Potential Solar UVR Exposure Health Risks in South Africa

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ABSTRACT

The detrimental effects of excess personal solar ultraviolet radiation (UVR) exposure include wrinkles, immunosuppression and skin cancer. Approximately 1 000 South Africans die each year from melanoma skin cancer and 30% of all histologically-diagnosed cancers are skin cancers, including the non-fatal non-melanoma skin cancers. Individuals with minimum natural protection from melanin, including fair skinned individuals, albinos and people spending extended periods outdoors and unprotected are at risk. In South Africa, research has focused on analyzing ambient UVR data, UVR modelling and personal exposure patterns. Personal sun behaviour and UVR exposure patterns were analysed among a sample of Durban schoolchildren in 2001. Children received about 5% of the total daily ambient UVR and activity was the most important influencing factor. However, no publicly available research has been carried out in the past 5 years. In a rudimentary exercise, monitored ambient solar UVR levels for Pretoria, Durban and Cape Town were converted into possible child and outdoor worker exposures using the reported 5% and 20% of the total daily ambient solar UVR, respectively. Results suggest that children and outdoor workers continue to be at risk, depending on skin type, sun protection, timing and duration of exposure, and activity. Information on South African sun behavioural patterns is needed to better quantify exposure risk. Future accurate, reliable research will only be achieved when such issues are resolved and a holistic research approach may then be applied.

1. INTRODUCTION

For humans, solar UVR exposure has both positive and negative effects. Sunburn and skin cancer (non-melanoma and melanoma skin cancers) are the two most commonly experienced adverse health effects. Non-melanoma skin cancers are seldom fatal; however, they may be disfiguring and painful. Melanoma is fatal if undetected sufficiently early enough for treatment. Melanin in human skin affords some natural protection against the harmful effects of solar UVR. The relationship between sun exposure, sunburn and skin cancer is complex. Childhood exposure has been associated with melanoma, and chronic exposure, such as experienced by an outdoor worker, with non-melanoma and ocular diseases. According to 1998-9 South African Cancer Registry records, melanoma and non-melanoma skin cancers accounted for approximately 30% of all histologically-diagnosed cancers. Ocular cataracts are considered responsible for 60% of blindness among South Africans.

1.2 Previous research in South Africa

In 2001, personal sun behaviour and UVR exposure patterns were analysed among a sample of Durban schoolchildren (Guy, 2003). Children received about 5% of the total daily ambient UVR, a finding consistent with similar studies among children in New Zealand, Australia and the UK, and activity was the most important influencing factor. However, no publicly available, published personal solar UVR exposure and sun behaviour research has been carried out in recent years.

Since 1994, the South African Weather Service has been monitoring ambient solar UVR levels at several permanent stations in South Africa. In this study, data were obtained for Durban, Pretoria, and Cape Town stations. Data were transformed into child and outdoor worker exposures to identify potential sunburn risk as a proxy for excess solar UVR exposure and associated adverse health risks in order to identify the impact of behaviour and work conditions on UVR exposure.

2. MATERIALS AND METHODS

2.1 Monitored Solar UVR Data

The South African Weather Service monitors ambient solar erythemal UV-B (290-320 nm) levels at several stations around South Africa using UV Biometers (model 501) comprising a Robertson-Berger pattern UVR detector, digital recorder and control unit. The erythemal UV-B spectral range closely mimics the McKinley / Diffey Erythemal Action Spectrum (CIE, 1998). Logged readings are converted into hourly MED values (MED, Minimal Erythemal Dose, 1 MED = 210 Jm^{-2}). Using this definition, hourly MED values during 2006 for each of the 3 stations were converted into hourly SED values, the international standard unit for expressing solar UVR exposure (defined as 1 SED = 100 Jm^{-2}) (CIE, 1998).

2.2 Calculating potential child and outdoor worker exposures

The potential total daily solar UVR exposure for a child was deduced using previously published data (Guy, 2003). No South African personal UVR exposure study has determined outdoor worker exposure levels; hence, the personal exposure percentage (20%) of the ambient, determined during a New Zealand (NZ) personal UVR dosimetry study (Hammond, 2009), was applied as a proxy for South African outdoor workers' UVR exposure. Outdoor workers in the NZ study were defined as builders, horticulturalists and road workers. The risk of erythema, an indication of excess sun exposure, is provided by skin type (Table 1) and overlaid onto the child and outdoor worker exposure graphs to provide an indication of exposure and, subsequently, health risk.

Table 1. Skin phototype classification with UVR exposure estimates likely to cause sunburn on un-tanned skin (Fitzpatrick, 1988)

Skin type; Unexposed skin colour	Constitutive characteristics	Continuous UVR exposure estimated to elicit sunburn on un-tanned skin (SED)
I White	Fair skin, blue or light eyes and freckles	2 - 3
II White	Red or blonde hair, blue, hazel or brown eyes and freckles	2.5 - 3
III White or light brown	Brown hair and blue, hazel or brown eyes	3 - 5
IV Light brown	Brown hair and dark eyes	4.5 - 6
V Brown	Brown eyes and dark brown or black hair	6 - 20
VI Black	Brown eyes and dark brown or black hair	6 - 20

3. RESULTS AND DISCUSSION

Results suggested that some children (Figure 1-top) and most outdoor workers (Figure 1-bottom) continue to be at risk of erythema in all 3 cities, depending on skin type, sun protection, timing and duration of exposure, and activity.

4. CONCLUSION AND RECOMMENDATIONS

Evidence suggests that, using 2006 data for Durban, Pretoria and Cape Town, children with skin types 1-3 and outdoor workers with all skin types are potentially at risk of excess solar UVR exposure, erythema (particularly during summer) and associated chronic health risks. To abate the public health risks associated with excess solar UVR exposure, awareness campaigns and prevention methods need to be informed by a co-ordinated, evidence-based research programme.

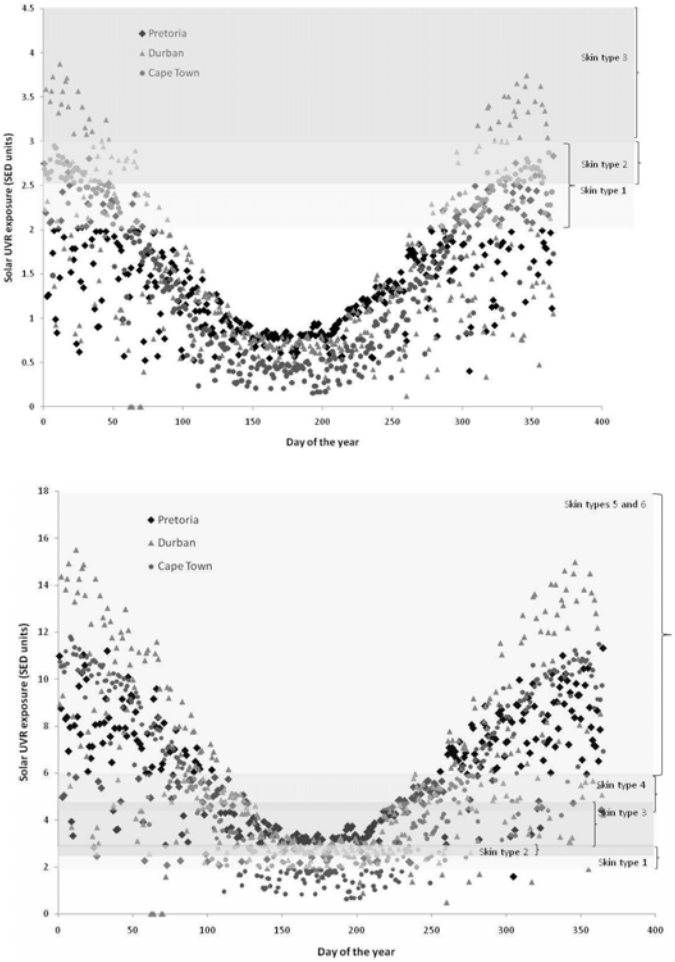

Figure 1. Potential (top) <u>child</u> and (bottom) <u>outdoor worker</u> total daily solar UVR exposure.

5. ACKNOWLEDGEMENTS

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