Sun exposure and health: risks, benefits and balance

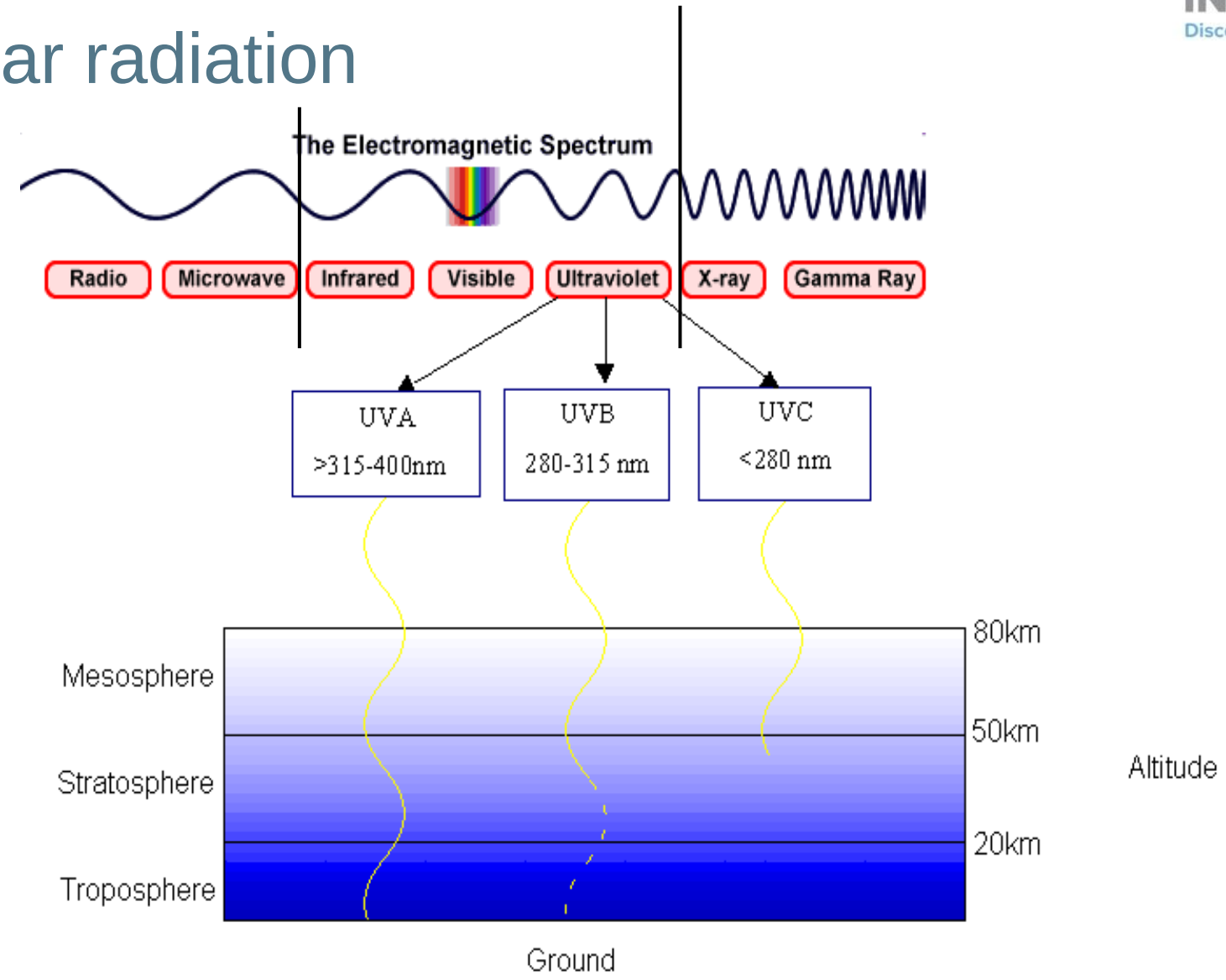
Professor Robyn M Lucas

National Centre for Epidemiology and Population Health

Telethon Kids Institute


Hamlet at the beach
U.V. or not U.V. ? That is the question
horacek

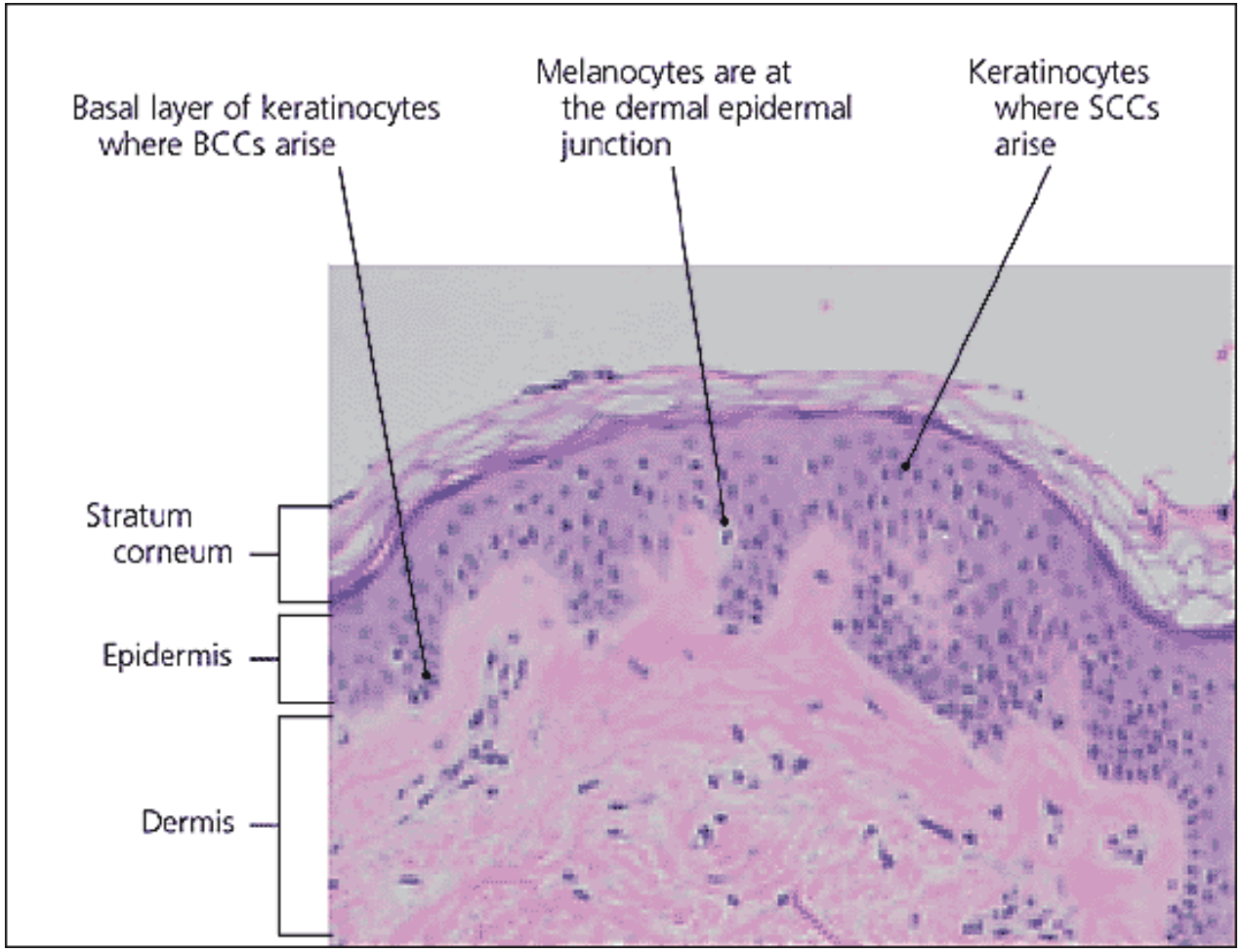
Solar radiation

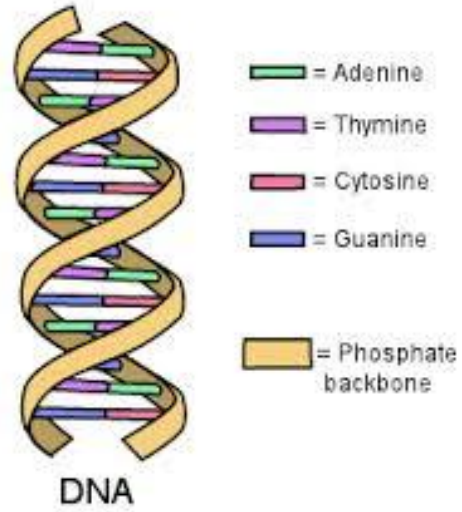


Risks

- Skin disease
  - Malignant melanoma
  - Non-melanoma skin cancers
    - Basal cell carcinoma
    - Squamous cell carcinoma
    - Other rare skin cancers, e.g. Merkel cell carcinoma
  - Actinic keratoses
  - Photoageing
- Immune suppression
- Eye diseases (cataracts, pterygium, etc)

Human skin and sun damage



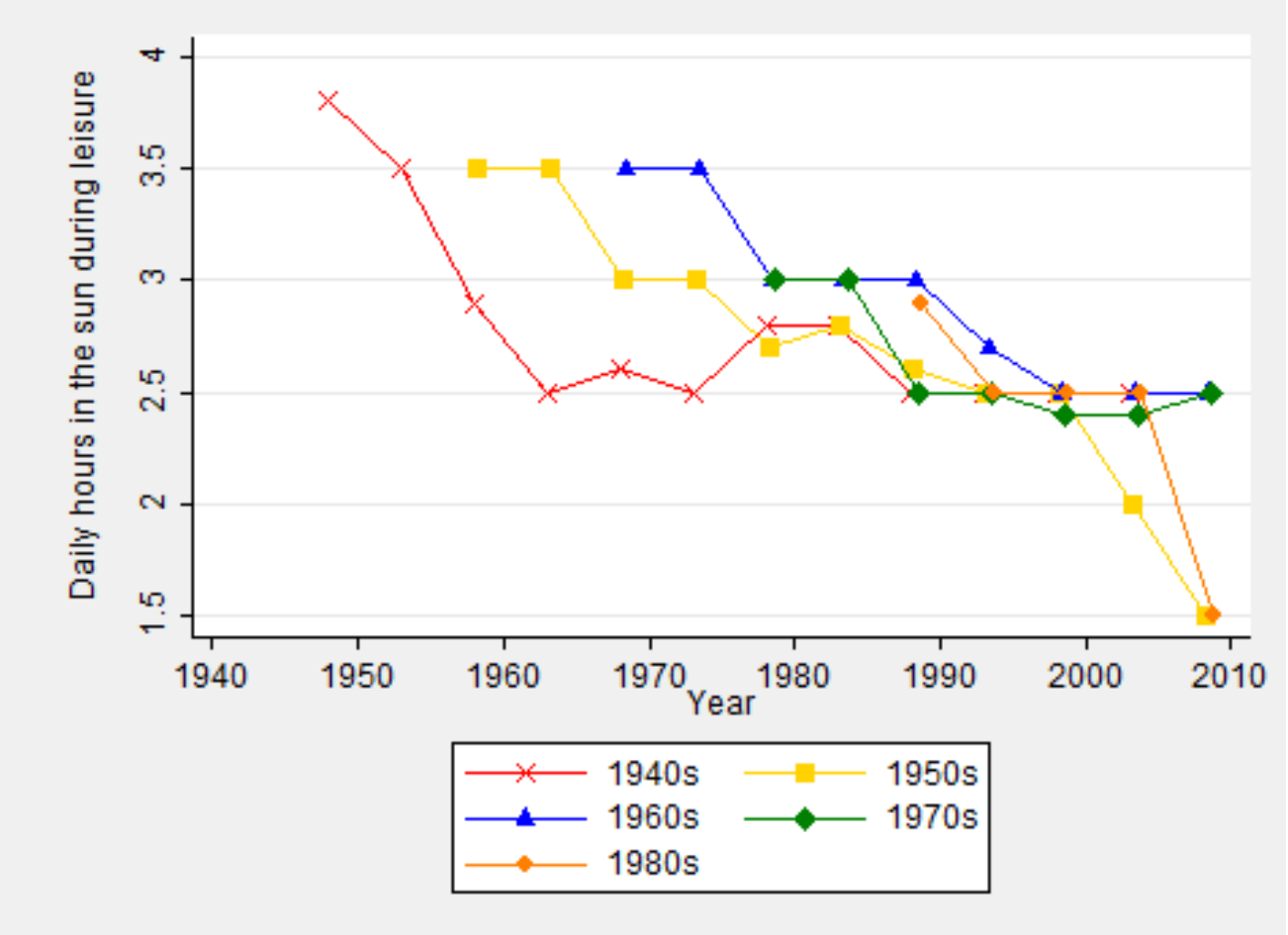


UV induces:

- DNA damage – mutations
- Oxidative stress
- Immune suppression

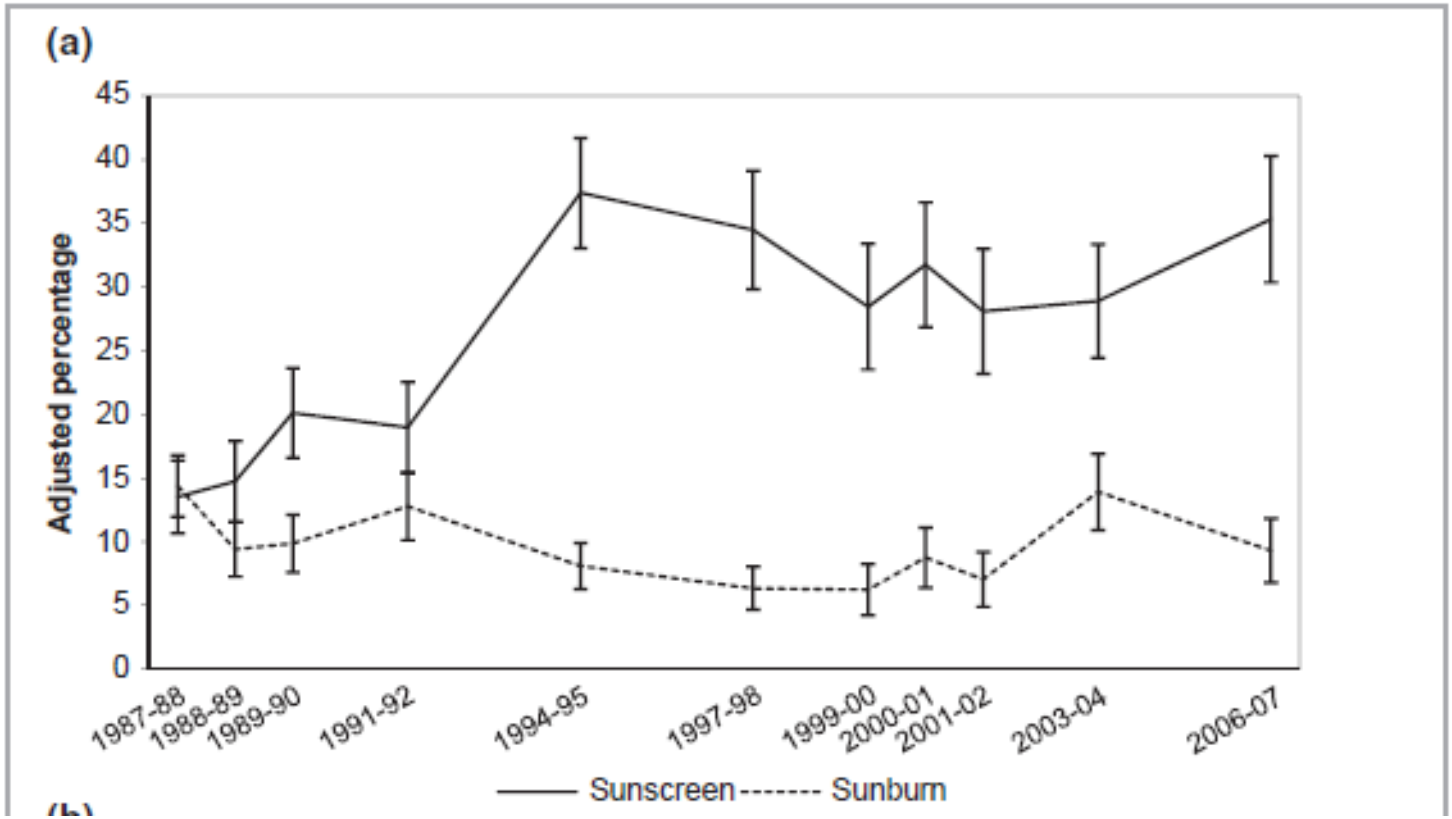
http://www.aafp.org/afp/2004/1015/p1481.html

Trends in sun exposure



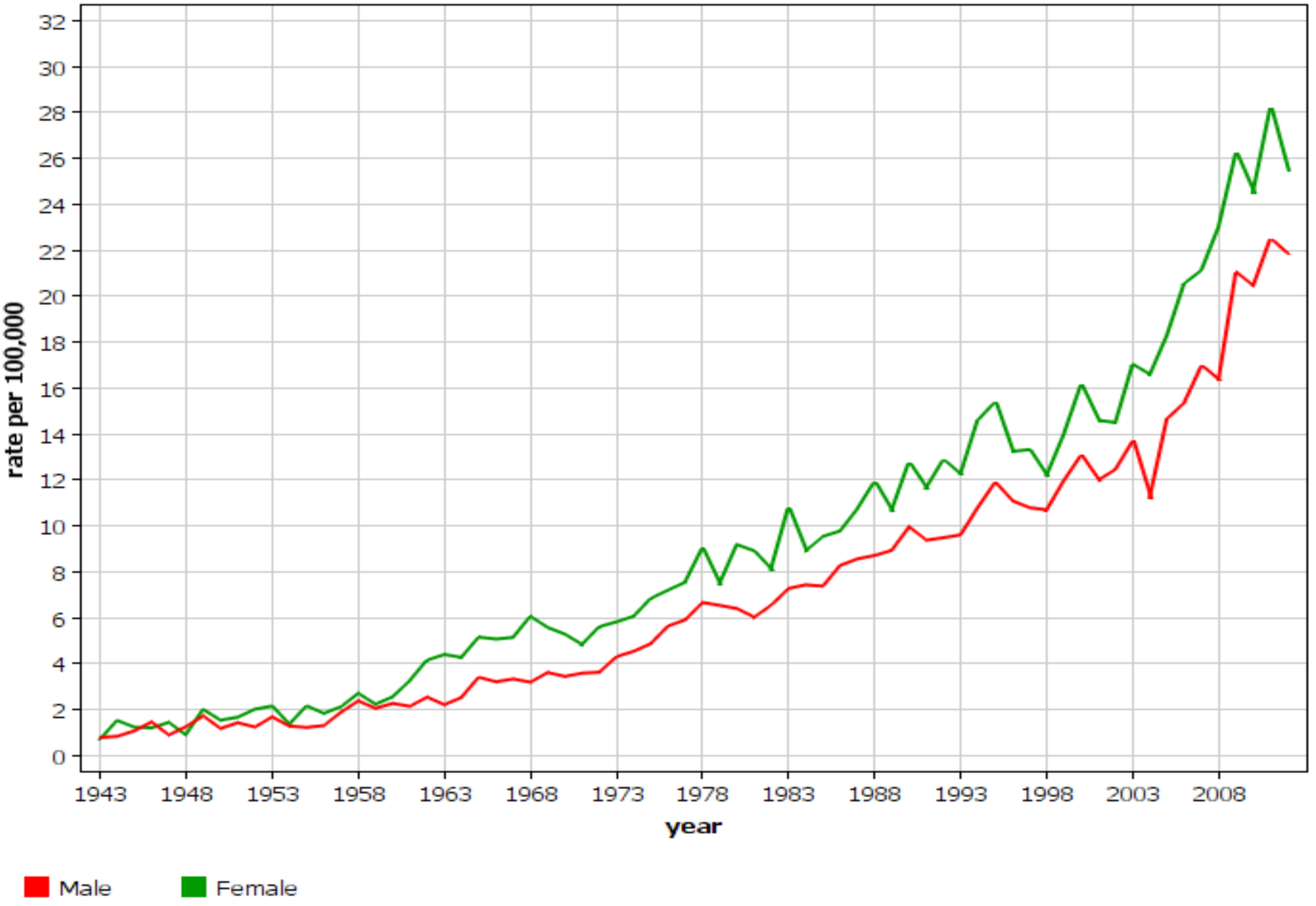
Daily time in the sun over successive age cohorts of Australian adults[1]

Trends in sunburn



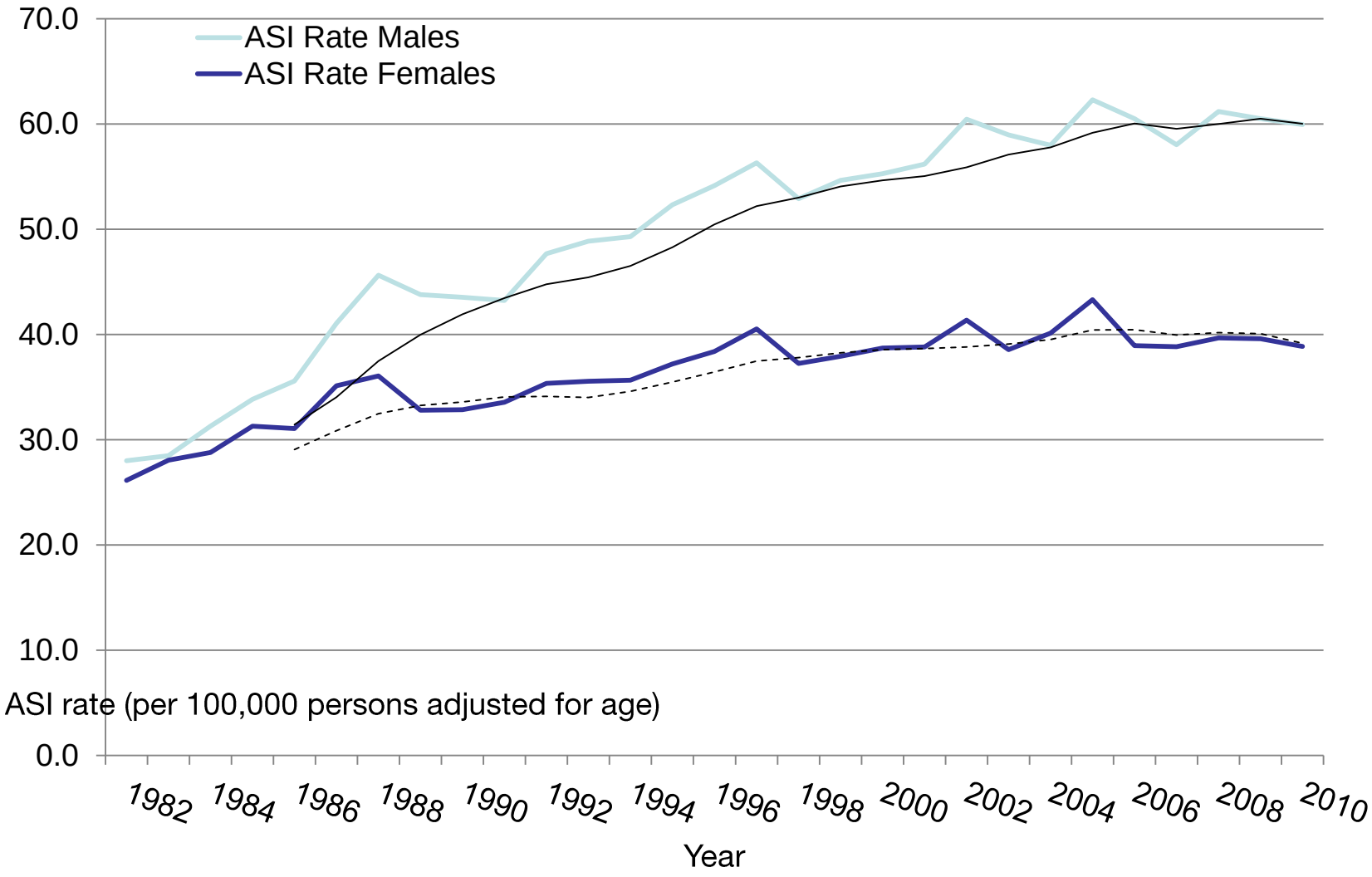
Trends in sunscreen use and sunburn in Melbourne, Victoria 1987-88 to 2006-07: rapid improvement in behaviours 1987-88 to 1994-5; 1997-98 to 2006-07 relatively static

Denmark
Melanoma of skin
Incidence: ASR (World) age 0-85+

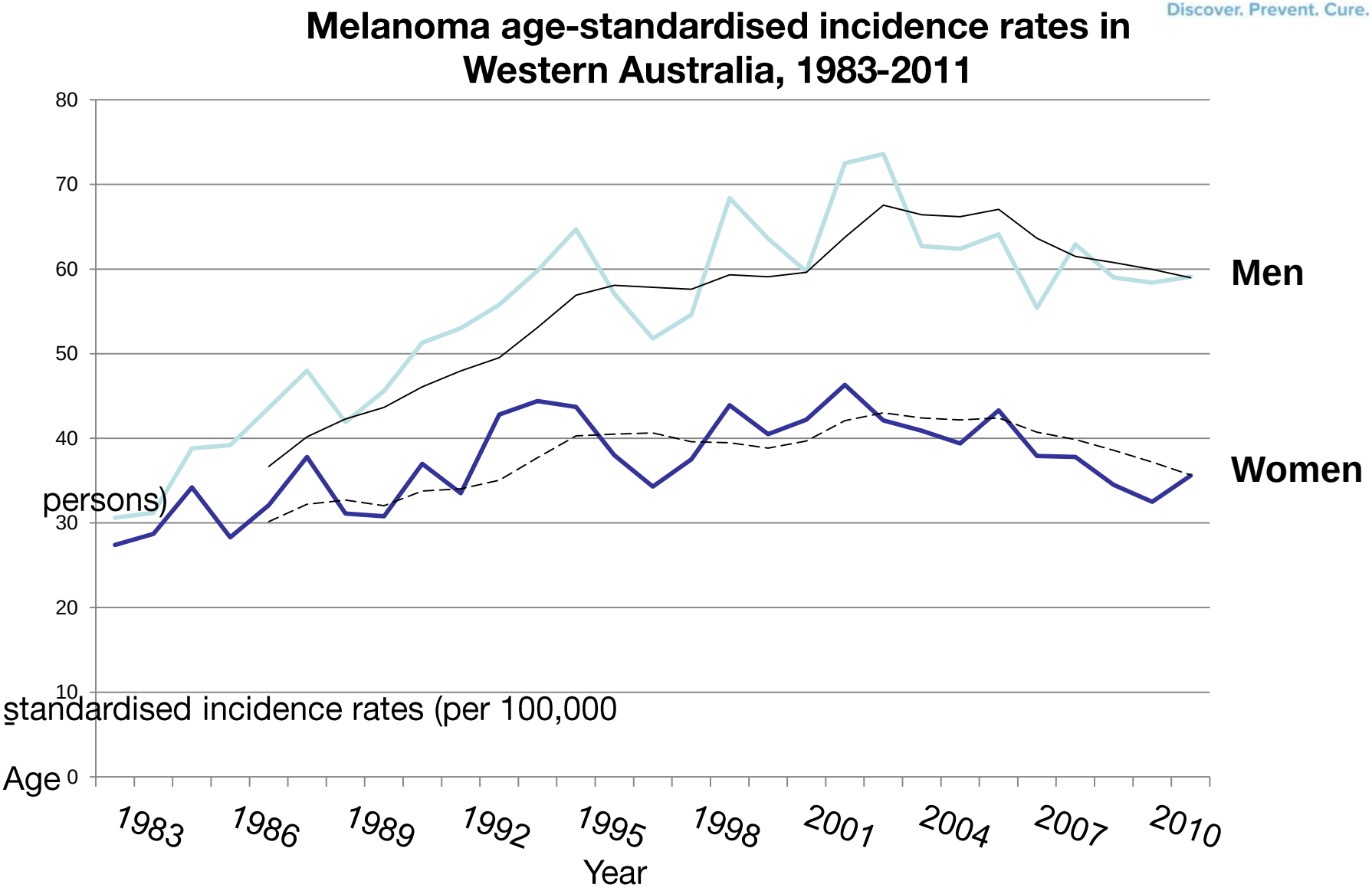


Melanoma incidence

Melanoma age-standardised incidence (ASI) rates in Australia 1982-2010

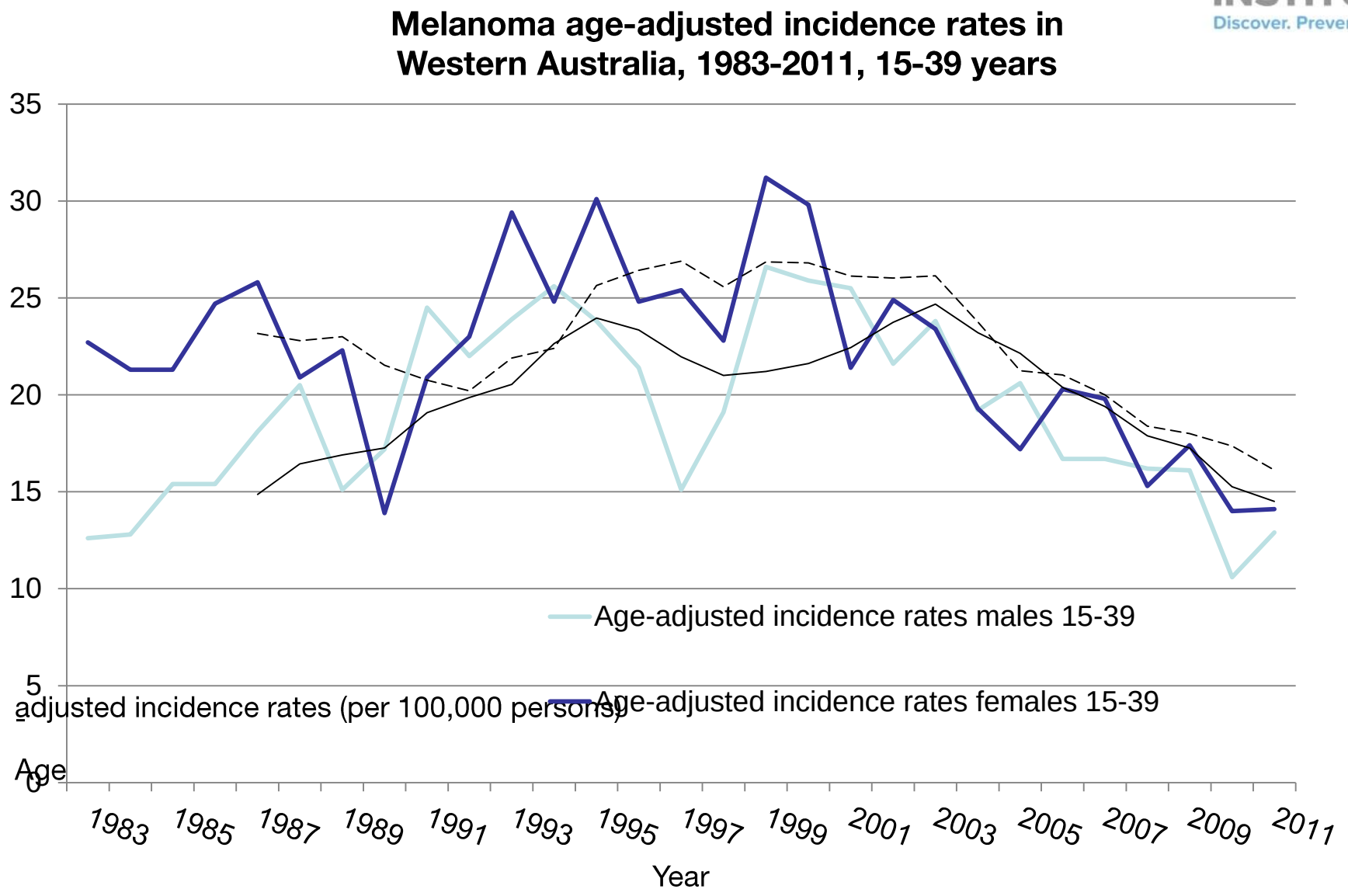


Melanoma incidence

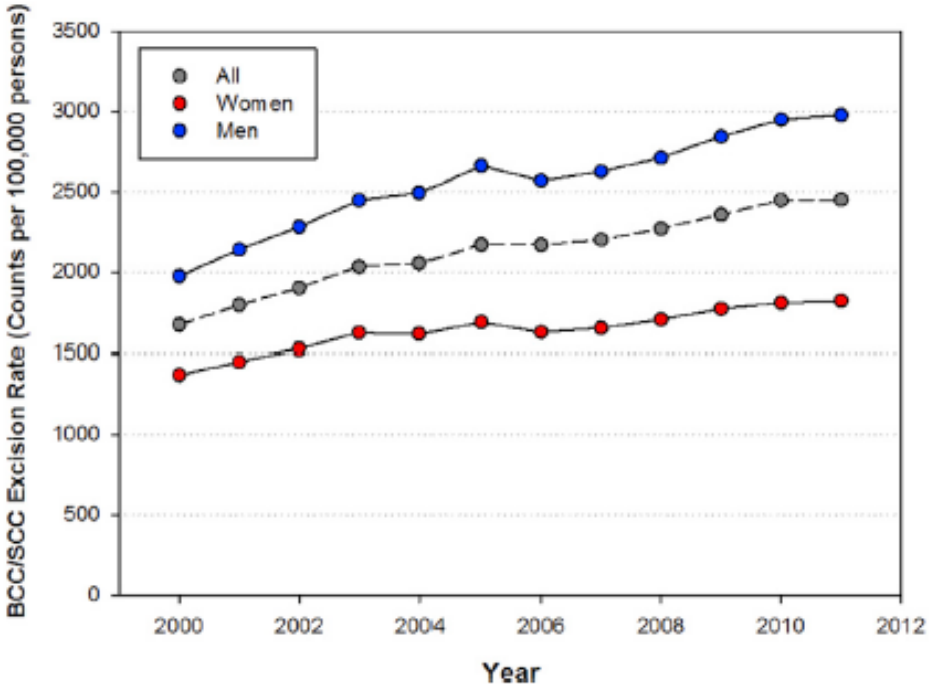


Data from AIHW, www.aihw.gov.au

Melanoma incidence

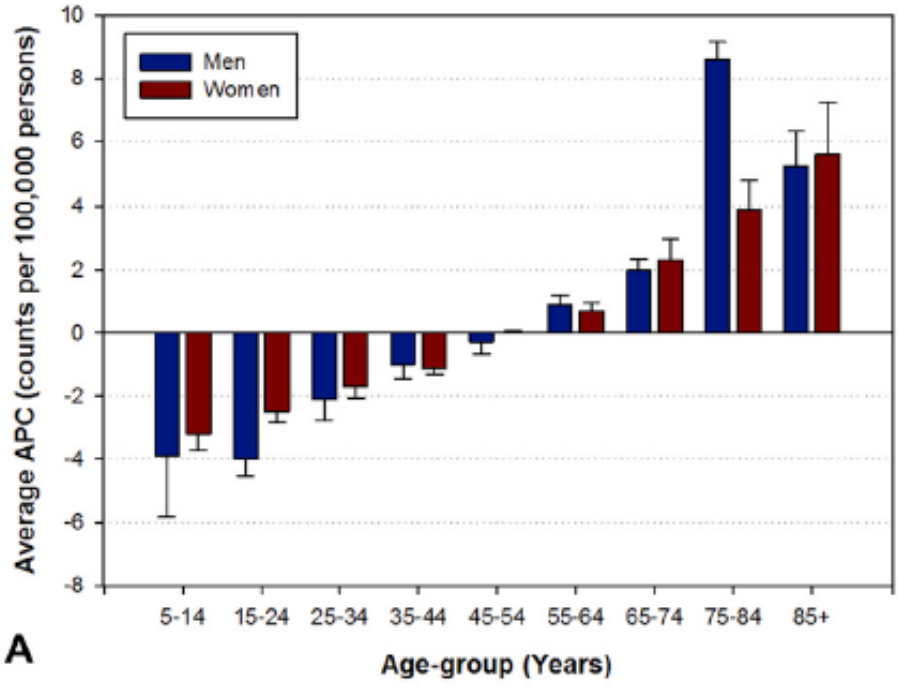


NMSC incidence



BCC and SCC excision rate from 2000 to 2011

Average annual percentage change of counts per 100,000 persons for first excision of BCC or SCC



Olsen et al. J Am Acad Dermatol 2014

Summary

- Time in the sun during leisure has been steadily decreasing over the past 30 years

BUT

- Sunburn on the previous weekend is no longer changing much

- Skin cancer is the most common and most expensive cancer in Australia ($510m): 2 in every 3 Australians will develop a skin cancer by age 70 years

BUT

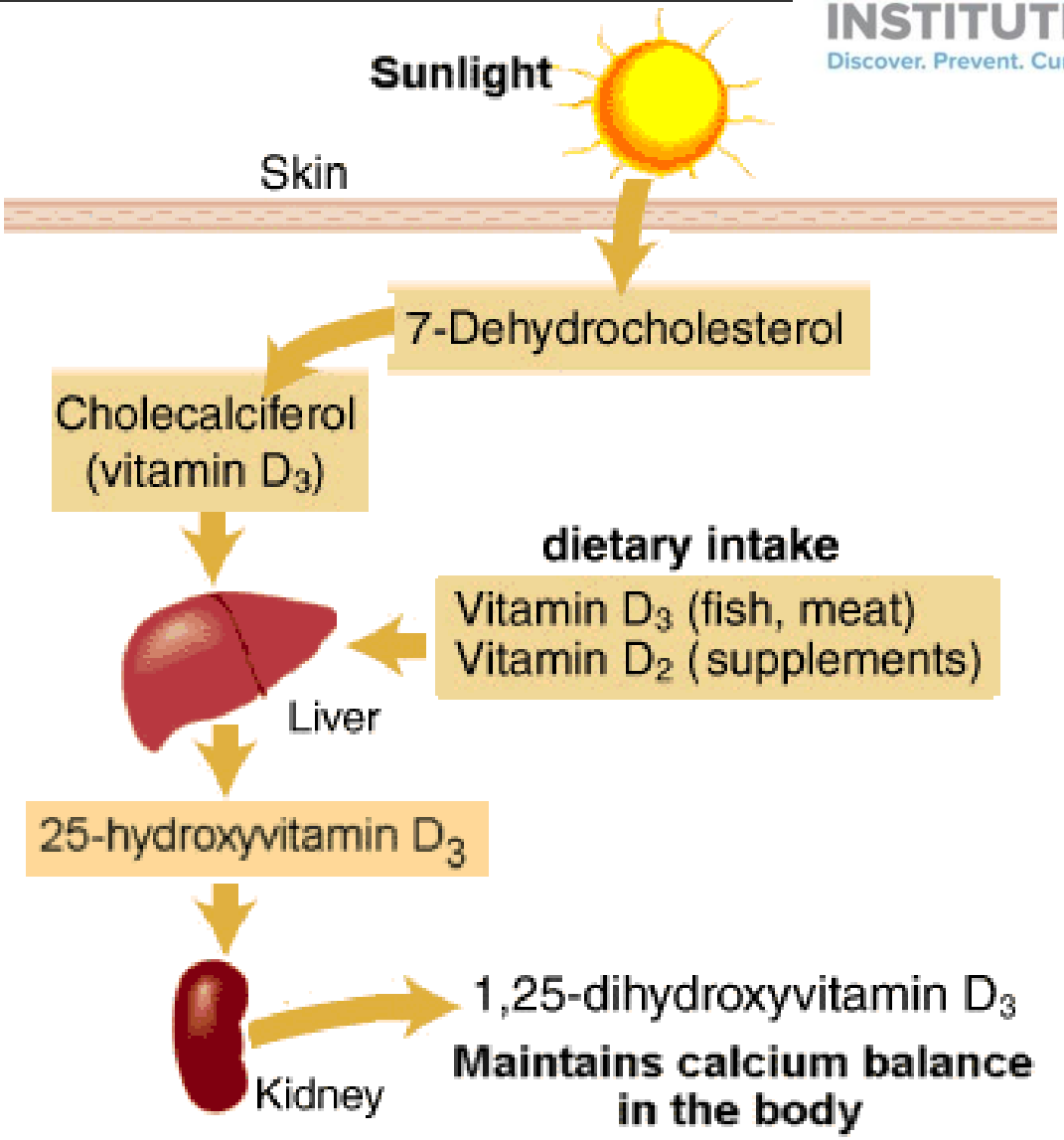
- Melanoma and non-melanoma skin cancer incidence are starting to decrease in younger age groups

Benefits

Production of vitamin D

Immune suppression

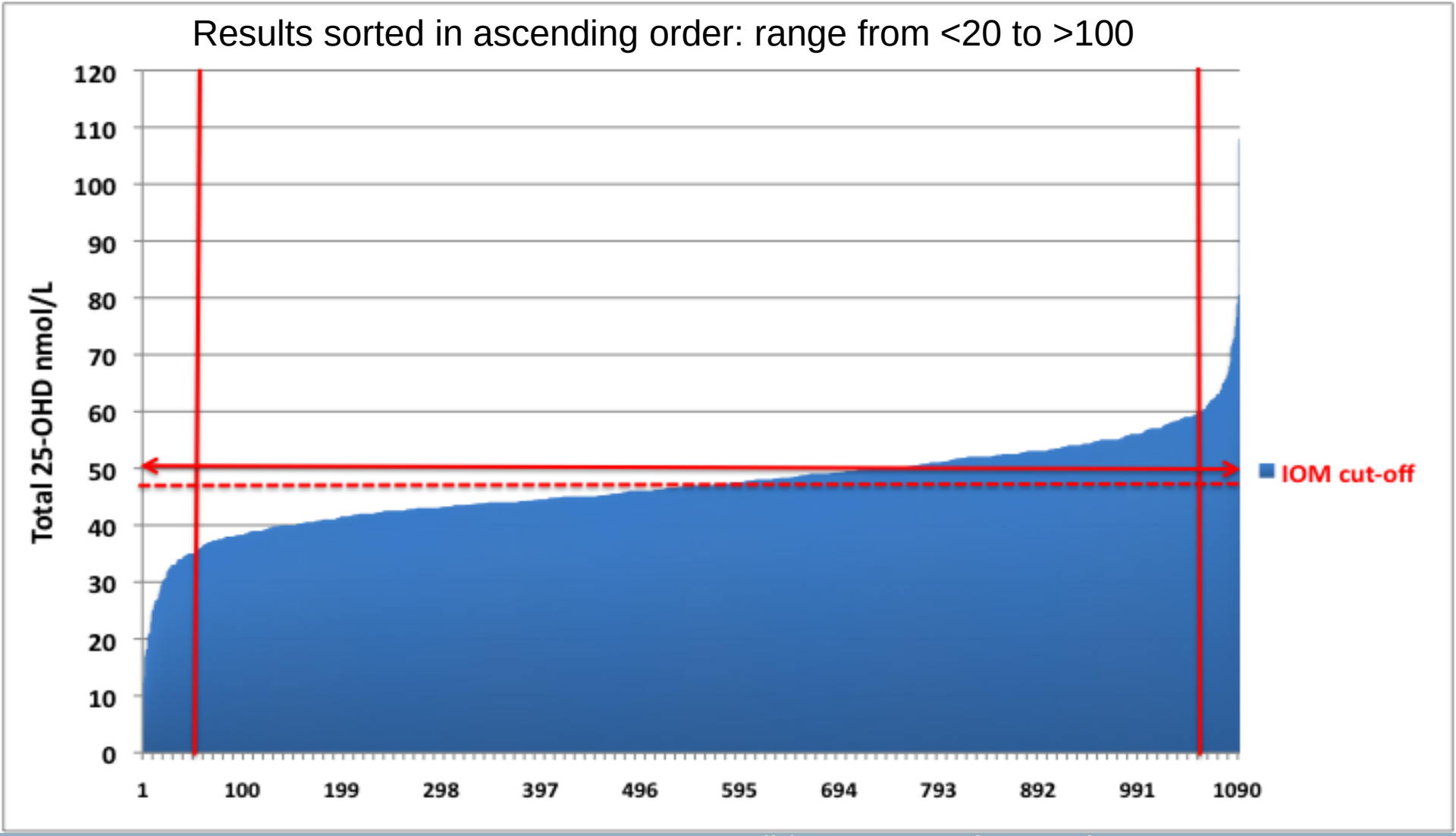
? Other photoproducts with beneficial effects on health



Is vitamin D deficiency common in Australia?

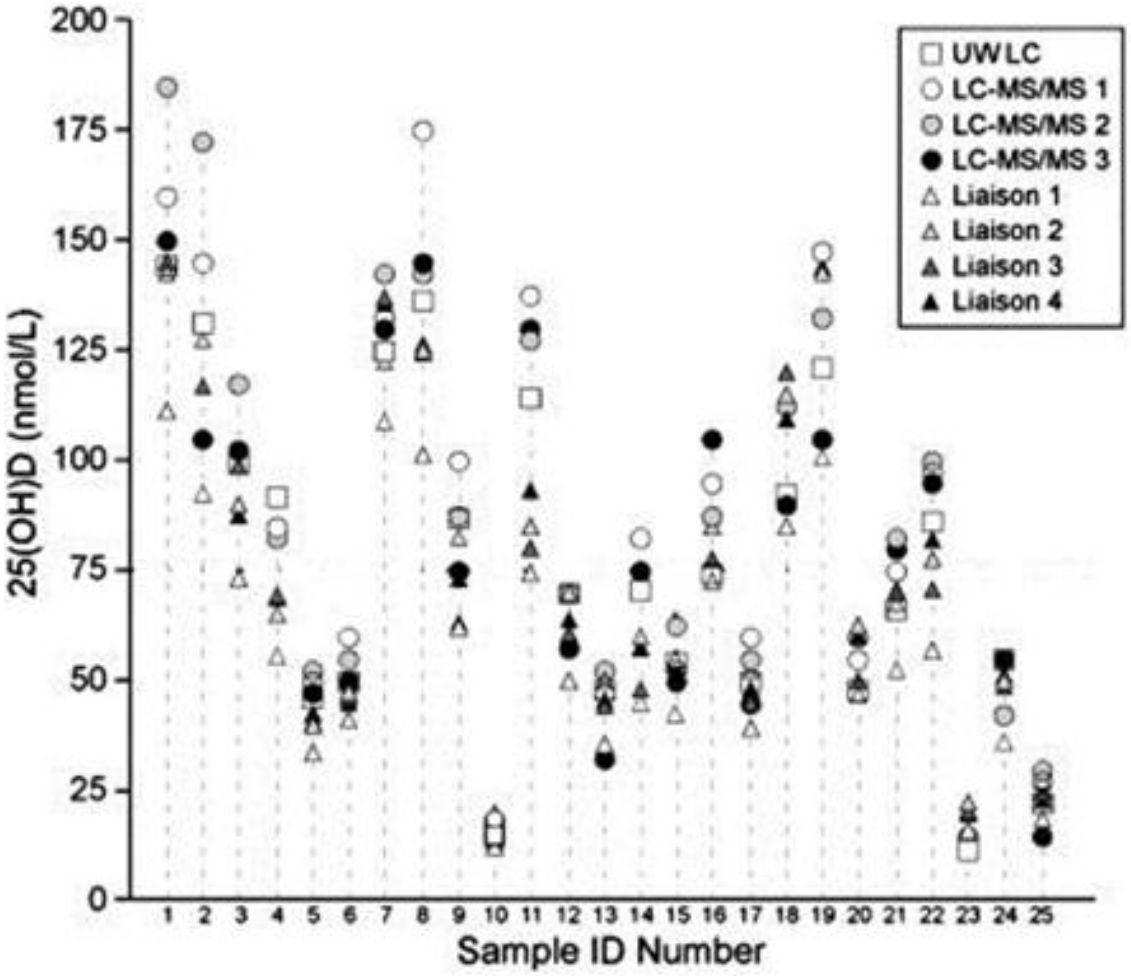
- Depends on how we measure it (which assay)
- Who we measure it on
  - General population
  - People being tested for vitamin D deficiency
  - Specific population groups
- When (in the year) we measure it
- What level we define as “deficient”
  - Not clear how to define this

DEQAS sample 417 (July 2012)
ALTM 47.1 nmol/L



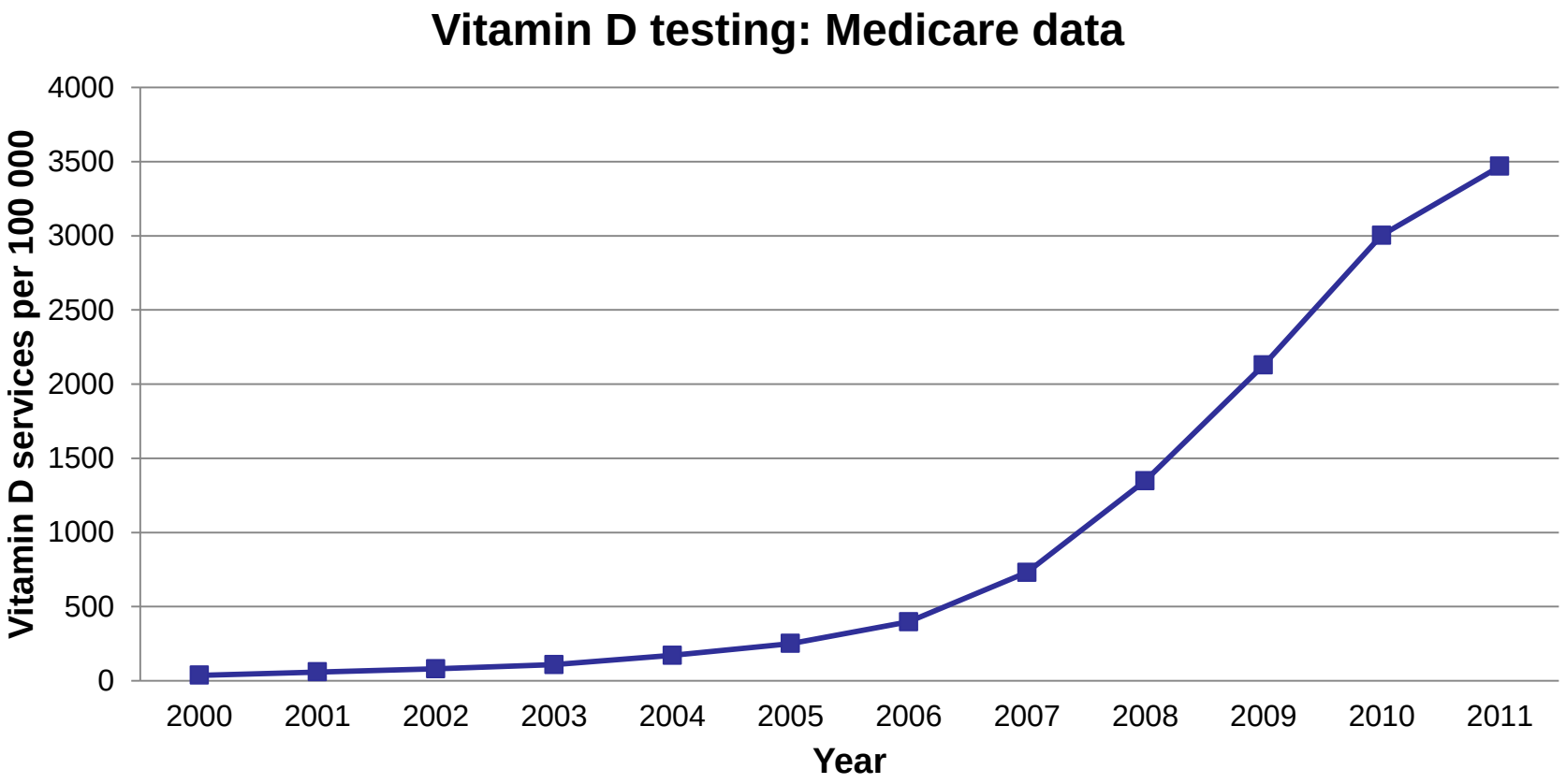
Slide courtesy of Dr Graham Carter

Variation in vitamin D assays



Binkley et al. Clin Chim Acta. 2010;411:1976-82

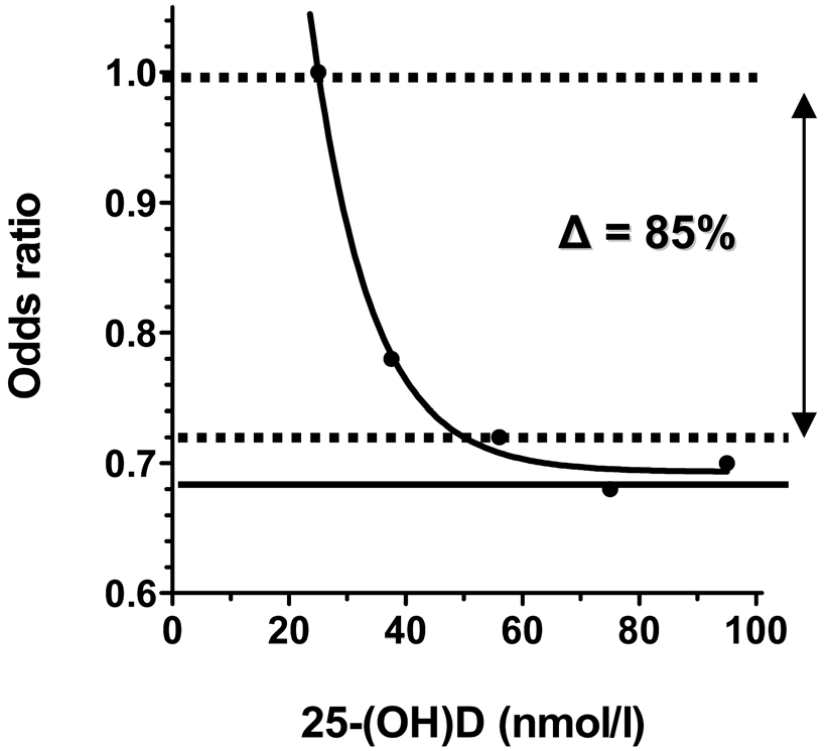
25(OH)D testing in Australia



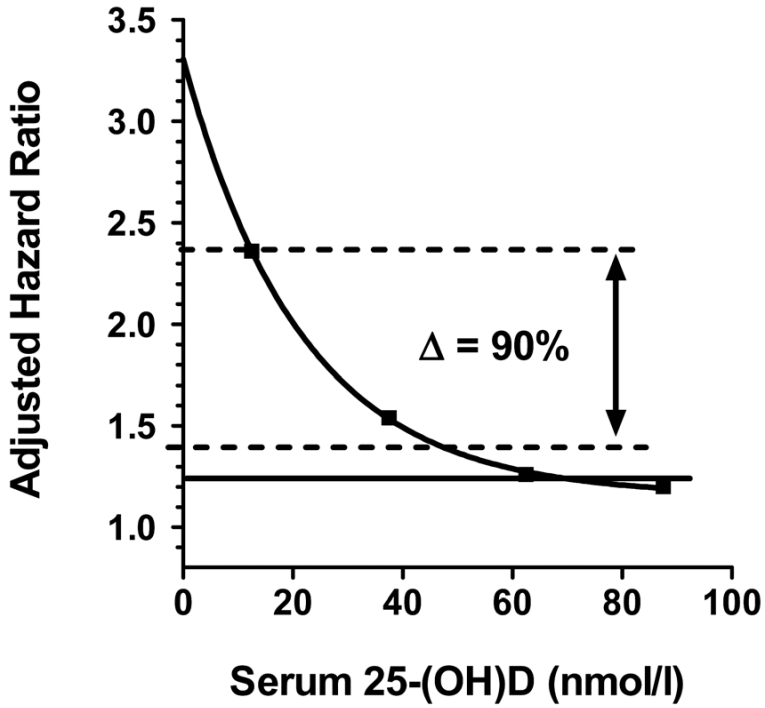
Increase in costs: from $1.02 million in 2000 to >$140 million in 2012

How much vitamin D is enough?

Breast cancer risk



Cardiovascular mortality



Most of any protective effect occurs with levels >50nmol/L

Rickets, osteomalacia – an effect of SEVERE vitamin D deficiency

Peterlik. Food and Function 2012

Vitamin D deficiency in Australians

- The media version[1]:

"The great Aussie paradox: vitamin D deficiency rates soar"

"58 per cent of Australians are vitamin D deficient, according to Australia's largest vitamin D study to date"

- The research[2]:

Sample: 24,819 ambulatory and inpatient samples being tested for 25(OH)D, mainly from NSW

Assay: Liaison 25(OH)D Total Assay

Season: year round

Median (IQR): 54 (24-75) nmol/L

Proportion <50nmol/L (%)

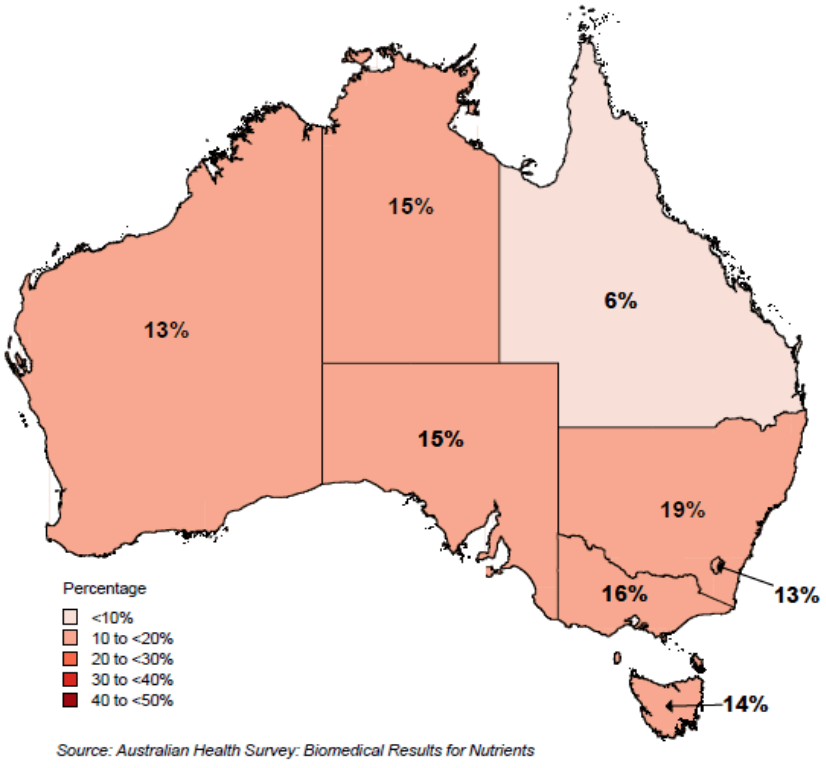
	Summer	Autumn	Winter	Spring	Total
Overall	33	36	52	58	45
Ambulatory male	17	26	42	45	32
Ambulatory female	32	32	51	56	43
Inpatient male	37	37	58	63	49
Inpatient female	41	43	56	62	50

1. http://www.smh.com.au/lifestyle/diet-and-fitness/the-great-aussie-paradox-vitamin-d-deficiency-rates-soar-20121023-282kg.html

2. Boyages & Bilinski Clin Endocrinol. 2012;77:515-23

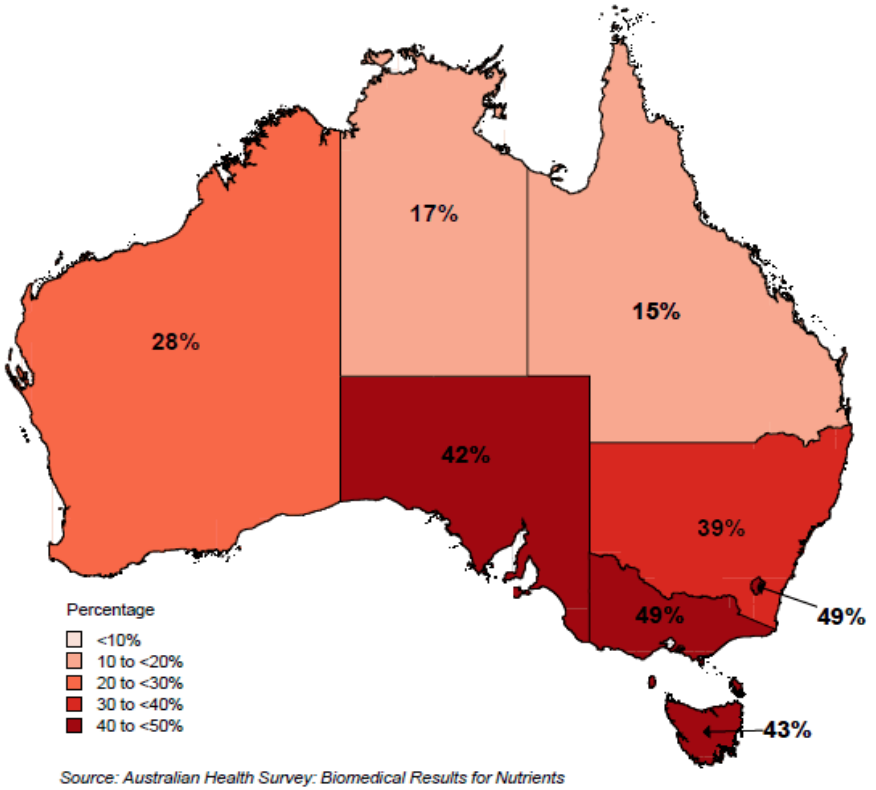
Vitamin D deficiency in Australians

Summer 2011-12



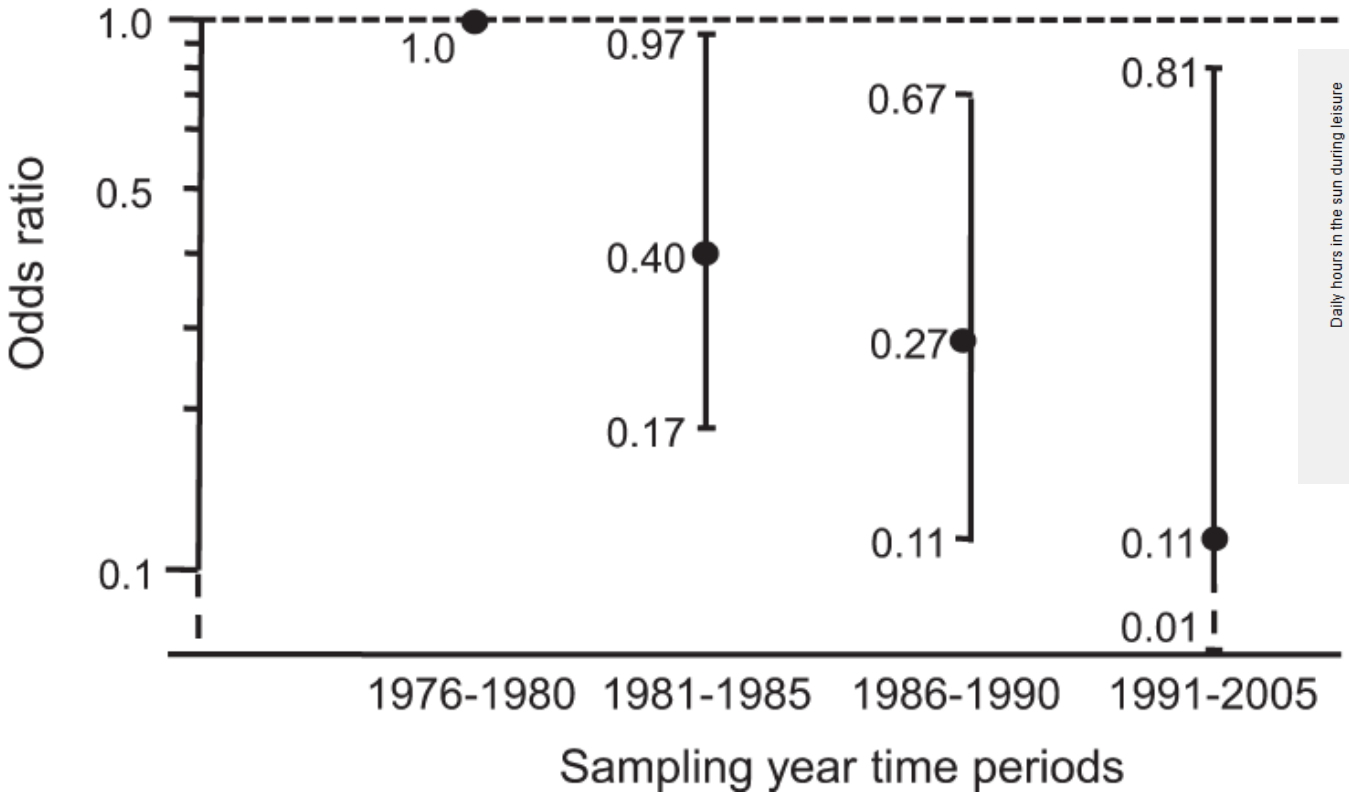
Source: Australian Health Survey: Biomedical Results for Nutrients

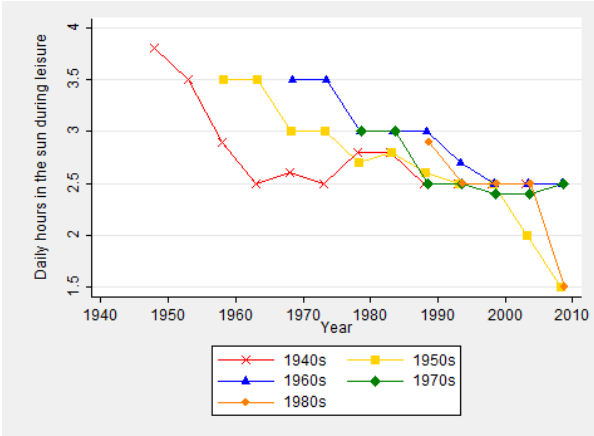
Winter 2011/12



Source: Australian Health Survey: Biomedical Results for Nutrients

Trends in vitamin D status



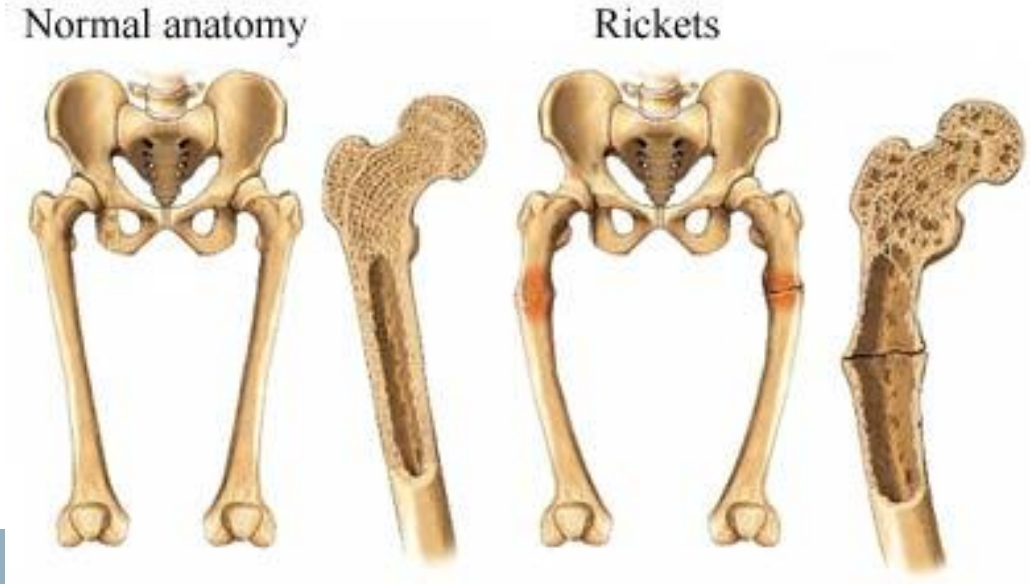


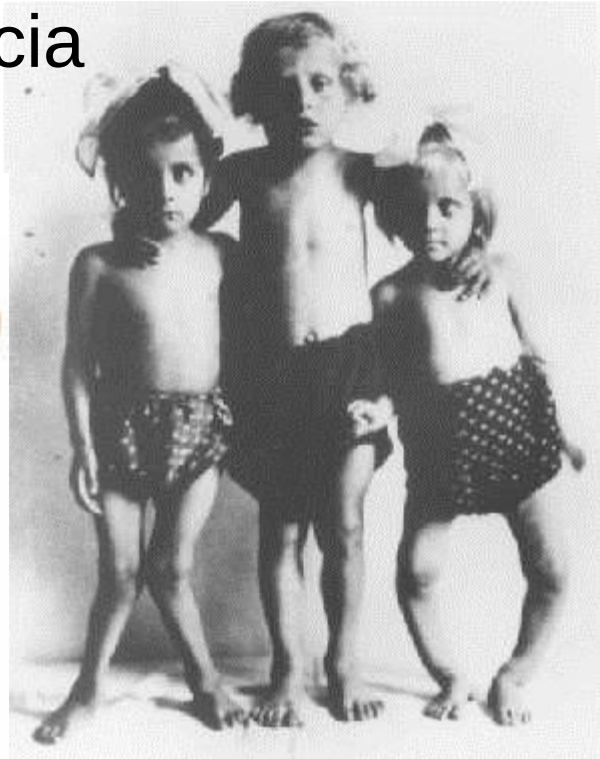
Odds of having 25(OH)D levels ≥75nmol/L by sampling year time period in Swedish adults[1]

1. Salzer et al. Neurology 2012, epub ahead of print

Why is vitamin D important?

- Maintains calcium homeostasis
  - Increases Ca absorption in gut, reduces Ca loss in urine, if low Ca diet – resorption from bone
  - Severe vitamin D deficiency causes rickets in children and osteomalacia in adults





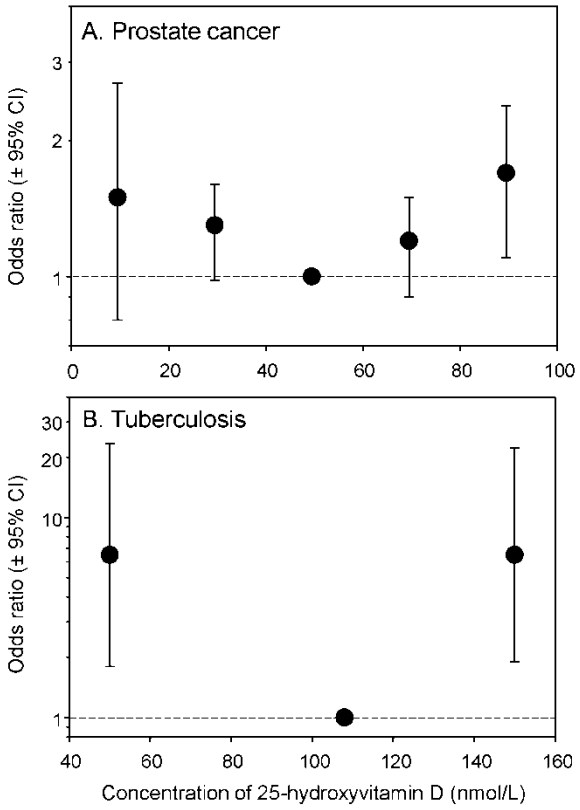
Vitamin D beyond bone

Vitamin D deficiency implicated as a risk factor in:

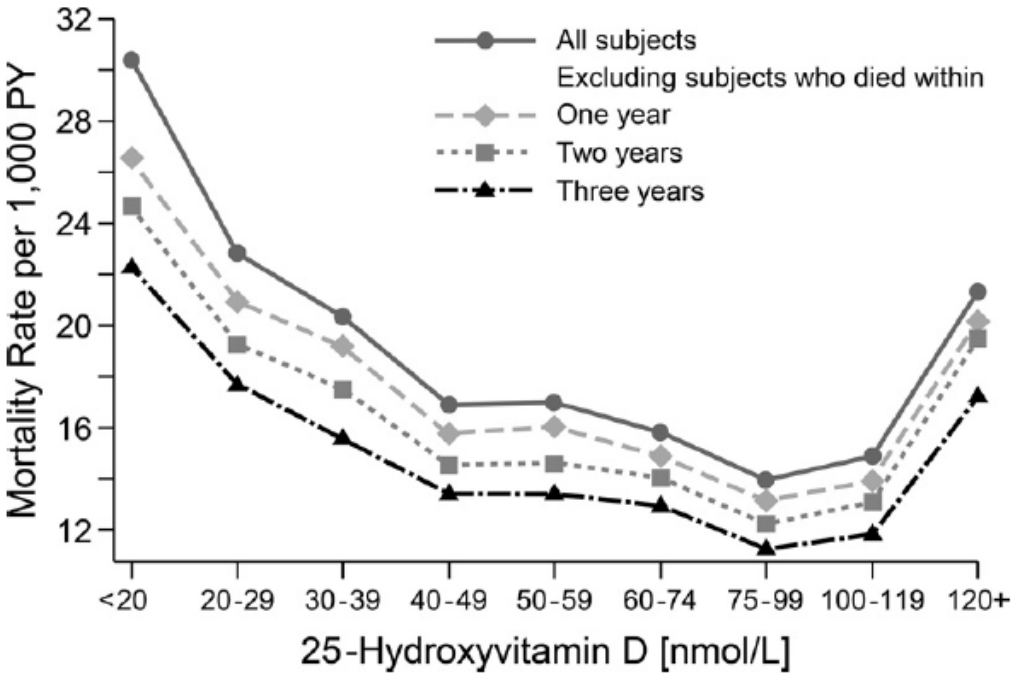
- Cancers: breast, bowel, prostate, ovary and others
- Autoimmune diseases: multiple sclerosis, type 1 diabetes, rheumatoid arthritis
- Schizophrenia, autism, depression
- Cardiovascular diseases: high blood pressure
- Pregnancy disorders: pre-eclampsia, infertility, small for gestational age babies, premature birth

WHICH COMES FIRST – disease or deficiency?
Vitamin D itself – or a marker for something else?

Is more always better?



Odds of prostate cancer (A)[1] and tuberculosis (B)[2] in relation to serum 25(OH)D concentration



Mortality rate adjusted for age, sex, race/ethnicity and season by 25(OH)D concentration. 15-year follow-up of NHANES III (n=15 099)[3]

1.Tuohimaa et al Int J Cancer 2004; 2. Nielsen et al Br J Nutr 2010; 3. Sempos Am J Clin Nutr 2013

Observational studies vs. supplementation trials

- Observational studies show low 25(OH)D/low sun exposure is associated with increased disease risk

BUT

- Vitamin D supplementation trials and meta-analyses of clinical trials are null

WHY

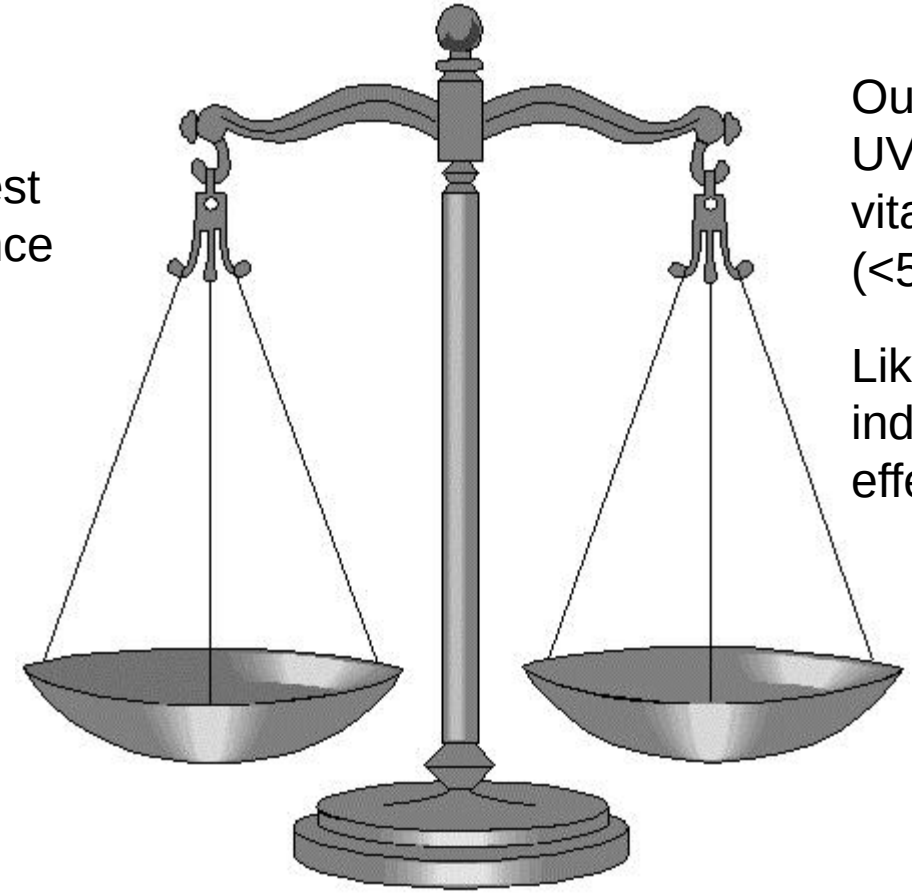
- ?Supplement dose too low, for too short a time; participants not vitamin D deficient to start with
- Uncontrolled confounding in observational studies

OR

- 25(OH)D level is a proxy for sun exposure effects

Balance: skin cancer vs. vitamin D

Australia has highest skin cancer incidence in the world



Our vitamin D is mainly UV-derived; 23% are vitamin D deficient (<50nmol/L)

Likely to be vitamin D-independent beneficial effects of sun exposure

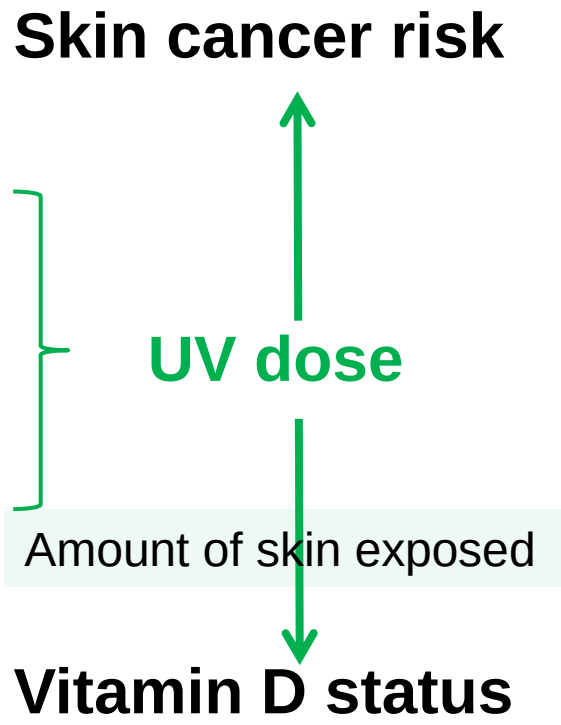
Is it possible to achieve a UV dose to relevant structures for beneficial effects without incurring adverse effects?

Competing risks

- **Increasing skin cancer incidence reflects:**
  - Past high sun exposure
  - Lag from exposure to disease
  - ? risks associated with childhood and high dose, intermittent sun exposure, cf. usual time outdoors
- **Current vitamin D deficiency**
  - Reflects current practice
  - Linked to usual time outdoors (recent/current)

What determines our skin cancer risk and vitamin D status

- UV levels and UVA vs UVB
  - Time of day, time of year
- Time in the sun



Modifiers of the balance point:

- Age, genetic make-up
- Use of sunscreen, shade
- Skin colour

Modifiers of received UV dose

Most clothing will block both sunburn and vitamin D production.

Sunscreen blocks vitamin D production only if applied thickly. Usual application will decrease but not stop vitamin D, but still decrease the risk of sunburn

Shade provides good protection from overhead sun, but may allow exposure from scattered and reflected UV (sunburn and vitamin D)

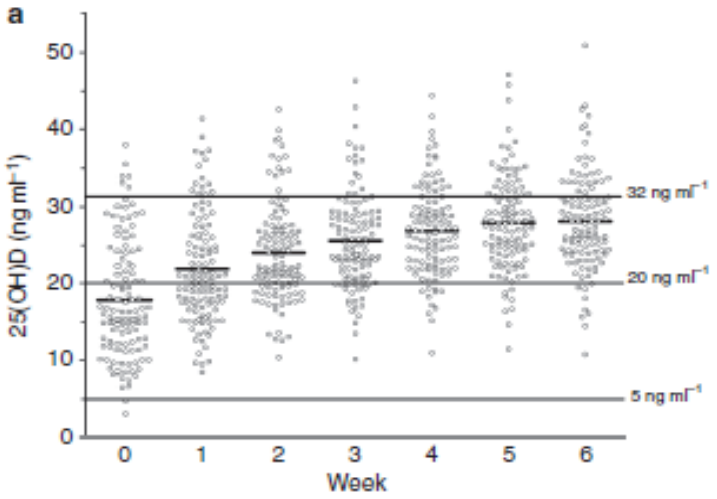
Groups at particular risk (of vitamin D deficiency)

- Deeply pigmented immigrants (a combination of skin colour and cultural effects on sun exposure behaviour)
- Veiled women and their children
- Elderly, particularly institutionalised
- Office workers
- Patients with specific conditions who may be sun avoidant, e.g. multiple sclerosis, past skin cancer
- Anyone practising extreme sun protection

http://www.savvymode.com/2012/08/extreme-sun-protection.html

Vitamin D from sun exposure

- Many uncertainties!
- What we do know:
  - Response to sun exposure depends on starting vitamin D level
  - Increasing UV dose increases vitamin D production
  - Regular sun exposure causes a plateau in vitamin D level
  - Prolonged exposure results in breakdown of synthesised vitamin D
  - Everyone is different!



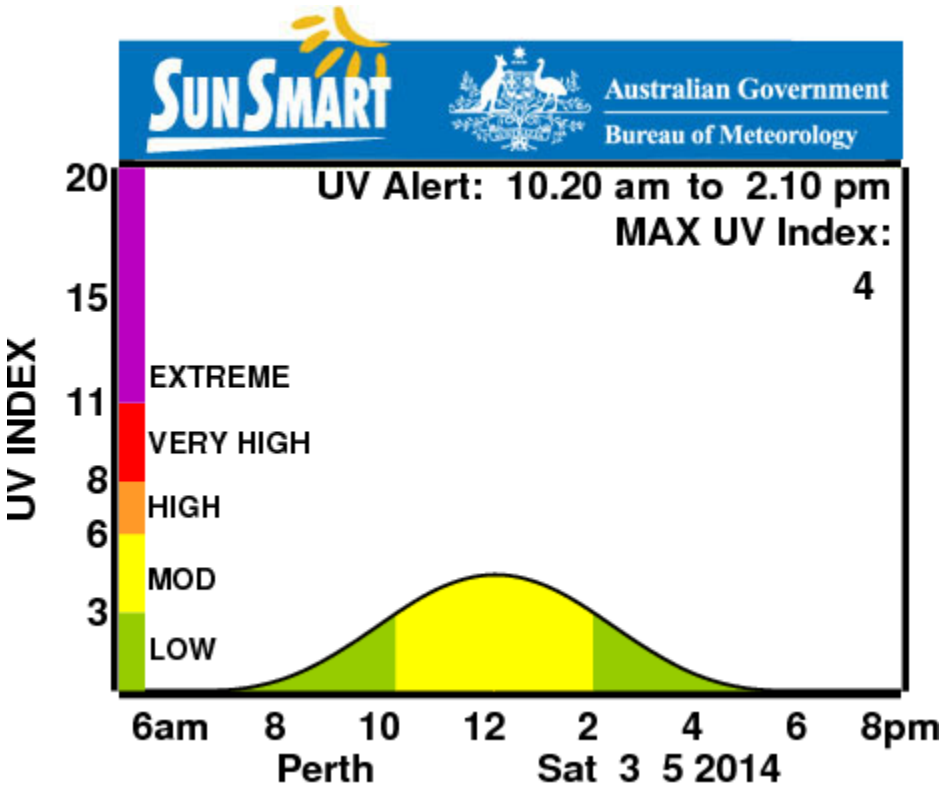
Simulated summer sunlight 1.3 SED to 35% body surface area, three times per week[1]

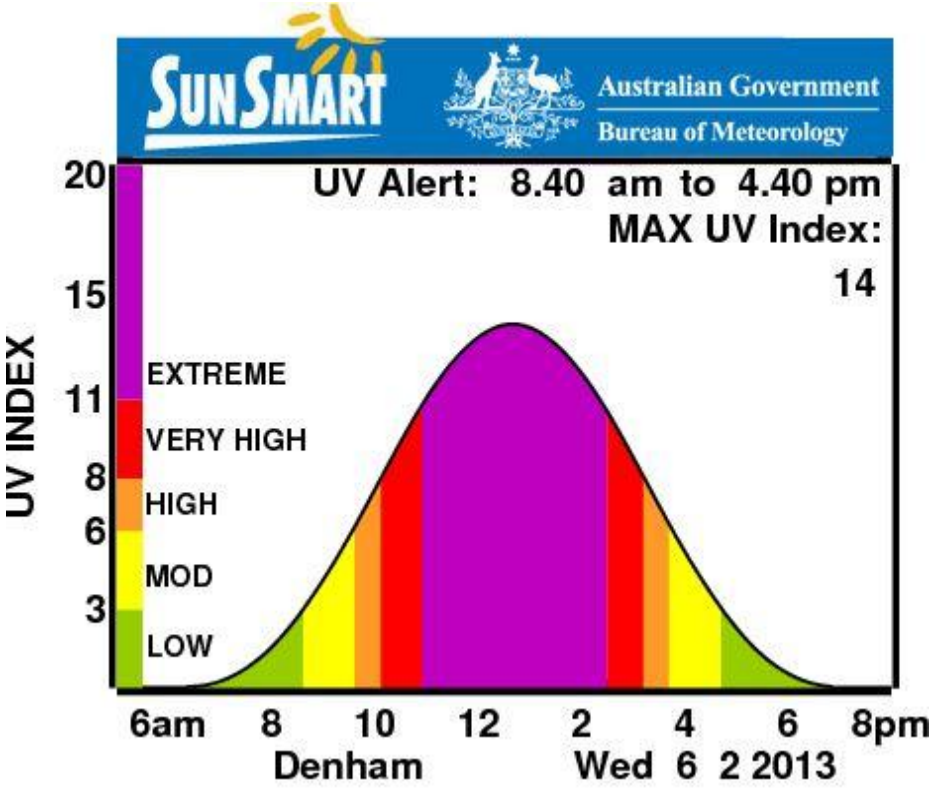
1. Rhodes et al J Invest Dermatol 2010; 130:1411-8;

Achieving balanced sun exposure

- Blanket rules not appropriate
- Need to be guided by the UV Index
  - For the location
  - For the time of year, time of day
- Change the pattern of sun exposure
  - Always protect the head and neck and probably the back of the hands
  - Brief exposures, frequently, to lots of skin

UV dose for sunburning (and probably pretty close for vitamin D production)

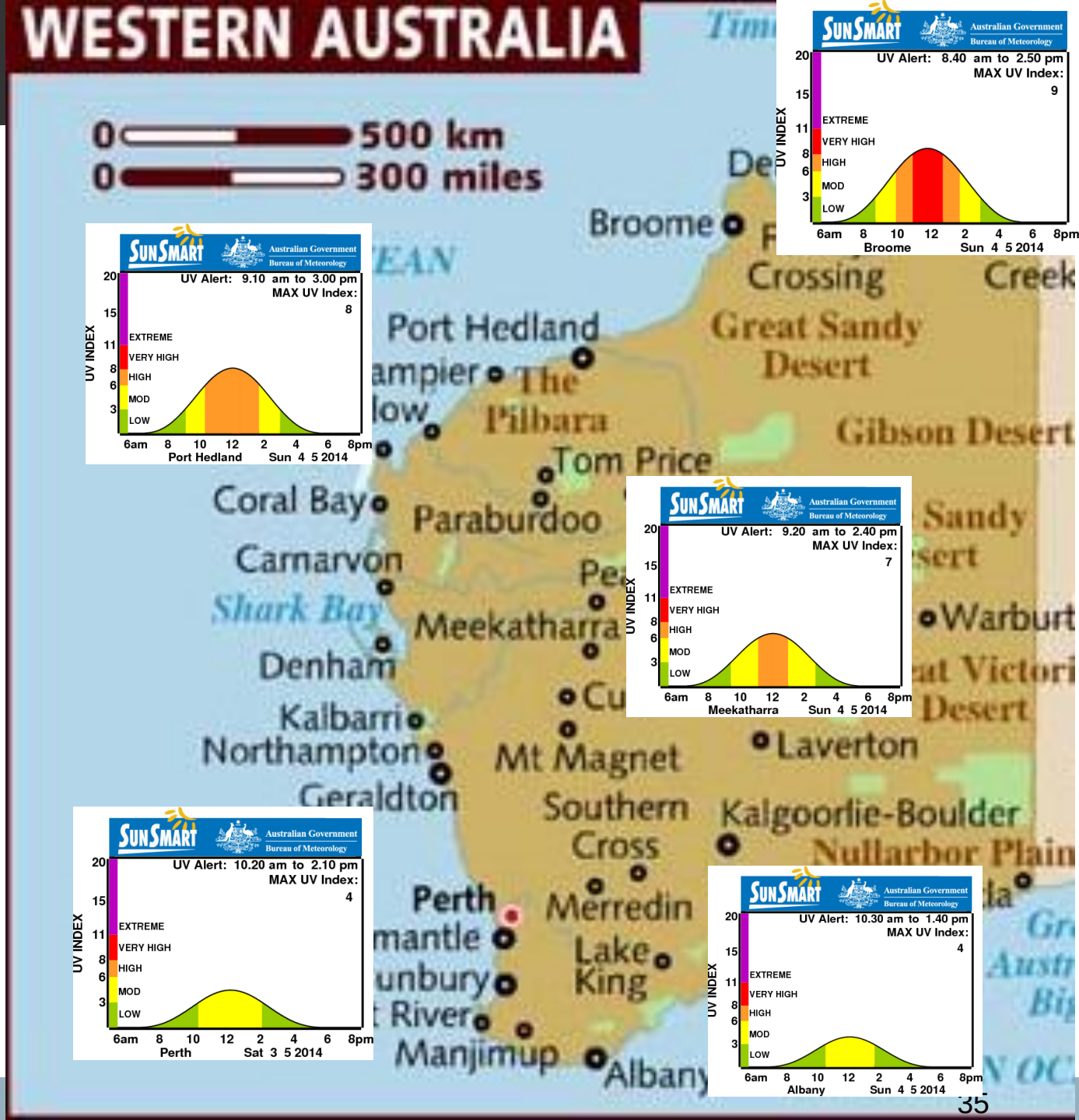




Australian National University

UV Index in WA

3 May 2014



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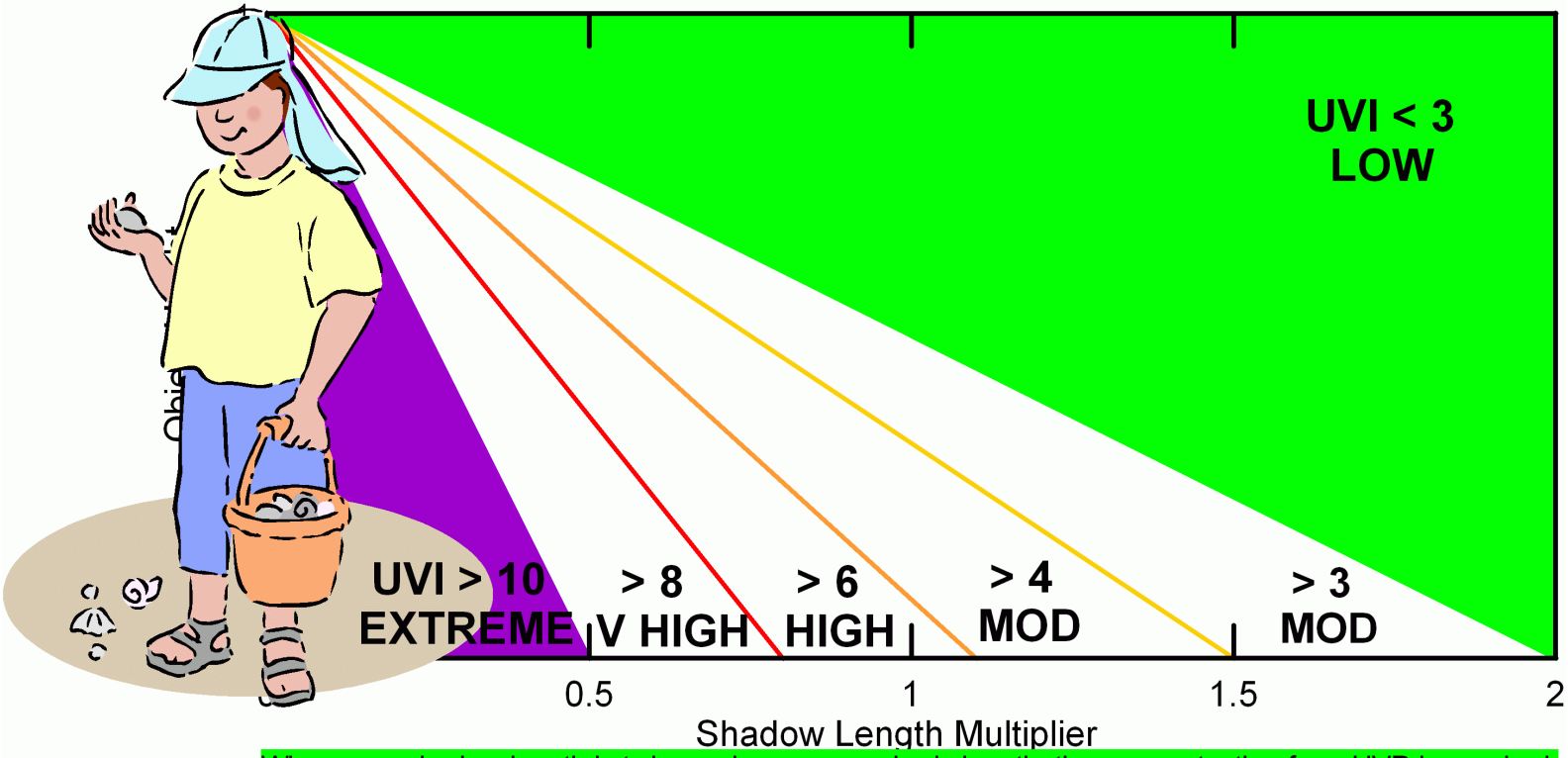


When your shadow length is twice as long as your body length, then no protection from UVR is required

When your shadow length is shorter than your body (i.e., for sun elevation > 45° above the horizon), skin damage can occur in less than 30 minutes

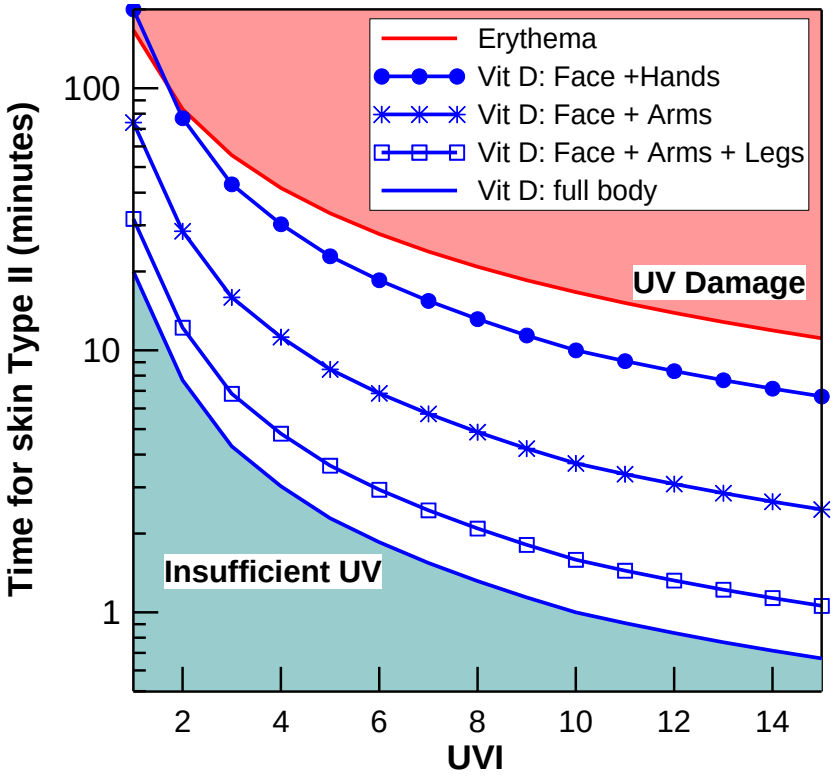
When shadow length is less than half body, skin damage occurs in less than 15 minutes

Slide courtesy of Ben Liley, NIWA, NZ

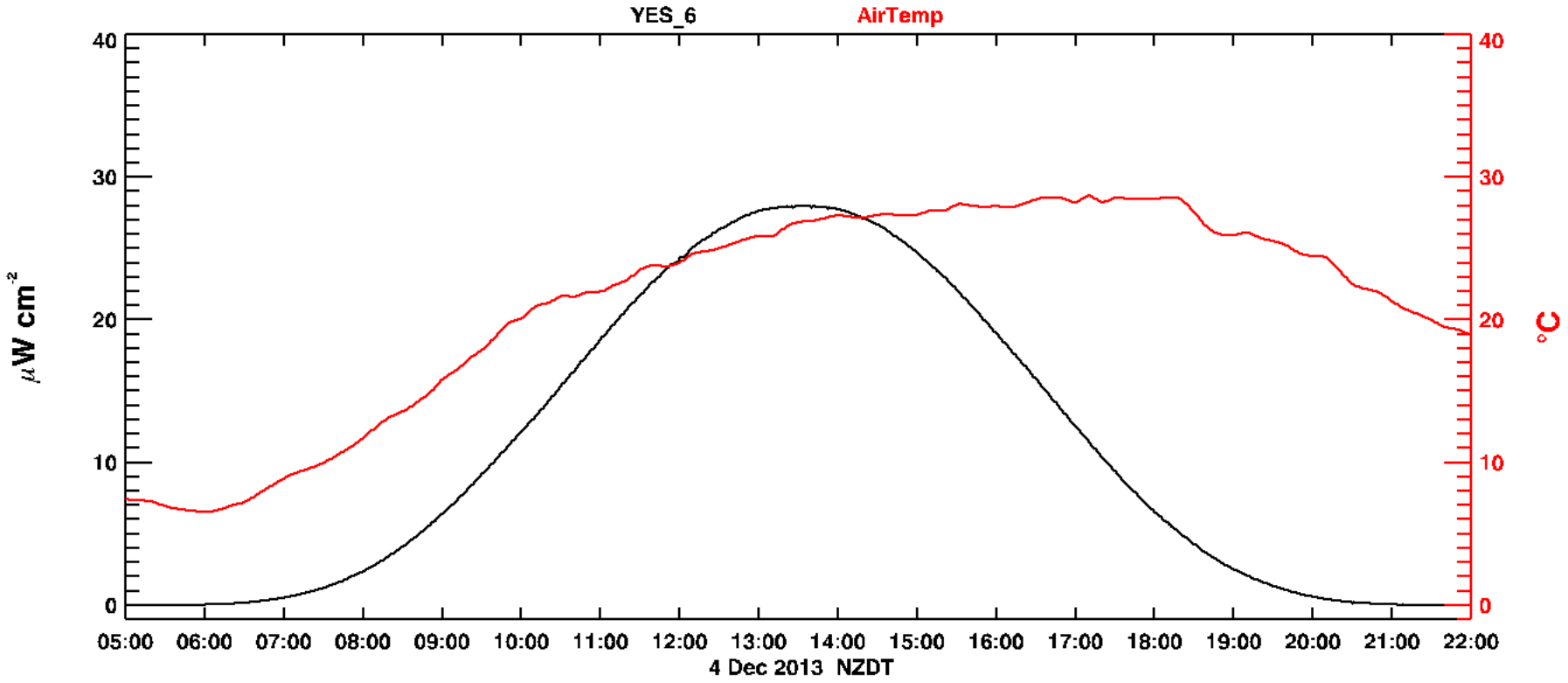
Safe UV doses for vitamin D sufficiency

- Modelled estimates based on:
  - UV dose to get minimum erythema (MED)
  - UV equivalent of vitamin D intake: 1 MED full body exposure=10,000 IU intake, i.e. 600 IU≈¼ MED to ¼ skin area)

Schematic based on UV Index: exposure times for skin damage or vitamin D production, based on skin type II [2]



Don’t be fooled by heat!



Highest UV occurs around the middle of the day, but peak air temperature lags well into the afternoon.

Achieving balanced sun exposure

- UV Index less than 3: sun protection is not required.
  - At this level fair skin is unlikely to burn
- UV Index of 3 or more:
  - Protect the head and neck
  - If planning to be outdoors for more than 10-15 mins, use sun protection: slip, slap, slop, seek and slide

New studies to provide more information

- Sun exposure and vitamin D supplementation (SEDS) Study
  - Can you use sun exposure to treat mild vitamin D insufficiency?
  - Do sun exposure and vitamin D have separate effects on health?
- The D-Light Project
  - Providing evidence on risks, benefits and balance