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SOLAR RADIATION AND HUMAN HEALTH
Too Much Sun is Dangerous

Sunlight, an essential prerequisite for life, may be extremely dangerous to human health. Excessive exposure to the sun is known to be associated with increased risks of various skin cancers, cataracts and other eye diseases, as well as accelerated skin ageing. It may also adversely affect people's ability to resist infectious diseases, and compromise the effectiveness of vaccination programmes.

Sunlight is electromagnetic energy, which is propagated by electromagnetic waves. Healthwise, the most important parts of the sunlight electromagnetic spectrum are: **ultraviolet radiation** (**UV**), invisible to the eye; **visible light** that allows us to see; and **infrared radiation**, which is our main source of heat but is also invisible. Excessive exposures to them poses particular risks to health.

Skin*:* Excessive UV exposure results in a number of chronic skin changes. These include various *skin cancers* of which *melanoma* is the most life-threatening; an increased number of moles (*benign abnormalities of melanocytes)* and a range of other alterations arising from UV damage to keratinocytes and blood vessels. UV damage to fibrous tissue is often described as "photoageing". Photoageing makes people look older because their skin loses its tightness and so sags or wrinkles.

- United Nations Environment Programme (UNEP) has estimated that more than 2 million nonmelanoma skin cancers and 200,000 malignant melanomas occur globally each year.
- In the event of a 10% decrease in stratospheric ozone, an additional 300,000 nonmelanoma and 4,500 melanoma skin cancers could be expected worldwide.
- Caucasians have a higher risk of skin cancer because of the relative lack of skin pigmentation.
- The worldwide incidence of malignant melanoma continues to increase, and is strongly related to frequency of recreational exposure to the sun and to history of sunburn.
- There is evidence that risk of melanoma is also related to intermittent exposure to UV, especially in childhood, and to exposure to sunlamps. However, the latter results are still preliminary.

Eye: UV exposure of the eye depends on many factors: ground reflection, the degree of brightness in the sky leading to activation of the squint reflex, the amount of atmospheric refection, and the use of eyewear.

- The acute effects of UV on the eye include the development of photokeratitis and photoconjunctivitis, which are like sunburn of the delicate skin-like tissue on the surface of the eyeball (cornea) and eyelids. While painful, they are reversible, easily prevented by protective eyewear and have not been associated with any long-term damage.
- Chronic effects include the possible development of pterygium (a white or cream coloured opaque growth attached to the cornea), squamous cell cancer of the conjunctiva (scaly or plate-like malignancy) and cataracts.
- Some 20 million people worldwide are currently blind as a result of cataracts. Of these, WHO estimates that as many as 20% may be due to UV exposure. Experts believe that each 1% sustained decrease in stratospheric ozone would result in an increase of 0.5% in the number of cataracts caused by solar UV.
- Direct viewing of the sun and other extremely bright objects can also seriously damage the very sensitive part of the retina called the *yellow spot*, *fovea* or *macula leutea*. When cells of the fovea are destroyed, people can no longer view fine detail. This is a serious visual impairment making it impossible to read, sew, watch TV, recognise faces, drive a vehicle or do any task which requires recognition of fine details.

Immune system*:* UV also appears to alter immune response by changing the activity and distribution of the cells responsible for triggering these responses. A number of studies indicate that UV exposures at environmental levels suppress immune responses in both rodents and humans. In rodents, this immune suppression results in enhanced susceptibility to certain infectious diseases with skin involvement, and some systemic infections. Mechanisms associated with UV-induced *immunosuppression and host defence* that protect against infectious agents are similar in rodents and humans. It is therefore reasonable to assume that UV exposure may enhance the risk of infection and decrease the effectiveness of vaccines in humans. Additional research is necessary to substantiate this.

Thermal Effects: Heating of tissues in the human body is the principal effect of infrared radiation. Excessive infrared radiation can result in heat strokes and other similar reactions particularly in elderly, infirm or very young individuals. At moderate levels of exposure, the warmth experienced from being in the sun is relaxing and restorative.

Protective Measures: Methods for personal protection from solar UV exposure include adequate clothing, hats and the proper use of sunscreens to protect UV-exposed skin. For eye protection, UV absorbing sunglasses are needed.
Changes in behavior could minimize solar UV exposure. These include staying out of the sun, either indoors or in shaded areas, during the four-hour period around solar noon when UV levels are at their highest. During summer, when daylight saving time is in effect, solar noon in most of Europe is at 14.00 hours (2 p.m.); in the UK and countries with a similar longitude, it is at 13.00 hours (1 p.m.).

Broad-spectrum sunscreens should be used when other means of protection are not feasible, and then to reduce exposure rather than lengthen the period of exposure. While topical applications of sunscreen are preferred for absorbing UVB, some preparations do not absorb the longer wavelength UVA effectively. Moreover, some preparations have been found to contain ingredients that are mutagenic in sunlight. People using sunscreens should use those with a high sun protection factor (SPF) and be aware that they are to protect from the sun and not for tanning purposes.
The reflective properties of the ground have an influence on UV exposure. Most natural surfaces such as grass, soil and water reflect less than 10% of incident UV. However, fresh snow reflects nearly 80% while sand reflects 10-25%, significantly increasing UV exposure for skiers and bathers.

Global Solar UV Index: The Global Solar UV Index is an important tool developed through the work of the *WHO INTERSUN Project* to assist local authorities in giving guidance on the degree of protection to be used on any given day. It provides an estimate of the maximum solar UV exposure at the Earth's surface. While the intensity of UV reaching the ground varies during the day, it reaches a maximum, when there is no cloud cover, around mid-day. It is generally presented as a forecast of the maximum amount of skin-damaging UV expected to reach the Earth's surface at solar noon. The values of the Index range from zero upward and the higher the Index number, the greater the likelihood of skin and eye damaging exposure to UV, and the less time it takes for damage to occur.

In the most extreme environments close to the equator, summer-time values can range up to 20. During a European summer the Index is generally not more than about 8, but can be higher, especially at beach resorts. The following descriptions are usually associated with various values of the Index: Low UV exposure - 1 and 2; Moderate exposure - 3 and 4; High exposure - 5 and 6; Very high exposure - 7 and 8; Extreme exposure - greater than 9.

Recommendations on the description, calculation, and dissemination of the Global Solar UV Index were made in 1995 by WHO, the World Meteorological Organization (WMO), the United Nations Environment Programme (UNEP) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP). National authorities throughout the world now use the Global Solar UV Index. These international organizations recommended that:

- The Global Solar UV Index should be used as a vehicle to raise public awareness of the potential harm of excessive UV exposure and to alert people about the need to adopt protective measures. This is especially important given the continuing decrease in stratospheric ozone and subsequent increase in UV intensities that cause increasingly severe UV-induced health effects;
- National governments should be encouraged to use the Global Solar UV Index as part of their public awareness and educational programmes;
- The news media should be encouraged to report the Global Solar UV Index with their daily weather information, so that people begin to accept this as something they need to know in addition to the news and weather.

Multiple UV Indices: There has been a proliferation of indices in various countries, especially in Europe, that provide different measures of the levels of UV to which people are exposed from the sun. These UV indices may be promoted by some sun-screen or cosmetic manufacturers for commercial purposes or by local authorities unaware that there has been widespread acceptance of an international agreement on the use of the Global Solar UV Index. Using the standardized Global Solar UV Index at the same time as other UV indices may, however, lead to public confusion about the important health messages related to different Global Solar UV Index values. The purpose of the Global Solar UV Index is to provide uniform information to the public about daily UV exposure levels so that consistent messages can be provided on what protective measures are necessary with various index values.

INTERSUN - the Global UV Project: The consequences of increased UV exposure were a major topic for discussion at the United Nations Conference on the Environment and Development, held in Rio de Janeiro in 1992. Agenda 21, adopted by the Conference, recommended as a matter of urgency that research be undertaken on the health effects of UV exposure and that appropriate measures be taken to mitigate them. Further to this recommendation the Global UV Project "INTERSUN" was launched in 1993.

The objectives of INTERSUN are to:

- Collaborate with specialist agencies to implement key research related to human health and environmental effects from UV exposure;
- Develop reliable predictions of health and environmental consequences of changes in UV exposure with stratospheric ozone depletion;
- Develop practical ways of monitoring change in UV-induced health effects over time in relation to environmental and behavioral change; and
- Provide practical advice and information to national authorities on health and environmental effects of UV exposure; Means of efficiently disseminating this information, particularly through use of a Global Solar UV Index; Measures to protect the general public, workers and the environment against the adverse effects of increased UV exposure.
- INTERSUN is a collaborative project between WHO, UNEP, the International Agency for Cancer Research (IARC), the International Commission on Non-ionizing Radiation Protection (ICNIRP), the World Meteorological Organization (WMO) and national authorities in the WHO Member States.

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