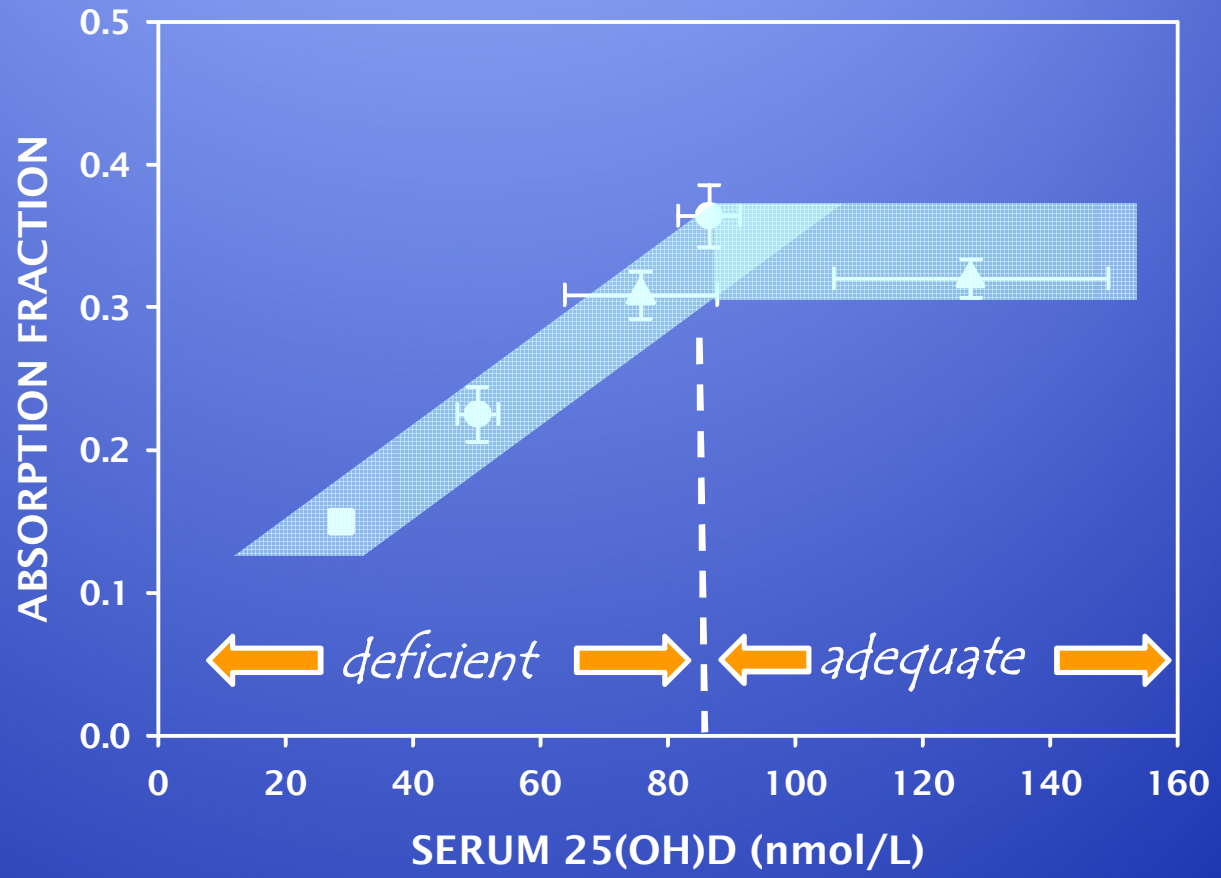
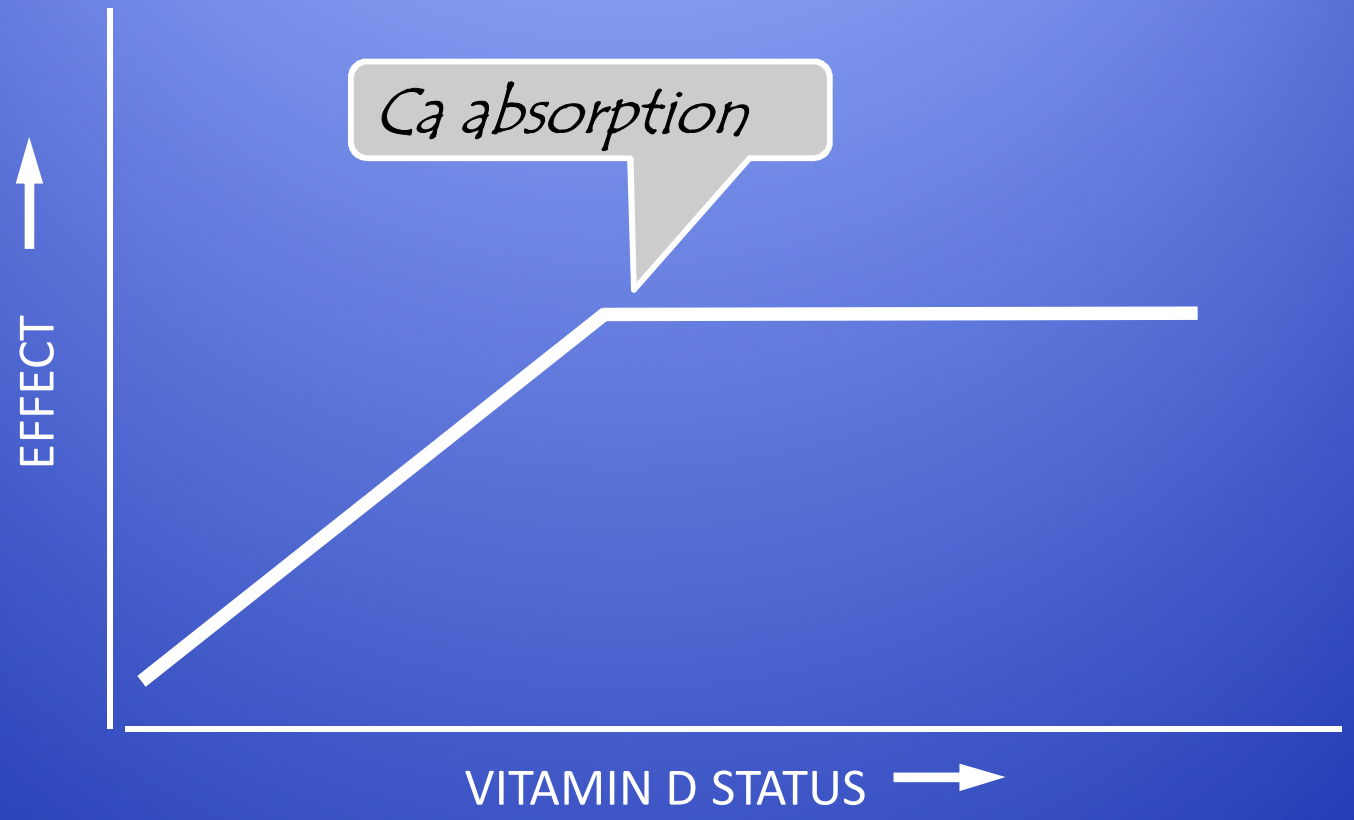


Vitamin D *enables* Ca absorption

It does not cause it

How much is enough?

THE RESPONSE THRESHOLD



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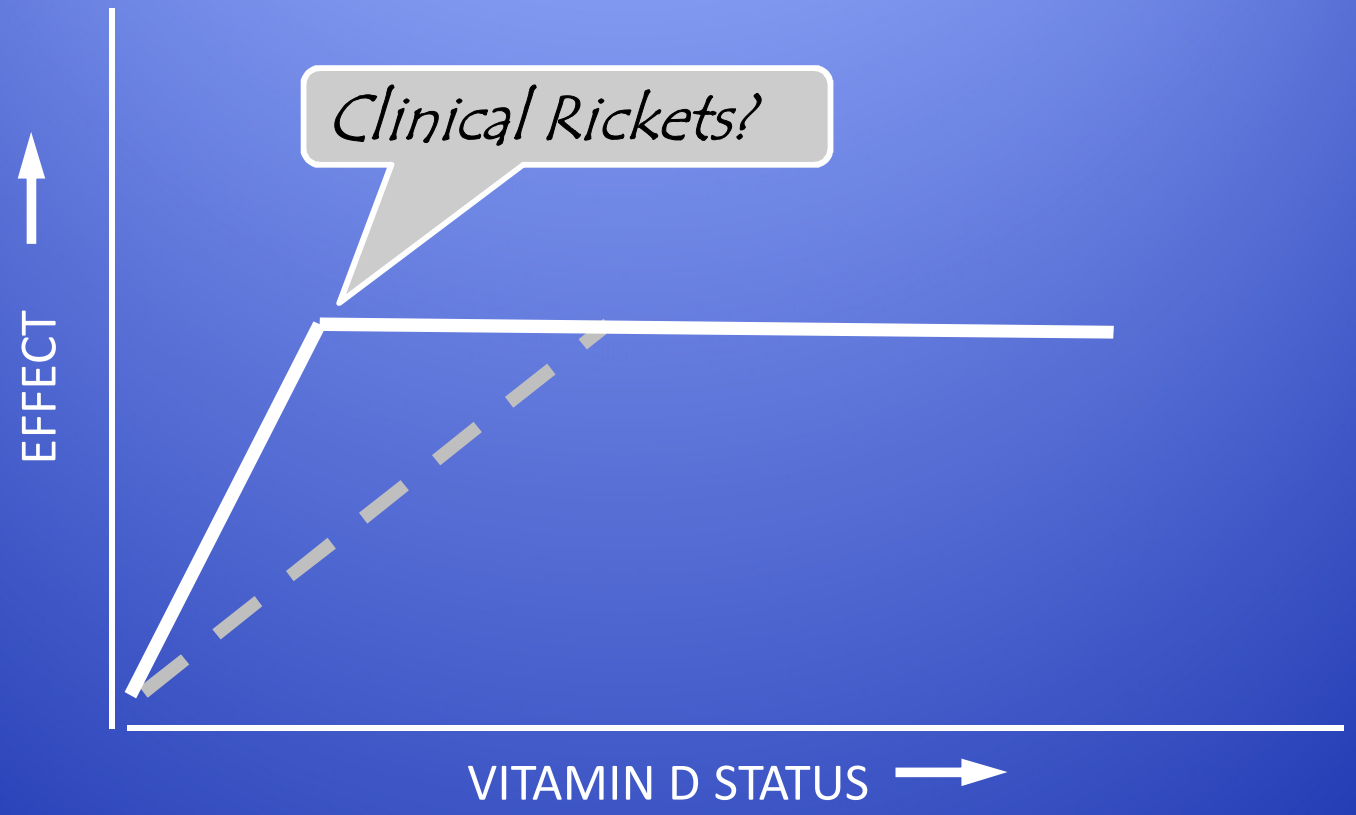

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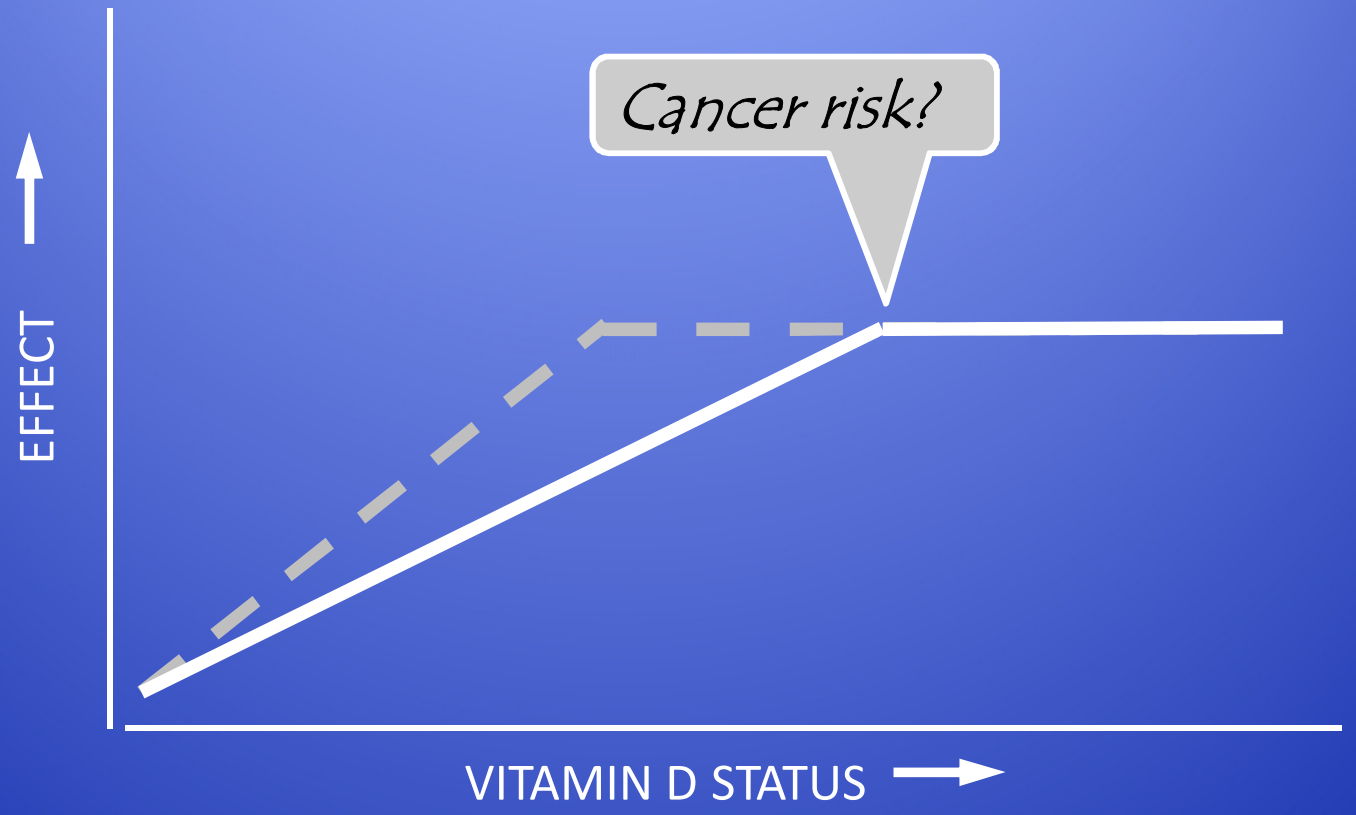

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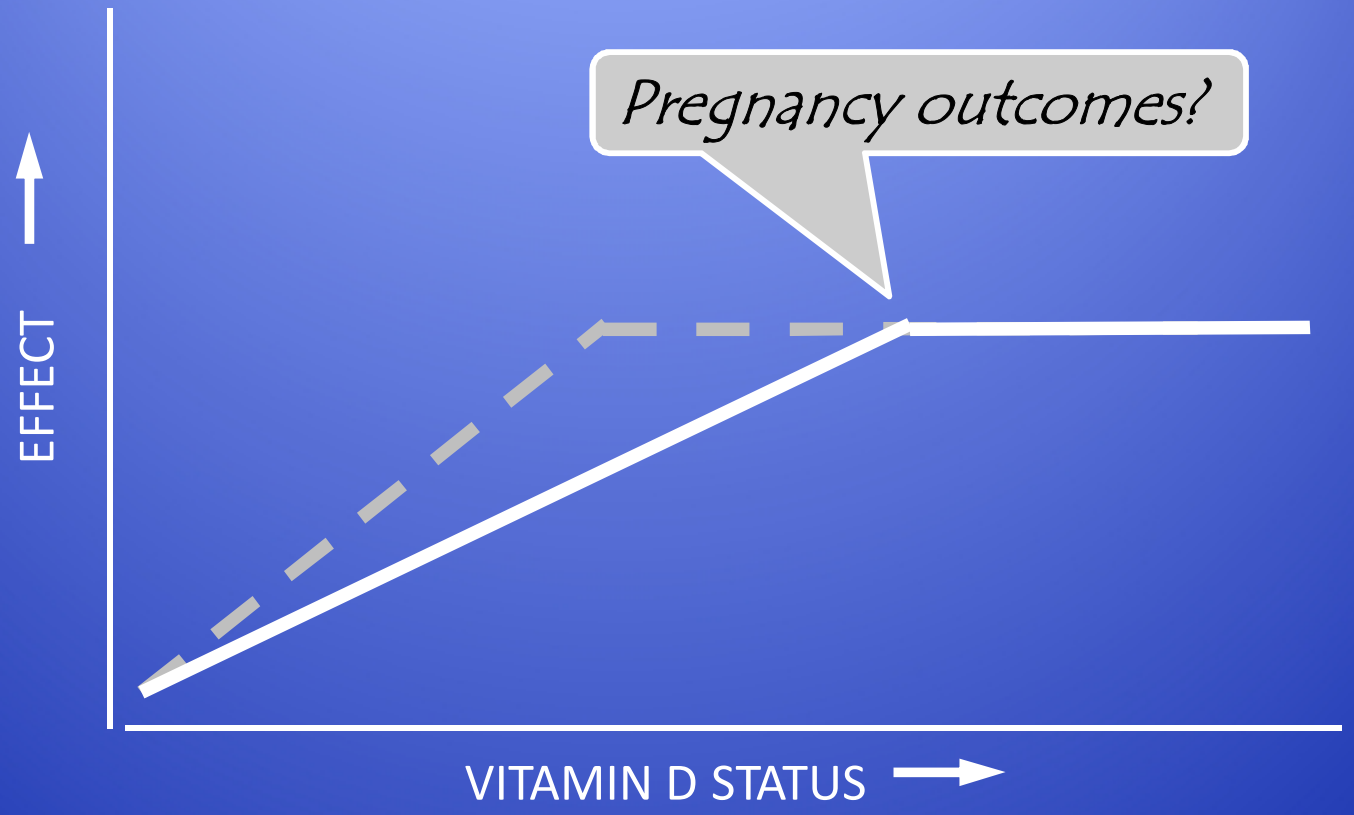

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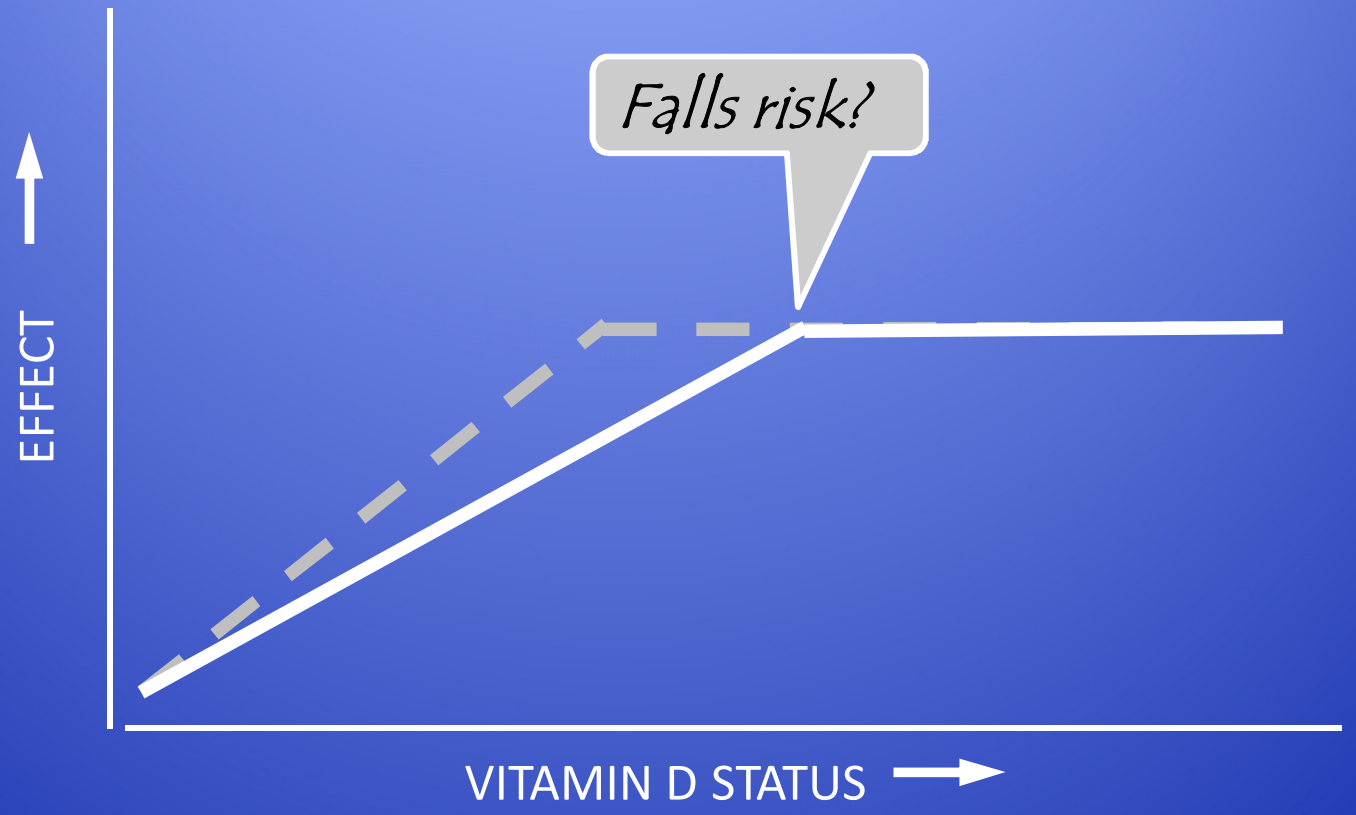

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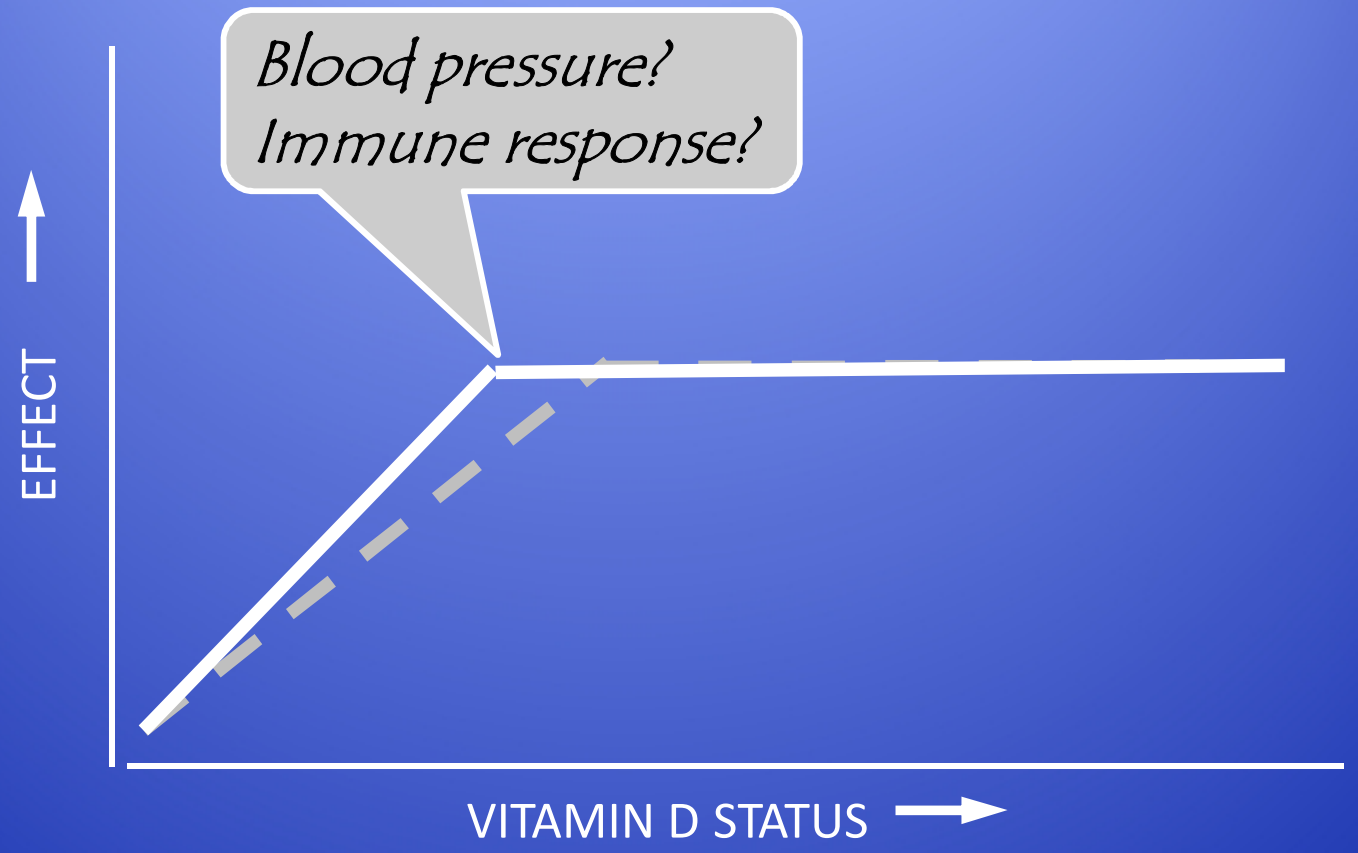

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