Sunscreen prevention of UV-induced skin cancer

I: Contribution of UV radiation to skin cancer

II: Evidence for skin cancer reduction by sunscreen

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Keratinocyte cancers (KC) (formerly 'NMSC')

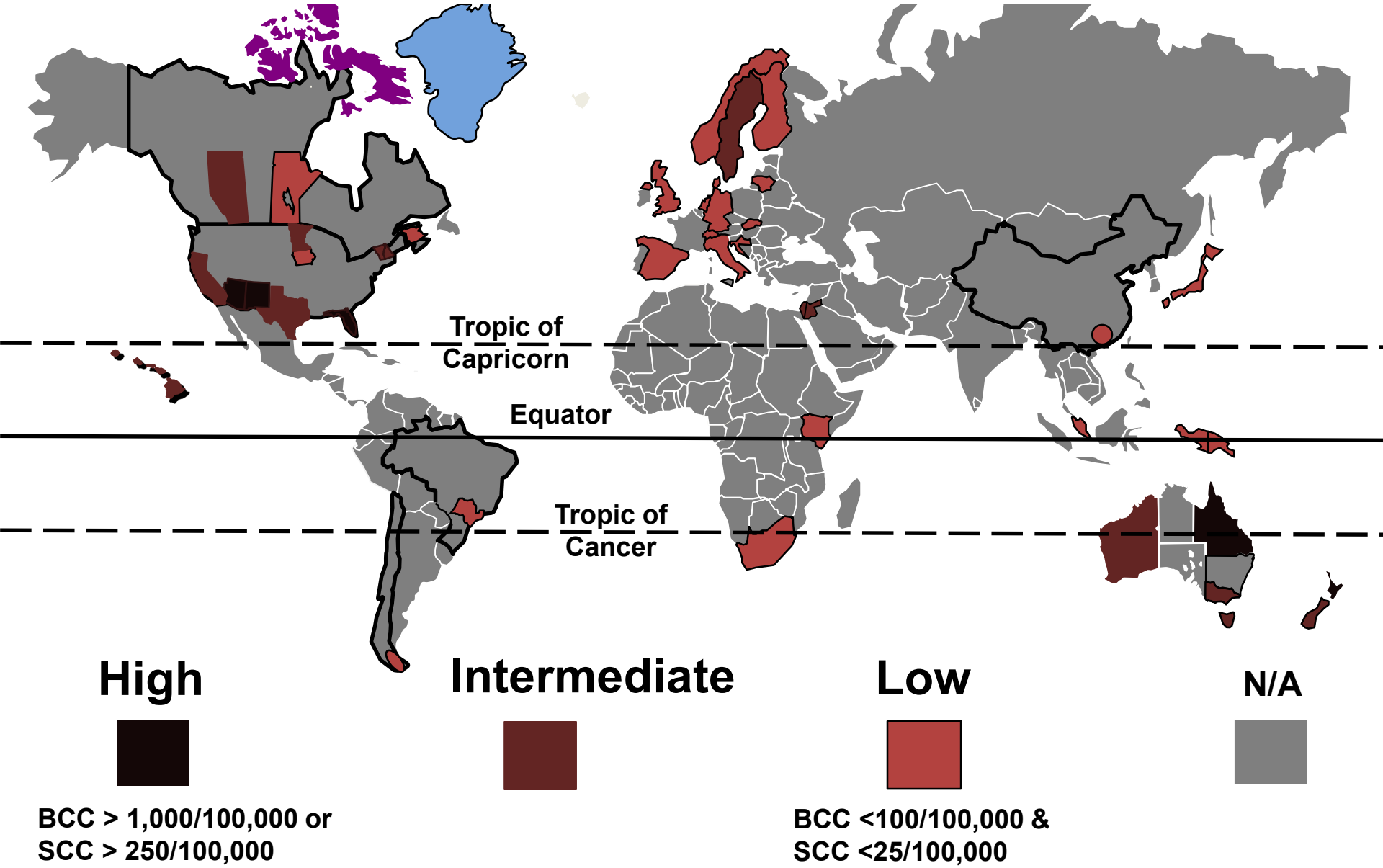
Basal cell carcinoma (BCC)

Squamous cell carcinoma(SCC)

True global incidence rates unknown

- *POOR REGISTRATION* in many countries (*none / selected subgroup*)
- Often *REGIONAL/LOCAL ESTIMATES* only
- *MULTIPLE PRIMARY KC* a particular problem
  - *IARC/IACR : count only 1st tumour of defined histological type on skin*

Keratinocyte cancer: Global incidence



Lomas et al, 2012

Melanoma

Lifetime Risk (<75 yrs)

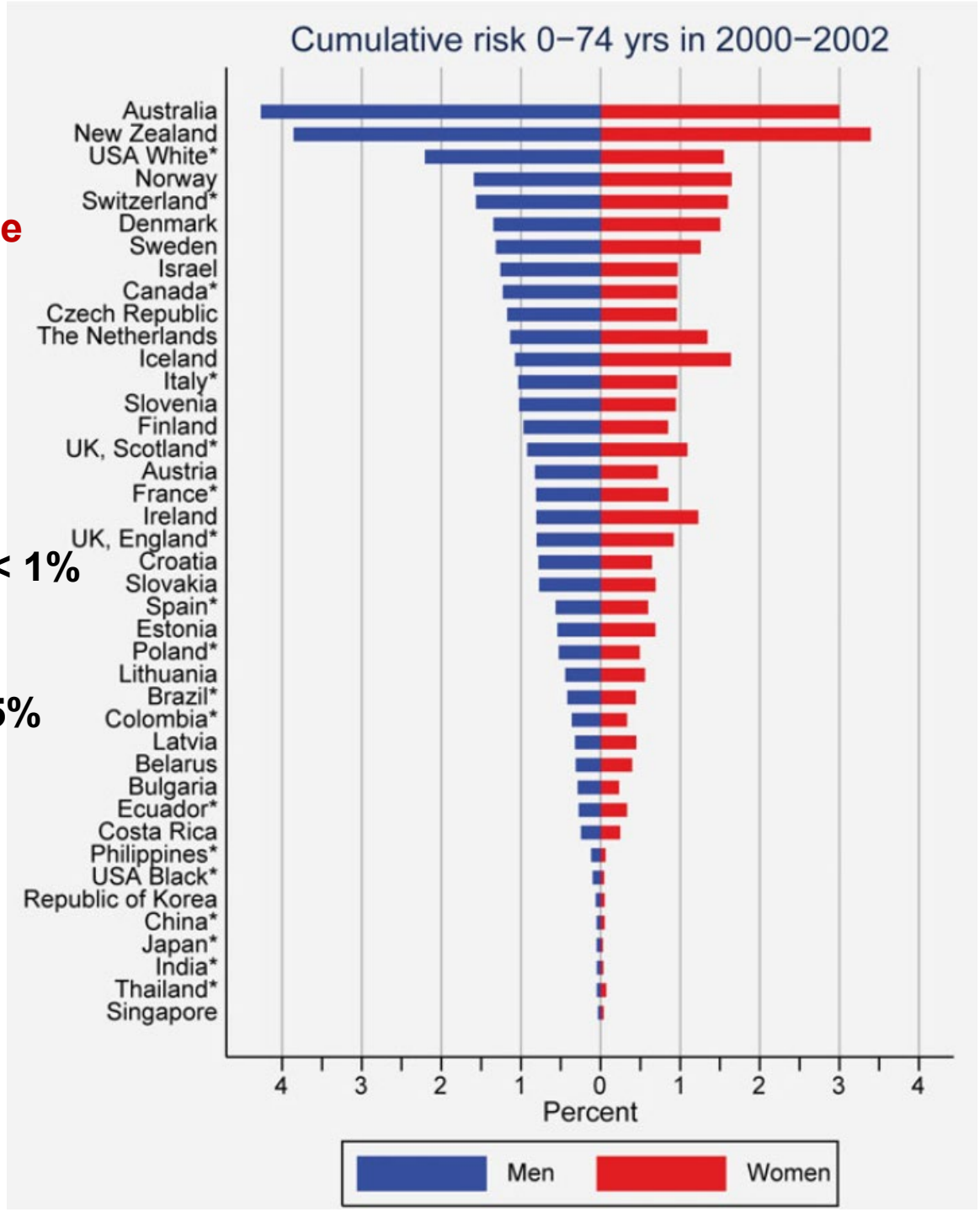
by country & sex

Australia, NZ ~4%

USA White ~2%

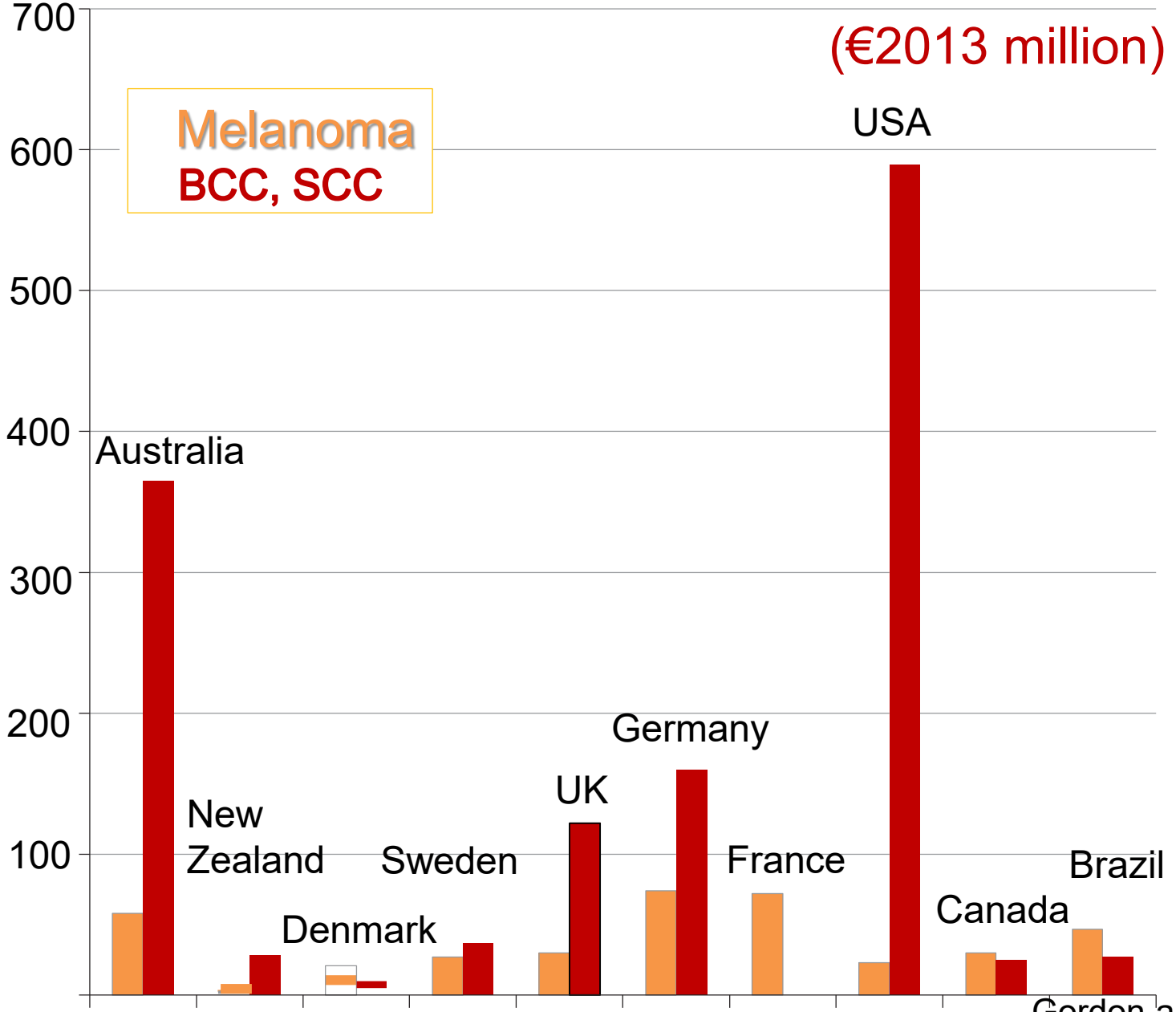
England < 1%

Brazil 0.5%



Erdmann et al, 2013

Annual direct healthcare costs skin cancers



Gordon and Rowell, 2014

What causes BCC, SCC, melanoma?

1. **Ultraviolet (UV) radiation**
   - -High sun exposure
   - -Indoor tanning devices (sunbeds)

2. **Immunosuppression (+UV)**
3. **Ionising radiation (BCC)**
4. **Smoking; chronic inflammation; ?HPV (SCC)**
5. **?Dietary and medications influence**

UV radiation

- **Shortest wavelength band of non-ionising EMF**
  - -UVC 100- 280nm; **UVB 280- 320nm; UVA 320-400 nm**
- **Solar UV radiation on earth's surface:** 5% UVB, 95% UVA
- ***Biologically-effective solar UV* on earth**: 85% UVB, 15% UVA

UV is a Type I Carcinogen (IARC 2009) because skin cancer risk is increased:

- ✓ **White-skinned** vs dark-skinned
- ✓ **High ambient UV** vs low

- ✓ **Tendency to sunburn with acute sun** vs not to burn
- ✓ **Multiple sunburns** vs none
- ✓ **Inherited UV 'sensitivity'** (XP; albinism)

- ✓ **Sun-exposed body sites** vs non-exposed
- ✓ **Actinic keratoses* present** vs absent

*

Proportion of skin cancers attributable to solar UV radiation?

13.

Cancers attributable to solar (ultraviolet) radiation exposure in the UK in 2010

DM Parkin*,[1], D Mesher[1] and P Sasieni[1]

[1]Centre for Cancer Prevention, Wolfson Institute of Preventive Medicine, Queen Mary University of London, Charterhouse Square, London EC1M 6BQ, UK

British Journal of Cancer (2011) 105, 566–569; doi:10.1038/bjc.2011.486 www.bjcancer.com

Brit J Cancer 2011; 195: 566-569

UK:
86% of melanomas
due to UV

Cancers in Australia attributable to exposure to solar ultraviolet radiation and prevented by regular sunscreen use

Catherine M. Olsen,[1,2] Louise F. Wilson,[1] Adele C. Green,[1,2,3] Christopher J. Bain,[1,4] Lin Fritschi,[5] Rachel E. Neale,[1,2] David C. Whiteman[1,2]

Aust NZ J Public Health. 2015; 39:471-6;

Australia:
~100% of BCCs+SCCs
&
63% of melanomas
due to UV

Evidence re Sunscreen effectiveness in reducing UV-induced skin cancer

- ***Randomised Controlled Trials only***

…To avoid "confounding by indication"

Predictors of sunscreen use (fair skin, outdoor activity)

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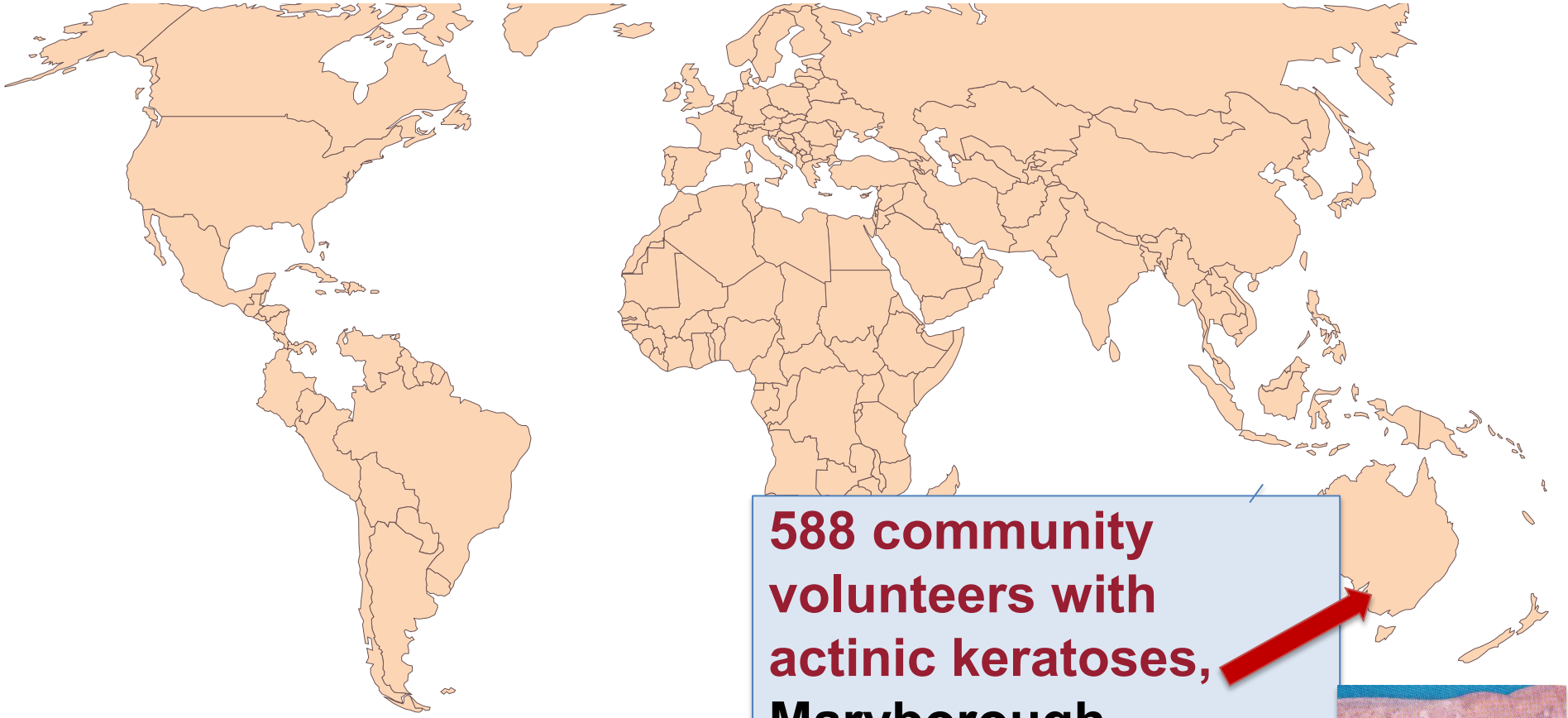
Predictors of skin cancer (fair skin, outdoor activity)

Sunscreen use appears to be positively associated with skin cancer

Green & Williams, 2014; Rueegg et al, 2019

Sunscreen use as a randomised intervention with skin cancer-related endpoints:
#1 of 3 population RCTs



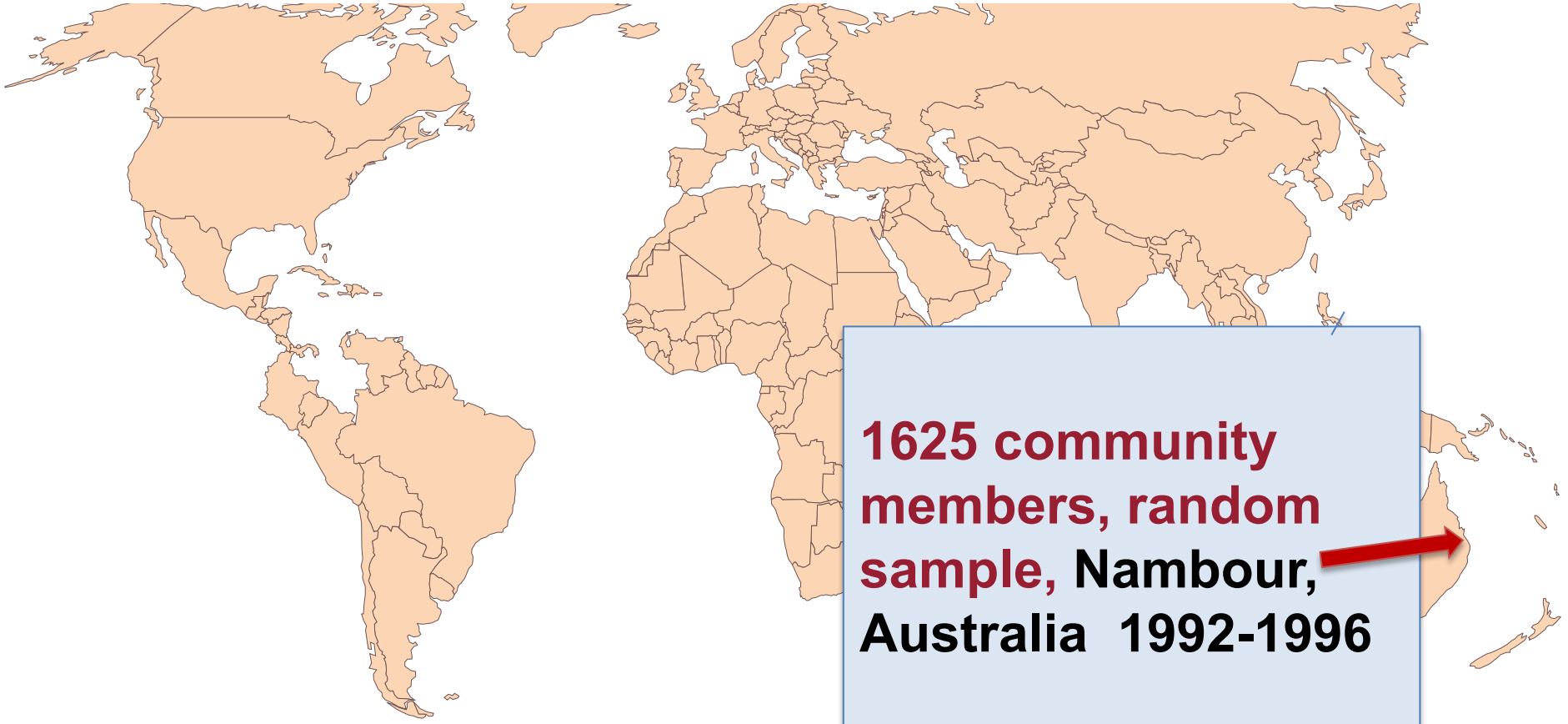
588 community volunteers with actinic keratoses,
Maryborough, Australia 1991-1992

Maryborough Actinic Keratosis Prevention Trial

- **Randomised sunscreen intervention**
  - broad-spectrum sunscreen SPF 17 *vs* base cream for 7 months (one Australian summer)
- **Compliance**
  - 80% applied sunscreen daily for at least 80% of period
  - 431 of 588 residents completed the trial
- **Results**
  - *In sunscreen users vs placebo*
    - **38% reduction in new AKs**
    - **53% more remissions in existing AKs**

Thompson et al, 1993

Sunscreen use as a randomised intervention with skin cancer-related endpoints:
#2 of 3 population RCTs



1625 community members, random sample, Nambour, Australia 1992-1996

Nambour Skin Cancer Prevention Trial *(1992-96)*

- **Sunscreen arm**

  N=812 adults ***randomly assigned,*** **supplied daily sunscreen**

- **Control arm**

  N=809 adults ***randomly assigned*** **no daily sunscreen**

Average age 49 years; 56% women

Intervention sunscreen

Supplied by Woolworths Ltd Australia & Ross Cosmetics Australia

- **SPF 15+ broad spectrum**
- **applied to head, neck, arms and hands**
- **daily for 4.5 yrs**

Compliance

- 75% applied sunscreen
  at least 3-5 times/week

Incidence of skin cancers on the head, neck, arms, hands by sunscreen treatment group, 1992-1996

SKIN CANCER	TUMOURS	
	Daily sunscreen	No daily sunscreen
BCC		
Number	153	146
Incidence per 100 000	6092	5814
Rate ratio (95%CI)	**1.05 (0.82-1.34)**	1.00
SCC		
Number	28	46
Incidence per 100 000	1115	1832
Rate ratio (95%CI)	**0.61 (0.46-0.81)**	1.00

Green et al, 1999

Sunscreen use and *repeated new BCCs*

during Nambour Trial (1992-1996)

Occurrence Rate in people with *multiple BCCs*

	Hazard Ratio (95% CI)
1st occurrence	1.0 (0.8 – 1.4)
2nd occurrence	**0.7 (0.4 – 1.2)**
3rd occurrence	**0.6 (0.3 – 1.3)**

Pandeya et al, Am J Epidemiol 2004

Regular sunscreen and actinic keratoses

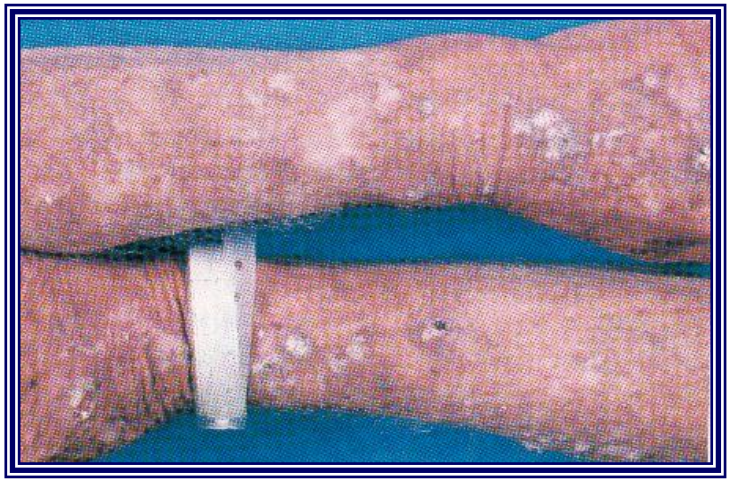
Ratio AK counts 1994 vs 1992

Sunscreen group:

1.20 (95% CI 1.04- 1.39)

Discretionary sunscreen group:

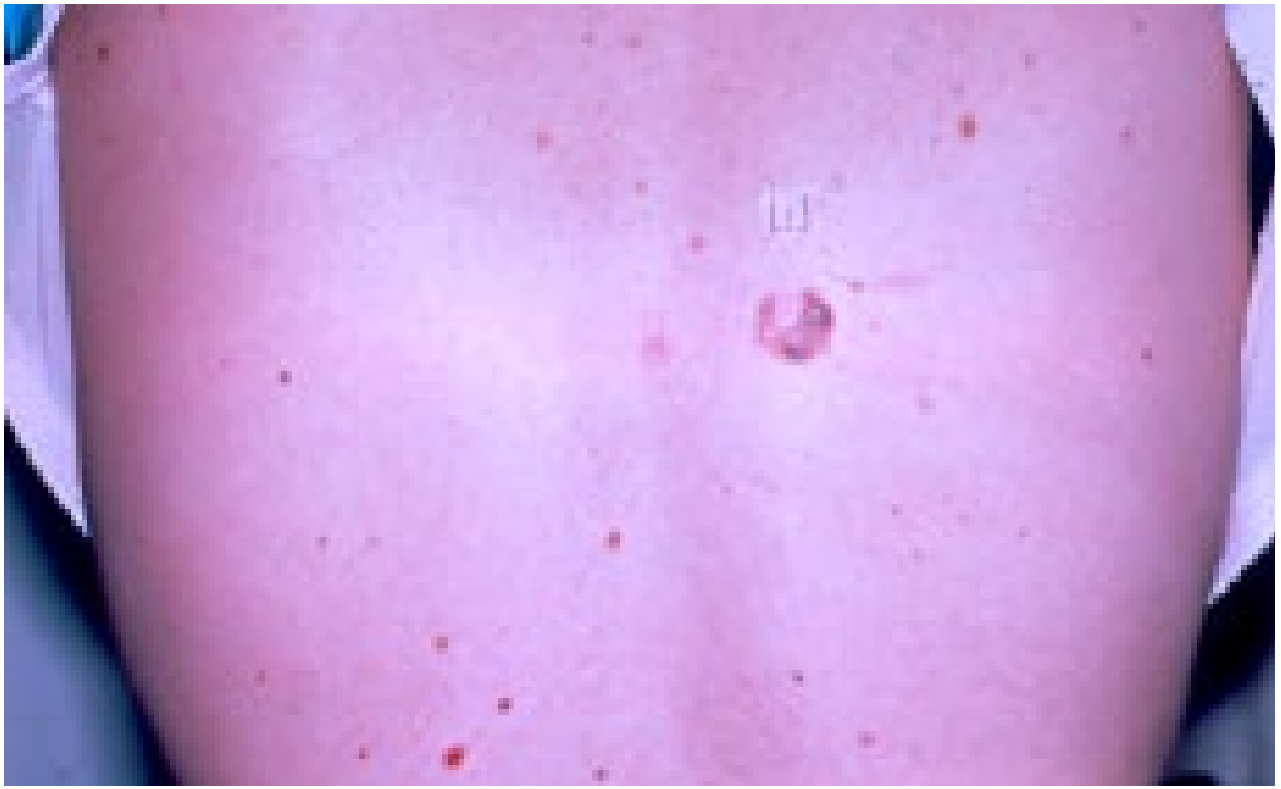
1.57 (95% CI 1.35- 1.84)



Sunscreen group: 24% reduction in rate of increase in new AKs

Darlington et al. 2003

Sunscreens, melanoma and naevi



First primary melanoma

by sunscreen intervention

Melanoma by Level	No. of Participants Affected		Analysis		
	Sunscreen (n = 812)	No Sunscreen (n = 809)	Hazard Ratio	95% CI	*P**
All	11	22	0.50	0.24 to 1.02	.051
I: in situ	8	11	0.73	0.29 to 1.81	.493
Invasive	3	11	0.27	0.08 to 0.97	.045
II: in papillary dermis	3	4			
III: filling papillary dermis	0	1			
IV: reticular dermis	0	5			

Green et al, 2011

Cancers in Australia attributable to exposure to solar ultraviolet radiation and prevented by regular sunscreen use

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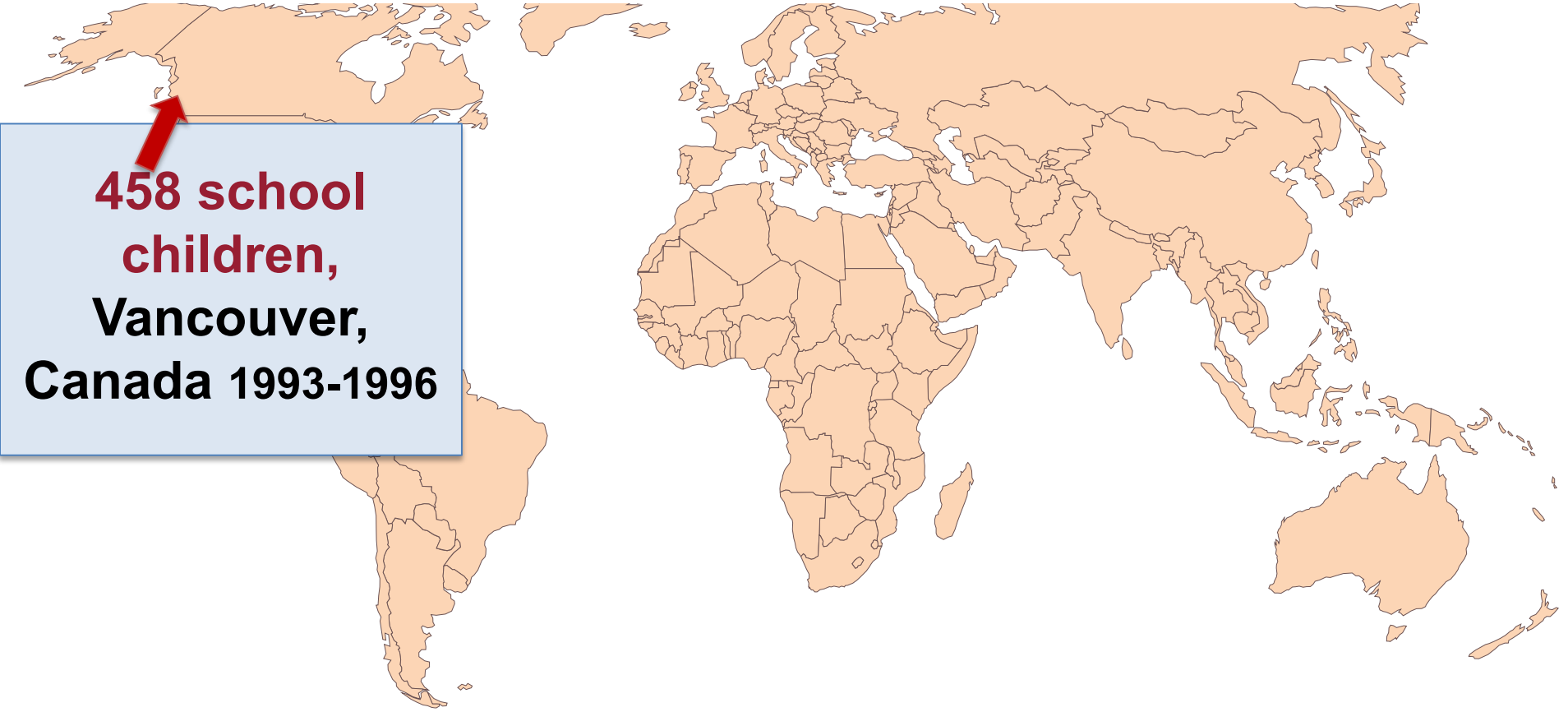
~10-15% skin cancers in Australia in 2008 were prevented by sunscreen use

Sunscreen use as a randomised intervention with skin cancer-related endpoints:

#3 of 3 population RCTs



Vancouver Naevus Prevention Trial

- **Randomised sunscreen intervention**
  - broad-spectrum sunscreen SPF 30 *vs* no sunscreen when in sun >30 mins, for 3 years
- **Compliance**
  - not measured
- **Results**
  - **Fewer new naevi in sunscreen (median = 24)**
  - **vs control group (median = 28), $p<0.05$**

Lee et al, 2005

Summary

RCTs of regular sunscreen use:

skin cancer (and related lesions) as outcome

- **Long-term effectiveness**
  - **Reduced AK, SCC, melanoma, naevi**
    - No significant effect on BCC overall
      - Decreased multiple BCCs

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