Photoaging and its preventability

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Outline

• Assessment of photoaging in community surveys using skin microtopography

• Previous evidence about prevention of photoaging

• Nambour Skin Cancer & Photoaging Prevention Trial
  o Methods; Results

• Towards a sun-culture change to prevent skin aging (and skin cancer)
Photoaging measurement in surveys: skin microtopography methods

• Silicone cast of skin on back of hand (resting around cylinder 4cm wide)

• Graded by experienced assessor (using low-power microscope; blinded to details of subjects)

• 6-point Beagley Gibson scale (Beagley & Gibson, 1980)
  – 1 = no photodamage …… to
  – 6 = severe photodamage: flattened, deeply-lined skin
Assessing skin microtopography: 6-point BG scale

Grade 1
Grade 2
Grade 3
Grade 4
Grade 5
Grade 6
Skin microtopography is a valid photoaging measure

- Associated with clinical photoaging signs (neck wrinkling, solar lentigines, actinic keratoses)

- Significant association with levels of dermal elastosis up to age 70 yrs

- High repeatability by experienced assessor (weighted kappa >0.8)

- Associated with % p53-positive epidermal cells

Queensland, Australia
Nambour Skin Cancer Study 1986-2006

- 1986: 2095 pale-skinned residents of Nambour: Skin Cancer Prevalence study
Photoaging in N=1400 Nambour residents age 20-54 years in 1986

Grade 1
1%

Grade 2
3%

Grade 3
13%

Grade 4
31%

Grade 5
24%

Grade 6
28%

Green et al, 2011
Risk factors for photoaging before age 55 years

Demographic, genetic

- Increasing age
- Male sex
- Fair skin
- Red hair colour
- Low ability to tan

Modifiable factors

- Occupational sun exposure
- Leisure mainly outdoors
- Multiple sunburns
- Smoking

Green et al, 2011
Nambour Skin Cancer Study 1986-2006

- **1986**: 2095 Nambour residents, prevalence study
- **1992-1996**: 1621 in prevention Trial
Aims: Nambour community-based Prevention Trial

To assess whether

- daily application of SPF 15+ sunscreen to face, neck, arms and hands prevents skin cancer and photoaging Vs
  - discretionary use of sunscreen

- daily 30 mg betacarotene supplements prevent skin cancer and photoaging Vs
  - placebo supplements
Nambour Trial Hypotheses

1. Continuing exposure to solar UV radiation accelerates photoaging

Primary prevention is possible in adults through sun protection

2. Betacarotene supplements retard photoaging by antioxidant effects
Previous evidence about *sunscren* prevention

- single trial, tertiary medical centre
- N=53, mean age 63 years, 87% males, past skin cancer
- patients randomized: apply sunscreen/placebo x2 daily
- biopsies pre-auricular skin at 0, 12 and 24 months
- Photoaging = epithelial thickness and dermal elastosis

- Only 16 of 53 patients with complete data
- **No difference in dermal elastosis, sunscreen Vs placebo**
- no information on compliance

Boyd *et al*., 1995
Previous evidence about beta-carotene prevention

- one clinical study, N= 29 Korean women
- daily beta-carotene supplementation for 3 months: 30 mg (15 women) vs 90 mg (14 women)
- Photoaging = skin elasticity; depth of imaged replicas of ‘crow’s feet’
- Improvement in crow’s feet wrinkles in 15 women after 30 mg beta-carotene capsules
- very small sample size, short duration, lack of controls, possible confounding by sunscreen use
  - findings difficult to interpret

Cho et al, 2010

816 residents aged 25-54 years

- 442 randomly assigned and supplied daily sunscreen
  - 444 no daily sunscreen (discretionary)

- 447 randomly assigned daily B-carotene supplements
  - 439 placebo supplements (Roche Vitamins & Fine Chemicals)
Sunsunscreen randomised intervention: The Nambour Trial

**Instructions to participants:**

<table>
<thead>
<tr>
<th>Controls</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Apply, or not, as you normally would”</td>
<td>“Apply to head, neck, arms and hands every morning. Reapply after heavy sweating, bathing, or long sun exposure”</td>
</tr>
</tbody>
</table>

*Supplied by: Woolworths Ltd Australia & Ross Cosmetics Australia*
WHERE TO APPLY YOUR SUNSCREEN.

FACE, EARS, AND FRONT OF NECK.

BACK OF NECK TOO!

ARMS AND HANDS

REMEMBER! APPLY SUNSCREEN EVERY DAY— IN SUNNY, CLOUDY AND EVEN RAINY WEATHER, WORKING OR PLAYING, INDOORS OR OUTDOORS.
Measurement of sunscreen compliance

- Frequency of application:
  75% compliance

- Weight of sunscreen used daily
  *intervention group only*

  Spearman’s correlation coefficient = 0.55
Proportion of people with no photoaging 1992 to 1996

<table>
<thead>
<tr>
<th>Photoaging Grade in 1992</th>
<th>Percent in 1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>29 18</td>
</tr>
<tr>
<td>4</td>
<td>54 53</td>
</tr>
<tr>
<td>5</td>
<td>56 49</td>
</tr>
<tr>
<td>6</td>
<td>53 41</td>
</tr>
</tbody>
</table>

- **Daily SS**
- **Discretionary**
Proportion of people with increased photoaging 1992 to 1996

Percent in 1996

<table>
<thead>
<tr>
<th>Photoaging grade in 1992</th>
<th>Daily SS</th>
<th>Discretionary</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>43</td>
<td>45</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>22</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>20</td>
</tr>
</tbody>
</table>
Proportions with decreased photoaging 1992 to 1996

Photoaging grade in 1992

Percent in 1996

Daily SS
Discretionary
## Odds of having higher microtopography grades in 1996 relative to 1992 by sunscreen intervention in 886 people

<table>
<thead>
<tr>
<th>Sunscreen Intervention</th>
<th>Odds (95% CI) 1996 compared to 1992</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily sunscreen</td>
<td>1.19 (1.00, 1.41)</td>
<td>0.046</td>
</tr>
<tr>
<td>Discretionary sunscreen</td>
<td>1.56 (1.29, 1.88)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Relative odds, daily /discretionary sunscreen: 0.76 (0.59, 0.98)
Regular sunscreen $\rightarrow$ decreased photoaging

**Sunscreen group**

- no detectable increase in aging in 4.5 years
- 24% less likely to show aging changes than non-daily users

Hughes et al. 2013
<table>
<thead>
<tr>
<th></th>
<th>Daily sunscreen</th>
<th>Discretionary sunscreen</th>
<th>Relative Odds</th>
<th>Approximate P for interaction*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.35 (1.05, 1.75)</td>
<td>1.39 (1.05, 1.86)</td>
<td>0.97 (0.66, 1.42)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1.10 (0.86, 1.39)</td>
<td>1.67 (1.30, 2.15)</td>
<td>0.66 (0.46, 0.93)</td>
<td>0.30</td>
</tr>
<tr>
<td><strong>Age, years</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 - 40</td>
<td>1.24 (0.96, 1.60)</td>
<td>1.55 (1.17, 2.05)</td>
<td>0.80 (0.55, 1.17)</td>
<td>0.79</td>
</tr>
<tr>
<td>40 - 55</td>
<td>1.07 (0.83, 1.37)</td>
<td>1.43 (1.10, 1.87)</td>
<td>0.74 (0.52, 1.07)</td>
<td></td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school</td>
<td>1.01 (0.79, 1.28)</td>
<td>1.58 (1.19, 2.11)</td>
<td>0.64 (0.44, 0.93)</td>
<td>0.22</td>
</tr>
<tr>
<td>Higher education</td>
<td>1.49 (1.17, 1.91)</td>
<td>1.71 (1.32, 2.20)</td>
<td>0.88 (0.62, 1.24)</td>
<td></td>
</tr>
<tr>
<td><strong>Skin color</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fair</td>
<td>1.04 (0.85, 1.29)</td>
<td>1.73 (1.35, 2.22)</td>
<td>0.60 (0.44, 0.83)</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>1.58 (1.16, 2.15)</td>
<td>1.33 (0.99, 1.78)</td>
<td>1.19 (0.78, 1.83)</td>
<td></td>
</tr>
<tr>
<td>Dark</td>
<td>0.95 (0.58, 1.55)</td>
<td>1.42 (0.67, 2.99)</td>
<td>0.67 (0.30, 1.51)</td>
<td>0.106</td>
</tr>
<tr>
<td><strong>Previous occupations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mainly outdoors</td>
<td>1.16 (0.87, 1.53)</td>
<td>1.32 (0.84, 2.06)</td>
<td>0.88 (0.52, 1.49)</td>
<td></td>
</tr>
<tr>
<td>Indoors and outdoors</td>
<td>1.21 (0.88, 1.66)</td>
<td>1.58 (1.15, 2.17)</td>
<td>0.77 (0.49, 1.19)</td>
<td></td>
</tr>
<tr>
<td>Mainly indoors</td>
<td>1.21 (0.96, 1.54)</td>
<td>1.75 (1.36, 2.27)</td>
<td>0.69 (0.49, 0.98)</td>
<td>0.49</td>
</tr>
<tr>
<td><strong>Nevi on back</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>0.82 (0.56, 1.21)</td>
<td>1.33 (0.84, 2.12)</td>
<td>0.62 (0.34, 1.13)</td>
<td></td>
</tr>
<tr>
<td>1 - 10</td>
<td>1.27 (1.04, 1.57)</td>
<td>1.58 (1.25, 1.98)</td>
<td>0.81 (0.59, 1.10)</td>
<td></td>
</tr>
<tr>
<td>≥ 11</td>
<td>1.22 (0.87, 1.72)</td>
<td>1.58 (1.09, 2.30)</td>
<td>0.77 (0.47, 1.27)</td>
<td>0.95</td>
</tr>
<tr>
<td><strong>History of skin cancer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1.20 (1.00, 1.44)</td>
<td>1.54 (1.26, 1.90)</td>
<td>0.78 (0.59, 1.02)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1.14 (0.69, 1.87)</td>
<td>1.63 (1.05, 2.50)</td>
<td>0.70 (0.36, 1.34)</td>
<td>0.89</td>
</tr>
<tr>
<td><strong>Body mass index</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25.0</td>
<td>1.17 (0.91, 1.50)</td>
<td>1.68 (1.29, 2.19)</td>
<td>0.69 (0.48, 1.00)</td>
<td></td>
</tr>
<tr>
<td>25 - 29.9</td>
<td>1.21 (0.90, 1.64)</td>
<td>1.44 (1.02, 2.02)</td>
<td>0.84 (0.54, 1.32)</td>
<td>0.66</td>
</tr>
<tr>
<td>≥ 30</td>
<td>1.02 (0.64, 1.63)</td>
<td>1.79 (1.01, 3.17)</td>
<td>0.57 (0.27, 1.19)</td>
<td></td>
</tr>
<tr>
<td><strong>Smoking status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-smoker</td>
<td>1.17 (0.93, 1.48)</td>
<td>1.36 (1.05, 1.77)</td>
<td>0.86 (0.61, 1.22)</td>
<td></td>
</tr>
<tr>
<td>Ex-smoker</td>
<td>1.21 (0.91, 1.61)</td>
<td>1.59 (1.14, 2.23)</td>
<td>0.76 (0.49, 1.18)</td>
<td></td>
</tr>
<tr>
<td>Current smoker</td>
<td>1.35 (0.88, 2.08)</td>
<td>2.74 (1.85, 4.06)</td>
<td>0.49 (0.28, 0.88)</td>
<td>0.197</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td>1.18 (0.99, 1.39)</td>
<td>1.54 (1.28, 1.86)</td>
<td>0.76 (0.59, 0.98)</td>
<td></td>
</tr>
</tbody>
</table>

- **P** for interaction* indicates the significance of interaction between the factors listed.
Odds of having higher microtopography grades in 1996 relative to 1992 by beta-carotene intervention in 886 people

<table>
<thead>
<tr>
<th>Beta-carotene Intervention</th>
<th>Odds (95% CI) 1996 compared to 1992</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta-carotene</td>
<td>1.32 (1.12, 1.55)</td>
<td>0.001</td>
</tr>
<tr>
<td>Placebo</td>
<td>1.40 (1.16, 1.70)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Relative odds, beta-carotene /placebo

0.94 (0.73, 1.20) 0.61

Hughes et al. 2013
## Odds of having higher microtopography grades in 1996 relative to 1992 by beta-carotene intervention in 886 people

<table>
<thead>
<tr>
<th>Beta-carotene Intervention by severity of baseline photoaging</th>
<th>Odds (95% CI) 1996 compared to 1992</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative odds, beta-carotene /placebo Grade 3-4 at baseline</td>
<td>0.52 (0.32, 0.84)</td>
</tr>
<tr>
<td>Relative odds, beta-carotene /placebo Grade 5-6 at baseline</td>
<td>1.38 (0.66, 2.88)</td>
</tr>
</tbody>
</table>

Hughes et al. 2013
Beta-carotene no overall effect on photoaging

Subgroup analysis

• Possible decrease in aging when mild-moderate aging baseline

• Possible increase in aging when more severe aging at baseline

Hughes et al. 2013
Towards a pale-skin sun-culture

- United government & community programs for sun protection

- Policy changes for cultural shift in Western-style sun behaviour
  - restricted advertising for tanned skin
  - subsidised UV-protective clothing in the sun
  - sunscreen dispensers in outdoor recreation areas
  - legislation banning sunbeds
Sun Protection Basics

When UV Index 3 or more, **protect skin (and eyes) against sun damage including photoaging:**

- Wear sun-protective clothing
- Apply (adequate layer of) sunscreen regularly
- Wear a (broad-brimmed) hat
- Seek (deep) shade
- Wear (wrap-around) sunglasses