Solar Exposure and Cancer

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Overview

• A few notes on UV as a risk factor

• Health effects: cancer
  – global epidemiology
  – sunbeds

• Current debate
  – Vitamin D
UV – A: 400-315 nm  
UV – B: 315-280 nm  
UV – C: 280-100 nm

Ozone layer and UV: UV-C absorbed

- UV = shorter and more energy-rich wavelengths than visible light
- UV-B biologically much more efficient than UV-A  
  – (factor $10^3 - 10^4$)
Practical approach: the UV - Index

Factors that determine UV intensity

- **Sun elevation**: the higher the sun in the sky, the higher the UVR level, with an increase in UVB relative to UVA
- **Cloud cover**: UVR levels are highest under cloudless skies
- **Latitude**: the closer to equatorial regions, the higher the UVR levels.
- **Altitude**: at higher altitudes, the atmosphere is thinner and the air mass is decreased - less UVR absorbed.
- **Ozone**: Ozone depletion leads to increased UVB levels with little impact on UVA levels.
- **Ground reflection**: grass, soil and water reflect less than 10% of UVR; fresh snow - as much as 80%

WHO fact sheet No. 305, 2006
Latitude and altitude

- Latitude: 3-4 % UVR increase per each degree closer to the equator

- Altitude: 3-4% UVR increase with every 300 m increased altitude

Godar 2005
Health effects of UV

- **Cancer:**
  - *Malignant Melanoma (MM),*
  - Basal cell Ca (BCC), Squamous cell Ca (SCC),
  - SCC of conjunctiva (SCCC)

- **Skin:**
  - Photodermatosis, Ageing, Sunburn…

- **Eyes:**
  - Pterygium, Cataract

- **Other**

- **Vitamin D:** 🔥

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**Skin types (Fitzpatrick)**

<table>
<thead>
<tr>
<th>Skin phototype</th>
<th>Sun sensitivity</th>
<th>Sunburn susceptibility</th>
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<tbody>
<tr>
<td>I</td>
<td>Very sensitive</td>
<td>Always</td>
</tr>
<tr>
<td>II</td>
<td>Moderately sensitive</td>
<td>high</td>
</tr>
<tr>
<td>III</td>
<td>Moderately insensitive</td>
<td>moderate</td>
</tr>
<tr>
<td>IV</td>
<td>Moderately resistant</td>
<td>Low</td>
</tr>
<tr>
<td>V</td>
<td>Resistant</td>
<td>Very low</td>
</tr>
<tr>
<td>VI</td>
<td>Very resistant</td>
<td>Extremely low</td>
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Incidence: more than a factor of 40 worldwide variation
Mortality: factor 6-10

Total new cases: ~ 102,000 annually
(IARC, Globocan 2008)
Total new cases: ~ 97,800 annually
(IARC, Globocan 2008)

Melanoma of skin: female, all ages

Men all ages

Lung
Prostate
Colorectum
Stomach
Liver
Oesophagus
Bladder
Non-Hodgkin lymphoma
Leukaemia
Lip, oral cavity
Kidney
Pancreas
Larynx
Brain, nervous system
Other pharynx
Melanoma of skin
Gallbladder
Nasopharynx
Multiple myeloma
Testis

Incidence
Mortality

Less developed regions
Melanoma - Trends

Age-standardized incidence and mortality rates in Germany, 1980–2006, ICD-10 C43
Incidence per 100,000 (European Standard)

Examples: Netherlands, Spain, Australia….

Catalonia, Spain:

Melanoma incidence (1985-2002)
Men: +3.5% per year
Women: +6.5% per year

NSW, Australia:

Melanoma incidence (1997-2006)
Men: +18.5%
Women: +16.7%

Mortality: decreasing
UV and Melanoma

- “Sun exposure is the main cause of melanoma” 
  (Gruber & Armstrong 2006)
- Up to 90% of melanoma caused by UV 
  (Armstrong & Kricker 1993)

- Solar UVR = IARC group I carcinogen (Pub.100D)
- US Nat. Toxicology programme:
  - Solar radiation = known human carcinogen
  - Broad spectrum UV = known human carcinogen

Sunbed use and melanoma

- Scientific evidence substantial
  - e.g. from IARC (2007)
- Recent prospective study of Nordic women
  - Solarium use ≥ 1 time/month*: 50% risk increase
  - More exposures = higher risks

- [Very high UV irradiation (UV index15+) normal]

* age 30-39
Veierød et al, 2010
Current scientific debate

• Vitamin D and Cancer prevention
  – some evidence that high Vitamin D levels have preventive effect for few specific cancers (namely: colorectal Ca)

  – Sunbeds: a dangerous source of Vitamin D!

• UV-radiation and Survival
  – For some cancers better survival with high sun exposure
<table>
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<th>Summary</th>
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<td>• UV radiation – a human carcinogen (+ Vitamin D)</td>
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<td>• Important factors determining population risk</td>
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<tr>
<td>– Skin type and other biological factors</td>
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<td>– Altitude, latitude</td>
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<td>– Behaviour</td>
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<td>– Policies</td>
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