Solar ultraviolet radiation exposure and human health in South Africa: Finding a balance

In considering the likelihood of South Africa (SA) attaining the 2015 Millennium Development Goals, many health issues require urgent attention. The adverse effect of insufficient or excessive exposure to solar ultraviolet radiation (UVR) may exacerbate an already stressed public health service. These concerns become important when considering climate variability and patterns of behaviour.

Latitude and altitude are significant in determining how much solar UVR reaches the Earth's surface. SA spans 15° of latitude (~22°S to 34°S), its altitude differs from sea level to 3 482 m (average plateau (Highveld) altitude 1 200 m), and the Highveld and other parts of the country have relatively cloud-free skies. SA thus has relatively intense solar UVR levels and, consequently, an increased risk of associated adverse health effects.

Sun exposure also has positive health effects including the promotion of vitamin D production. A balance must be struck to allow sufficient solar UVR exposure to attain adequate vitamin D levels, while minimising the negative aspects. This balance is not straightforward as it varies from person to person and depends on factors such as skin type, clothing, and the timing of outdoor activities.

Harmful effects

Excessive sun exposure is detrimental to individuals of all ethnicities and skin types. Sunburn is a common acute effect, particularly in those with fair skin, and sun exposure is the major environmental risk factor for skin cancer. The carcinogenic and immunosuppressive effects of chronic UVR exposure induce changes that result in the cutaneous cancers – melanoma, squamous cell carcinoma (SCC) and basal cell carcinoma (BCC). The lifetime risk of melanoma is estimated to be 60 times lower among dark-skinned individuals compared with those of fair skin. BCC is the most frequent type of skin tumour in whites, and the rarest in blacks. The last report from the National Cancer Registry (2000 - 2001) described an incidence of 20 000 new cases of skin cancer per year in SA, based on pathology reports. This is undoubtedly an underestimate, as most SCCs and BCCs are under-reported and/or not recorded or biopsied. SA's melanoma incidence is reported to be among the highest in the world (69 new cases per 100 000 whites in 2009) and roughly similar to that of Australia and New Zealand, with 700 associated deaths per annum.[1] Even with limited available data, the incidence of skin cancer in SA appears to be increasing. Data are urgently required to monitor this situation; the reinstatement of the National Cancer Registry in 2011 was a positive development.

Roughly 1/3 900 people live with occulocutaneous albinism (OCA) in SA;[2] hypopigmentation of the skin, hair and eyes, due to melanin deficiency or absence, places them at increased risk of the adverse effects of sun exposure. The most common cutaneous tumours in Africans with OCA are SCCs of the head and neck.[3] Psychological and social issues[2] affecting their quality of life are similar to those in individuals with melasma (uneven hyperpigmentation on the face) and vitiligo. Interestingly, skin cancer in vitiligo sufferers is rare, while melasma is caused by several factors, including lifestyle, hormones and sun exposure.[4]

Cortical cataract, pinguecula and pterygium are the most common eye conditions related to sun exposure in SA. However, reliable figures of their incidence and prevalence are not available. Corneal diseases, mainly pterygium and climatic droplet keratopathy, were found in 20% of a local community in the North Western Cape.[5]

The immunosuppressive effect of solar UVR exposure has the potential to reduce resistance to infectious diseases. While this has been shown in numerous animal models, there are limited data from human studies (e.g. the sun-induced reactivation of latent herpes simplex virus). Although not systemically investigated to date, evidence suggests that immune response to vaccination may also be affected adversely by solar UVR, at least for a proportion of vaccines.[6] Vaccination forms a major part of public health policy in SA, warranting urgent research in this area.

Health benefits

Benefits of personal solar UVR exposure in SA include feelings of well-being, related mainly to the sensation of heat, and a reduction in the incidence of seasonal affective disorder. The major positive outcome is vitamin D production, which protects against rickets, osteomalacia and osteoporosis. Due to its effects on the immune response, vitamin D may also play a protective role in common diseases such as multiple sclerosis, diabetes mellitus, cancer (e.g. colorectal and breast cancer), infectious diseases such as tuberculosis, and cardiovascular disease.[7] Dark-skinned individuals require approximately 6 times more solar UVR exposure than fair-skinned individuals to produce the same amount of vitamin D. Deficiency of the vitamin is reportedly prevalent among black Africans living in Cape Town,[8] highlighting that vitamin D status may be exacerbated by the trend of rural to urban migration in those seeking work and improved living standards.

Groups at particular risk

Children, adolescents and outdoor workers are most at risk of the detrimental health effects of solar UVR, as they spend much time outdoors, often around midday when exposure to harmful UVB rays is highest. Fair-skinned individuals who do not tan in response to sunlight must take particular care to avoid sunburn. Conversely, dark-skinned people, indoor workers and those who wear full-body clothing risk insufficient solar UVR exposure and may lack the benefits of vitamin D.

Finding a healthy balance through research and intervention

Opportunities exist for raising awareness about achieving the balance between the positive and negative consequences of solar UVR exposure. A network of 6 solar UVR monitoring stations in SA, managed by the South African Weather Service, provide hope that awareness may be expanded and that stations will provide validated, locally derived information daily concerning the UV Index. This measure of solar UVR intensity, represented as a colour scale of 1 to 11+ (yellow/moderate: 3 - 5; high/red: 8 - 10), is broadcast in weather reports in some countries, with alerts issued when high values are predicted.

The World Health Organization INTERSUN programme could be effective in SA, but first, information is required on the prevalence and incidence of sun-related diseases, patterns of personal sun exposure and the influence of local cultural beliefs and practices. Improved recording and tracking of public health data would be beneficial to support this research. Guidance is needed for the general public on strategies to lessen the risk of skin cancer. Information on the effects of solar UVR on diseases of special importance in SA (HIV/AIDS, malaria and tuberculosis) and the vaccine immune

response, would be of considerable interest. The human health effects related to temperature or infrared radiation exposure during time spent in the sun, particularly in occupational settings, is an area for concern, particularly in the context of future climate variability.

Formulating an appropriate public health message regarding personal solar UVR exposure is a challenge. The message is not as clear-cut as for tobacco smoking, for example; solar irradiation has benefits as well as drawbacks, which are multifactorial and vary from person to person. Behavioural aspects must also be considered and monitored, including changes in the time spent outdoors, diet, fashion (clothing and hats), and attitudes towards tanning and sunscreen use. A population-wide public health message may not be the answer; targeting susceptible sub-groups may be more effective for developing solar UVR awareness campaigns and interventions in SA.

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