Health implications of exposure to solar UV radiation in South Africa

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CANSA Solar Radiation Symposium, 16 February 2012, Jhb
THE ELECTROMAGNETIC SPECTRUM OF THE SUN

SHORT WAVELENGTHS

ULTRAVIOLET RADIATION (INVISIBLE)

VACUUM UV    FAR UV    NEAR UV

LONG WAVELENGTHS

X-RAYS
GAMMA RAYS

HIGH ENERGY    MIDDLE ENERGY    LOW ENERGY

UVC
UVB
UVA

VISIBLE LIGHT
INFRA RED
HEAT WAVES
MICRO WAVES
RADIO WAVES

NOTE:
NM = NANOMETRE
MM = MILLIMETRE

THE OZONE LAYER

THE EARTH
SAWS UVB Biometer Monitoring Network

Started in 1990s

UVB

Cape Town Cape Point
Port Elizabeth De Aar
Durban
Pretoria

Purpose: raise public awareness

www.csir.co.za
The **UV Index** is a standard indicator of UV levels adopted by the WMO and WHO.

(Maximum UV Index Value by year per station)

(Graph drawn by K Ncongwane)
Satellite Local Noon Time UV Index for South Africa

Factors influencing ambient/surface solar UV radiation:

- Altitude
- Clouds
- Aerosols
- Stratospheric ozone
- Latitude (distance to the equator)

(Analyses and visualization used on this slide was produced with the Giovanni online data system, developed and maintained by the NASA GES DISC)
Health impacts of solar UV radiation exposure

(Lucas et al., 2006)
Evidence for Health Impacts in South Africa

- **Skin cancer** – melanoma and non-melanoma skin cancers
  - Evidence exists (Prof Whitaker’s presentation)
  - Risk increases with number of blistering sunburns
  - Exposure during childhood and adolescence important role to play
  - Chronic exposure more associated with NMSC
    - concern among outdoor workers

- **Melasma** - uneven hyperpigmentation
  - Caused by genetic, hormonal, therapy and lifestyle-related contributions, sun exposure is also involved
  - Significant emotional effect on women
Evidence for Health Impacts in South Africa

- **Opthalmohelioses** (eye diseases)
  - acute sun exposure
    - photoconjunctivitis, photokeratitis, activation of ocular herpes simplex virus
  - chronic sun exposure
    - pterygium, NMSC of the lid and conjunctiva, age-related cataracts, ocular melanoma
  - In northwestern Cape corneal diseases found in 20% of the study community

- **Oculocutaneous albinism**
  - Genetically inherited autosomal recessive condition
  - Prevalence in South Africa of 1 in 3 900
  - SCCs of neck and head most common cutaneous tumours
Evidence for Health Impacts in South Africa

- **Immuno-suppression and effects on diseases**
  - Optimal sun exposure
    - UV and/or vitamin D has the potential to **protect** against some inflammatory diseases and autoimmune diseases
  - Excess sun exposure
    - **decreasing immune surveillance** against skin tumours and infectious diseases

- **Vaccination** is a major public health strategy to control common infections, particularly in childhood
  - potential of UV to decrease efficacy of vaccination by down-regulating has not yet been rigorously assessed
  - there is evidence that a less effective immune response is induced if the vaccine is administered in summer compared to winter, and in tropical compared to temperate regions.
Disease treatment, awareness and prevention

- Continued support for screening, treatment
- Increased efforts towards awareness, intervention (physical, behavioural etc)
- Research towards disease prevention and supportive healthy behaviour
Numerous international studies

- Numerous studies in sun exposure patterns, use of sun protection etc in Australia, New Zealand, USA, Europe, less in Africa and South Africa

- Public health interventions to alleviate the burden of these adverse health effects on individuals and healthcare systems should be based on South African information

- To date, no large epidemiological study has been carried out among a South African population; however, this information is probably required for successful implementation of sun protection intervention strategies

- Poor empirical understanding of the full spectrum of our population’s personal behaviour, knowledge, attitudes, sun-protective practices
Earliest study – at-risk subpopulation of beachgoers

Sunscreen use among 231 beachgoers in Cape Town in 1991

90% of sample knew overexposure caused skin cancer yet risk-taking behaviour (sunbathing) was still pursued

About half of the people sampled used sunscreen, only 6% of those used an SPF > 15

(von Schirnding et al, 1991/92)
At-risk subpopulation – Schoolchildren

- Human health risk assessment of solar UV radiation among schoolchildren, outdoor workers (car guards), indoor workers and mixed mode workers in Durban in 2000 (Guy and Diab, 2000)
- Personal dosimetry study of solar UV radiation among schoolchildren in Durban in 2001 (Guy, Diab and Martincigh, 2002)
- Anatomical distribution of solar UV radiation in Durban (Wright, Diab and Martincigh, 2003)
At-risk subpopulation – Schoolchildren and sunburn risk

Number of days per year that schoolchildren of varying skin types may be at risk of sunburn from excess solar UV radiation exposure

<table>
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<th>Site</th>
<th>I  (2-3 SED)</th>
<th>II (2.5-3 SED)</th>
<th>III (3-5 SED)</th>
<th>IV (4.5-6 SED)</th>
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<td>Cape Point</td>
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</tr>
</tbody>
</table>

(Wright, Coetzee and Ncongwane, 2011)
Continuous UV exposure estimated to elicit sunburn on un-tanned skin

| Skin type | Description of skin type & phenotypic characteristics | UV exposure (SED) *
|-----------|---------------------------------------------------------|----------------------
| V-VI      | Brown or black skin, dark hair, brown eyes, rarely burns | 6-20                 |
| IV        | Light brown skin, brown eyes, burns rarely              | 4.5-6                |
| III       | White or light brown skin, brown hair, may burn         | 3-5                  |
| II        | Fair skin, fair/red hair, freckles, burns very readily  | 2.5-3                |
| I         | Fair skin, fair/red hair, light eyes, freckles, always burns on minimal sun exposure | 2-3                  |

(Fitzpatrick, 1988) * SED = standard erythemal dose, 1 SED = 100 Jm²
Potential child total daily solar UVR exposure
(SED, Standard Erythemal Dose; 1 SED = 100 Jm$^{-2}$)
Results of a NZ study among schoolchildren in 2005 (Wright et al., 2006)

High risk period
10am – 2pm

School break and lunch times

Timing of schoolchildren’s sun exposure on a weekday
Sun protection and skin cancer prevention efforts targeted at schoolchildren

Given the sun exposure risk posed to schoolchildren and the link between timing of exposure and risk of skin cancer incidence, schools can play an important role

CANSA – Be SunSmart – A guide for schools (2010)
- Aimed at primary school teachers
- Activities and programmes for learning

Visits by Health Promoting Officers
School pilot study

- In 2010, 12 schools included through word-of-mouth
- 5 KZN, 4 Gauteng, 2 Free State, 1 Western Cape
- 10 government schools, 2 private
  - 2 Junior Primary, 2 Preparatory, 1 Senior Primary
  - 6 High Schools
  - 1 College (including Primary)
- Results
  - 1 school had a SunSmart School Policy
  - 8 schools encouraged hat use (3 had a ‘no hat, play in shade’ rule)
  - 11 schools did not try to schedule outdoor activities outside peak UV hours
- Not representative of country, pilot only
At-risk subpopulation - outdoor workers

- Outdoor workers in South Africa are susceptible to chronic sun exposure (heat and solar UV radiation)
- No studies documenting prevalence of non-melanoma skin cancer and skin damage among outdoor workers (difficult to do, of course)
- Role of employers – PPE, supportive environments
- Role of legislation – no standards / limits for environmental exposure
At-risk subpopulation - outdoor workers

Maximum number of sunburn-risk days skin type & season (averaged for all places)

(Wright, Coetzee and Ncongwane, 2011)
Adult pilot study

- Gauge sun-related knowledge, attitudes and behaviours among adults to direct development of a full, nationally-applicable questionnaire.
- 512 adult participants (22.5% response rate) - 244 males, 265 females, 3 missing
- Results
  - 30% had been taught about sun protection and sun-safe behaviours at school
  - 77% had heard of the UVI
  - 11% thought it was safe to get sunburnt once or twice a year
  - 25% liked a suntan because it makes them feel healthy
  - 33% experienced sunburn last summer
  - 75% said they regularly used sun protection last summer
‘Tools’ for the public

- **Forecasting** UVI readings nationwide – some value
  - Problem of no change, discourages behavioural response
- **Instruments** to give UVI reading available commercially – **caution!**

![Graph showing correlation between Monitor 1 and Monitor 2 solar UV radiation measurements. The linear equation is given as $y = 0.5931x$ with $R^2 = 0.8112$.](https://www.csir.co.za)
Information and awareness

Long-term interventions have proven successful in Australia. Knowledge attained doesn’t mean attitude and behaviour are appropriate. Targeted approach may work best—‘real-time UVI impact’

Public swimming pool

Marathon
Final thoughts

• There are health risks and implications of solar UV radiation exposure in South Africa
  – Some evidence exists, need more
• Many research questions remain unanswered
• In a changing climate, changes in behaviour, clothing use and activities etc may all impact on personal sun exposure patterns

• We need to find a South African public health message that prompts an appropriate behavioural response to minimise adverse health threats and maximise health benefits of sun exposure
SunSmart Research Programme and Lab

The SunSmart Research Programme and Lab is a co-ordinated set of research projects led by Senior Researchers at several universities, science councils and institutions in southern Africa.

News and notices

**Research projects available**
The SunSmart Research Programme and Lab has many research projects available for postgraduate studies (Honours, Masters, PhD and Post-doctoral). Fields of research include sun exposure and behaviour, human health impacts, solar UV radiation monitoring and analysis, sunscreens, etc.

**Published research articles**

Upcoming event

**Solar Radiation Symposium**
16 February 2012, Gauteng, South Africa
An informative symposium to obtain recent scientific knowledge on solar radiation its impact and...
A network to share knowledge and ideas about environmental health
NRF / CSIR Seminar and Roundtable Discussion
towards a research road map for South Africa

Combating the health consequences of sun exposure in South Africa

Venue: CSIR Knowledge Commons, Pretoria

Date: June 2012

For more information, please visit www.ehrn.co.za/sunsmart

If you would like to be kept informed of the final seminar date and details, please give me your contact information (cwright@csir.co.za)