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Ultraviolet Radiation, the Ozone Layer and Skin Cancers

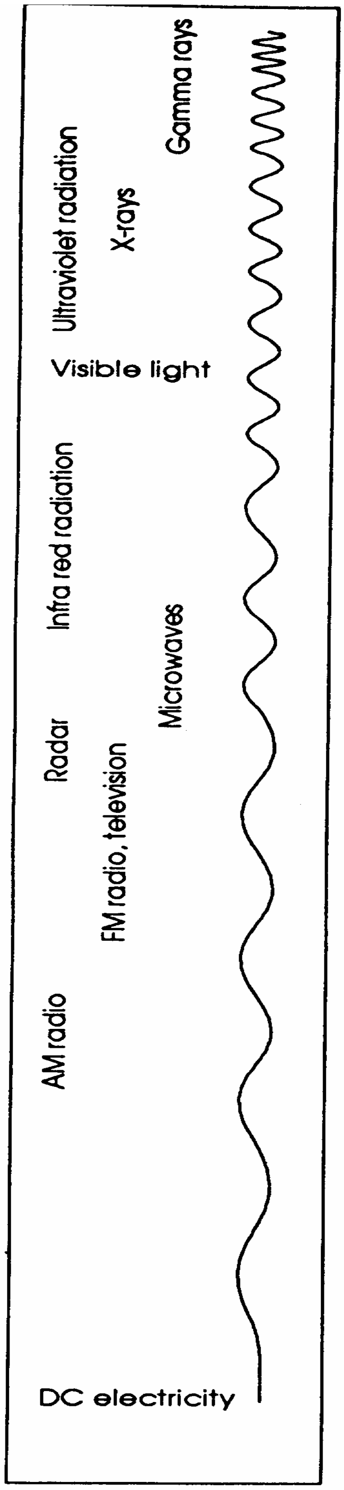


Figure 1

The link between skin cancers and exposure to ultraviolet (UV) radiation has been well established in the scientific literature. It has been brought to a wider audience through advertising campaigns which highlight the dangers of leaving skin exposed while outdoors. As part of the thrust of these campaigns television news programs are providing their audiences with information on the intensity of UV radiation throughout the day.

What is UV Radiation?

UV radiation lies within the broad spectrum of electromagnetic radiation — energy transmitted through space or the atmosphere in the form of waves. This spectrum of electromagnetic waves covers a wide range of wavelengths from the long radio wavelengths used to communicate with submarines on patrol to the extremely short wavelengths of X-rays and gamma rays. Figure 1 shows the electromagnetic spectrum diagrammatically. Towards the shorter wavelength part of the spectrum lies the band of frequencies of visible light running from red with longer wavelengths to blue with shorter wavelengths. The UV portion of the spectrum, with still shorter wavelengths, lies adjacent to the blue end of the visible spectrum. UV radiation has wavelengths that lie in the range 4 to 400 nanometres (nm). A nanometre is one thousand-millionth of a metre. In comparison the finest wool has a fibre diameter of around 20,000 nanometres.

Parts of the UV spectrum are selectively absorbed by organic matter.

Biologically Active UV

The biologically active portion of the UV spectrum — UV-B — has wavelengths in the range 290 nm to 315 nm. It is UV-B that is largely responsible for sunburn and skin cancers.

The level of UV-B is measured throughout the day at a score of locations across Australia and reported nightly on television news programs. A UV-B chart is shown at Figure 2; such a chart is usually simplified for television transmission.

The horizontal axis of the UV-B chart represents the time of day from 5 am to 8 pm using 24 hour notation. The vertical axis is divided into four ranges: moderate, high, very high and extreme. These ranges provide a broad classification of the number of *erythemal doses per hour*. An erythemal dose is the amount of UV radiation that is sufficient to cause sunburn on sensitive skin.

Table 1 shows for the top of each range the minimum number of erythemal doses that it represents. For example if UV intensity reaches the top of the very high region the radiation is strong

Figure 2: Melbourne UV radiation typical March day

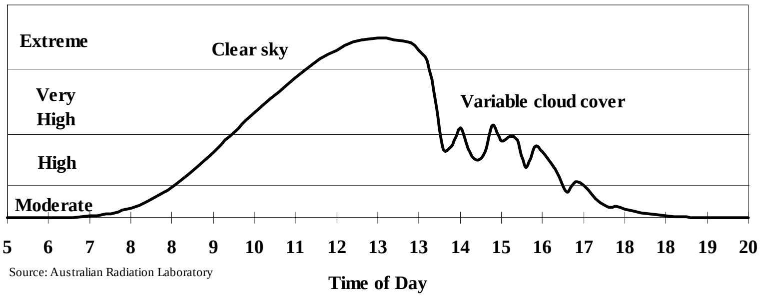


Table 1

Region of UV-B chart	Minimum number of erythemal doses at top of range	Minutes for sensitive skin to burn
Moderate	0.8	75
High	2.0	30
Very High	3.5	17
Extreme	5.0	12

enough to inflict 3.5 doses of sunburn per hour on sensitive skin or in other words sensitive skin will be sunburned in about 17 minutes.

Factors Limiting UV-B

The amount of UV-B radiation measured at ground level varies with the time of day, time of year, cloud cover, atmospheric turbidity — a measure of the particulate matter in the air — and the ozone concentration above the site the UV-B readings are taken. High ozone concentrations in the upper atmosphere; high turbidity; and cloud cover each reduce the amount of UV-B that reaches the ground. The amount of UV-B reaching ground level is also less in winter and in the early morning and late afternoon when the sun is lower in the sky.

Ozone

Of great current concern is the effect that a reduction in ozone concentration has on the amount of UV-B reaching the ground. Ozone is one of the many naturally occurring gases of the upper atmosphere. It has the ability to absorb UV radiation coming to Earth from space and to reduce it to levels which are not dangerous to life on Earth. This ozone layer can be destroyed by the release of certain synthetic chemicals into the atmosphere. Since readings began, ozone concentrations have been falling in a large region of the upper atmosphere centred around the poles. The South Pole ozone *hole* breaks up in November - December as winds which confine it weaken. Ozone concentrations over southern Australia then reduce as ozone-depleted air from the ozone hole mixes with air over Australia. The mean monthly total ozone for Melbourne for the period since 1956 is shown at Figure 3. The downward trend in the period 1980-1994 is around 4% per decade.

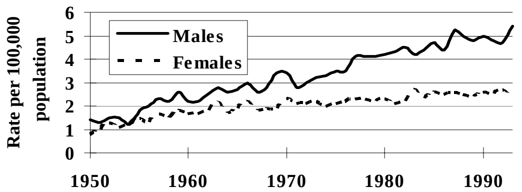
A reduced ozone concentration means that more UV-B penetrates to ground level placing those exposed at increased risk of developing skin cancers later in life.

Skin Cancers

Skin cancers can be broadly classified into *melanomas* and *non-melanocytic skin cancers* (NMSC). There are about 135,000 new cases of NMSC every year in Australia. If treated early these cancers are not life-threatening. Between 1950 and 1993 however there has been a significant increase in deaths from melanoma. Figure 4 shows the melanoma death rate per 100,000 people in this period.

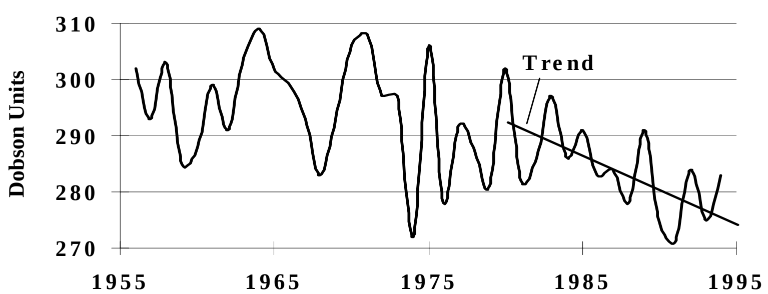
The increase in incidence and death from melanoma is linked to lifestyle changes in the post-war period. Because melanoma takes many years to develop the thinning of the ozone layer cannot be cited as the cause of existing cancers. Without continuing attempts to stop the destruction of the protective ozone layer and to encourage people to protect their skin from sunlight the increased level of UV at ground level will present an additional risk factor for skin cancers and the incidence of these life-threatening cancers will continue to increase.

Figure 4: Deaths from melanoma Australia 1950 to 1993



Source: Australian Institute of Health and Welfare

Figure 3: Mean monthly total ozone for Melbourne



Source: Bureau of Meteorology

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