A marked increase in the incidence of skin cancers has been observed in fair-skinned populations worldwide since the early 1970s. This is strongly associated with personal habits in relation to sun exposure and its ultraviolet (UV) component, and the societal view that a tan is desirable and healthy.

The Global Solar UV Index (UVI) described in this document was developed in an international effort by WHO in collaboration with WMO, UNEP and ICNIRP, and is a simple measure of the UV radiation level at the Earth’s surface. It serves as an important vehicle to raise public awareness and to alert people about the need to adopt protective measures when exposed to UV radiation.

Intersun, WHO’s Global UV Project, aims to reduce the burden of disease resulting from exposure to UV radiation by assessing and quantifying health risks, and developing an appropriate response through guidelines, recommendations and information dissemination.
GLOBAL SOLAR UV INDEX

A Practical Guide

A joint recommendation of:

World Health Organization

World Meteorological Organization

United Nations Environment Programme

International Commission on Non-Ionizing Radiation Protection
Everyone is exposed to UV radiation from the sun and many artificial sources used in industry, commerce and recreation. Emissions from the sun include light, heat and UV radiation.

The UV region covers the wavelength range 100–400 nm and is divided into three bands:

- **UVA** (315–400 nm)
- **UVB** (280–315 nm)
- **UVC** (100–280 nm)

As sunlight passes through the atmosphere, all UVC and approximately 90% of UVB radiation are absorbed by ozone, water vapour, oxygen and carbon dioxide. UVA radiation is less affected by the atmosphere.

Therefore, the UV radiation reaching the Earth’s surface is largely composed of UVA with a small UVB component.
Small amounts of UV radiation are beneficial for people and essential in the production of vitamin D. UV radiation is also used to treat several diseases, including rickets, psoriasis and eczema. This takes place under medical supervision and the benefits of treatment versus the risks of UV radiation exposure are a matter of clinical judgement.

Prolonged human exposure to solar UV radiation may result in acute and chronic health effects on the skin, eye and immune system. Sunburn and tanning are the best known acute effects of excessive UV radiation exposure; in the long term, UV radiation-induced degenerative changes in cells, fibrous tissue and blood vessels lead to premature skin ageing. UV radiation can also cause inflammatory reactions of the eye, such as photokeratitis.

Chronic effects include two major public health problems: skin cancers and cataracts. Between two and three million non-melanoma skin cancers and approximately 132000 melanoma skin cancers occur globally each year. While non-melanoma skin cancers can be surgically removed and are rarely lethal, malignant melanoma substantially contributes to mortality rates in fair-skinned populations. Some 12 to 15 million people are blind from cataracts. According to WHO estimates, up to 20% of these cases of blindness may be caused or enhanced by sun exposure, especially in India, Pakistan and other countries of the “cataract belt” close to the equator.

Furthermore, a growing body of evidence suggests that environmental levels of UV radiation may enhance the risk of infectious diseases and limit the efficacy of vaccinations. Please see Annex A for a detailed description of the health effects of exposure to UV radiation.

People’s behaviour in the sun is considered to be a major cause for the rise in skin cancer rates in recent decades. An increase in popular outdoor activities and changed sunbathing habits often result in excessive exposure to UV radiation. Many people consider intensive sunbathing to be normal; unfortunately, even children, adolescents and their parents perceive a suntan as a symbol of attractiveness and good health.

Sun protection programmes are urgently needed to raise awareness of the health hazards of UV radiation, and to achieve changes in lifestyle that will arrest the trend towards more and more skin cancers. Beyond the health benefits, effective education programmes can strengthen national economies by reducing the financial burden to health care systems caused by skin cancer and cataract treatments. Billions are spent worldwide to treat these diseases, many of which could have been prevented or delayed. The Global Solar UV Index should be an important element of an integrated and long-term public health approach to sun protection.

**UV RADIATION LEVELS ARE INFLUENCED BY:**

**SUN ELEVATION**
The higher the sun in the sky, the higher the UV radiation level. Thus UV radiation levels vary with time of day and time of year. Outside the tropics, the highest levels occur when the sun is at its maximum elevation, at around midday (solar noon) during the summer months.

**LATITUDE**
The closer to equatorial regions, the higher the UV radiation levels.

**CLOUD COVER**
UV radiation levels are highest under cloudless skies but even with cloud cover, UV radiation levels can be high. Scattering can have the same effect as the reflectance by different surfaces and thus increase total UV radiation levels.

**ALITITUDE**
At higher altitudes, a thinner atmosphere absorbs less UV radiation. With every 1000 metres increase in altitude, UV radiation levels increase by 10% to 12%.

**OZONE**
Ozone absorbs some of the UV radiation that would otherwise reach the Earth’s surface. Ozone levels vary over the year and even across the day.

**GROUND REFLECTION**
UV radiation is reflected or scattered to varying extents by different surfaces, e.g. fresh snow can reflect as much as 80% of UV radiation, dry beach sand about 15% and sea foam about 25%.
The Global Solar UV Index

WHAT IS THE GLOBAL SOLAR UV INDEX?
The Global Solar UV Index (UVI) describes the level of solar UV radiation at the Earth’s surface. The values of the index range from zero upward – the higher the index value, the greater the potential for damage to the skin and eye, and the less time it takes for harm to occur.

WHY DO WE NEED THE UVI?
A marked increase in the incidence of skin cancer in fair-skinned populations worldwide is strongly associated with excessive UV radiation exposure from the sun; it may also be associated with the use of artificial UV radiation sources such as sunbeds. Current evidence indicates that personal habits in relation to sun exposure constitute the most important individual risk factor for UV radiation damage. The UVI is an important vehicle to raise public awareness of the risks of excessive exposure to UV radiation, and to alert people about the need to adopt protective measures. Encouraging people to reduce their sun exposure can decrease harmful health effects and significantly reduce health care costs.

HOW SHOULD THE UVI BE USED?
This educational tool should be used as an integral component of a programme to inform the public about UV radiation health risks and sun protection, and to change people’s attitudes and behaviour with respect to UV radiation exposure. The UVI should especially aim at vulnerable and highly-exposed groups within the population, e.g. children and tourists, and should inform people about the range of UV radiation-induced health effects including sunburn, skin cancer and skin ageing, and effects on the eye and immune system. Educational messages should emphasize that the risk of adverse health effects from UV radiation exposure is cumulative, and that exposure in everyday life may be as important as exposure during vacations in sunny climates.

HOW IS THE UVI PRESENTED?
UV radiation levels and therefore the values of the index vary throughout the day. In reporting the UVI, most emphasis is placed on the maximum UV radiation level on a given day. This occurs during the four-hour period around solar noon. Depending on geographical location and whether daylight saving time is applied, solar noon takes place between local noon and 2 p.m. The media usually present a forecast of the maximum UV radiation level for the following day.

WHERE IS THE UVI REPORTED?
In many countries the UVI is reported along with the weather forecast in newspapers, on TV and on the radio; however, this is usually done only during the summer months. Annex B lists a series of Internet links that provide the UVI for a range of countries and in many different languages.

WHAT IS THE IMPORTANCE OF A HARMONIZED UVI?
Many countries use the UVI to promote sun protection. Surveys suggest that a large percentage of the public is aware of the existence of the UVI but does not understand its meaning or usefulness. These problems are related to the lack of standardized messages associated with the UVI. The UVI is clearly defined as an educational tool, and its use must be based on effective communication with the public and the media. Uniformity of UVI presentation, and uniformity of sun protection messages associated with different UVI values, will facilitate the delivery of a simple and relevant message, and will help to familiarize people with this important concept.
Reporting the UV Index

THE BASIC SCHEME

REPORTING UVI VALUES
The UVI is a measure of the intensity of UV radiation on the Earth’s surface that is relevant to effects on the human skin.

- UVI reports should present at least the daily maximum value. When forecasting or reporting daily maxima, a 30-minute average value should be used. Where continuous observations are available, a 5–10 minute average is useful to display short-term changes.

- The UVI should be presented as a single value rounded to the nearest whole number.

- However, when cloud cover is variable, the UVI should be presented as a range of values. UVI forecasts should include effects of cloud on UV radiation transmission through the atmosphere. Programmes not incorporating cloud effects in their forecasts should refer to them as a “clear sky” or “cloud free” UVI.

UVI values are grouped into exposure categories (Table 1). The national meteorology office or media service may choose to report the exposure category, the UVI value or range of values, or both.

<table>
<thead>
<tr>
<th>EXPOSURE CATEGORY</th>
<th>UVI RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>&lt; 2</td>
</tr>
<tr>
<td>MODERATE</td>
<td>3 TO 5</td>
</tr>
<tr>
<td>HIGH</td>
<td>6 TO 7</td>
</tr>
<tr>
<td>VERY HIGH</td>
<td>8 TO 10</td>
</tr>
<tr>
<td>EXTREME</td>
<td>11+</td>
</tr>
</tbody>
</table>

Table 1: UVI radiation exposure categories

REPORTING BURN TIMES IS NOT RECOMMENDED.

Burn times have been used in many countries as a simple concept that can be directly translated into action. However, people tend to interpret burn times to mean that there is a safe level of unprotected sun exposure. Hence, relating UVI values to “time to burn” or “safe tanning time” sends out the wrong message to the public. The UVI should not imply that extending exposures is acceptable. Although the priority goal of primary skin cancer prevention is to avoid sunburn, cumulative UV radiation exposure plays a major role in developing skin cancer and promotes damage to the eyes and immune system.

A SIMPLE AND RELEVANT MESSAGE
Acceptance by the general public of the UVI as useful daily information is the ultimate goal. In order to achieve this, the messages must be simple and easily understood. Reporting the UVI with relevance to the recipient will allow people to put recommendations into practice and accept the UVI as a guide to healthy, sun-protective behaviour.

From a public health point of view, it is especially important to protect the most vulnerable population groups. Based on the finding that more than 90% of non-melanoma skin cancers occur in skin types I and II (Table 2), the basic protective messages associated with the UVI should focus on fair-skinned people who tend to burn. Children, who are particularly sensitive to UV radiation, require special protection.

Even though the incidence of skin cancer is lower in dark-skinned people, they are nevertheless susceptible to the damaging effects of UV radiation, especially to the effects on the eye and immune system. Additional messages at the national or local level will allow the particular needs of other population sub-groups to be addressed.

These should take into account differences in climate and culture, the perception of UV radiation risks in the population, and the stage of sun protection education.

<table>
<thead>
<tr>
<th>SKIN TYPE CLASSIFICATION</th>
<th>BURNS IN THE SUN</th>
<th>TANS AFTER HAVING BEEN IN THE SUN</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Melano-compromised</td>
<td>Always</td>
<td>Seldom</td>
</tr>
<tr>
<td>II.</td>
<td>Usually</td>
<td>Sometimes</td>
</tr>
<tr>
<td>III. Melano-competent</td>
<td>Sometimes</td>
<td>Usually</td>
</tr>
<tr>
<td>IV.</td>
<td>Seldom</td>
<td>Always</td>
</tr>
<tr>
<td>V. Melano-protected</td>
<td>Naturally brown skin</td>
<td>Naturally black skin</td>
</tr>
</tbody>
</table>

Table 2: Classification of skin types (adapted from TB Fitzpatrick and JL Bologna, 1995)

A standard graphic presentation of the UVI promotes consistency in UVI reporting on news and weather bulletins, and serves to improve people’s understanding of the UVI concept. Ready-made materials for UVI reporting facilitate successful media uptake, and more than one option is given to allow different media to cope with technical limitations. The graphics package (see Annex D) can be downloaded from the website of WHO’s Global UV Project Intersun https://www.who.int/uv/ and includes the UVI logo, icons for UVI reporting, sun protection icons, and colour codes for different values of the UVI.

Two different concepts of sun protection have been proposed: a binary response with a defined threshold UVI value beyond which sun protection is recommended, or a graded response with increasing UVI values that would involve the successive use of different sun-protective measures. There is little scientific basis to support the latter: if sun protection is required, this should include all protective means, i.e. clothing, sunglasses, shade and sunscreen (Figure 1). Nevertheless, a graded approach is relevant in the sense that more sun protection is needed at higher UV radiation levels. Even for very sensitive fair-skinned people, the risk of short-term and long-term UV radiation damage below a UVI of 3 is limited, and under normal circumstances no protective measures are needed. Above the threshold value of 3, protection is necessary, and this message should be reinforced at UVI values of 8 and above.

Shade, clothing and hats provide the best protection – apply sunscreen to parts of the body that remain exposed, like the face and hands. Sunscreen should never be used to prolong the duration of sun exposure.
Sun Protection Messages

CREATING VARIETY

ADDITIONAL SUNSMART MESSAGES

The basic scheme for UVI reporting and sun protection can be varied and expanded through the use of additional messages at the national or local level. Messages on suntanning, sun protection and people’s inability to perceive UV radiation underlie the basic message and can be used in all settings.

Environment-based, activity-based or risk group-based messages can be geared specifically to local weather conditions, or the particular environmental or societal situation of a given country. Annex E lists examples of such additional sun protection messages adapted from Australia, Canada and France.

<table>
<thead>
<tr>
<th>FALSE</th>
<th>TRUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A suntan is healthy.</td>
<td>A tan results from your body defending itself against further damage from UV radiation.</td>
</tr>
<tr>
<td>A tan protects you from the sun.</td>
<td>A dark tan on white skin offers only limited protection equivalent to an SPF of about 4.</td>
</tr>
<tr>
<td>You can’t get sunburnt on a cloudy day.</td>
<td>Up to 80% of solar UV radiation can penetrate light cloud cover. Haze in the atmosphere can even increase UV radiation exposure.</td>
</tr>
<tr>
<td>You can’t get sunburnt while in the water.</td>
<td>Water offers only minimal protection from UV radiation, and reflections from water can enhance your UV radiation exposure.</td>
</tr>
<tr>
<td>UV radiation during the winter is not dangerous.</td>
<td>UV radiation is generally lower during the winter months, but snow reflection can double your overall exposure, especially at high altitude. Pay particular attention in early spring when temperatures are low but the sun’s rays are unexpectedly strong.</td>
</tr>
<tr>
<td>Sunscreens protect me so I can sunbathe much longer.</td>
<td>Sunscreens should not be used to increase sun exposure time but to increase protection during unavoidable exposure. The protection they afford depends critically on their correct application.</td>
</tr>
<tr>
<td>If you take regular breaks during sunbathing you won’t get sunburnt.</td>
<td>UV radiation exposure is cumulative during the day.</td>
</tr>
<tr>
<td>If you don’t feel the hot rays of the sun you won’t get sunburned.</td>
<td>Sunburn is caused by UV radiation which cannot be felt. The heating effect is caused by the sun’s infrared radiation and not by UV radiation.</td>
</tr>
</tbody>
</table>

Figure 4: Children require special protection

Table 3: UV radiation danger: Facts and fiction

USING COLOUR TO INCREASE VARIABILITY

Specific colours should be used for presenting the solar UVI. These do not have a scientific basis but are a means of making the presentation of the UVI more appealing. The colour coding facilitates variation between geographic areas of high and low UV radiation levels, and a basic colour is defined for each category (Table 4; see also Annex D).

Table 4: Presenting the UVI: International colour codes

<table>
<thead>
<tr>
<th>UVI INDEX</th>
<th>Colour</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (1,2)</td>
<td>Green</td>
<td>PMS 375</td>
</tr>
<tr>
<td>Moderate (3,4,5)</td>
<td>Yellow</td>
<td>PMS 102</td>
</tr>
<tr>
<td>High (6,7)</td>
<td>Orange</td>
<td>PMS 151</td>
</tr>
<tr>
<td>Very high (8,9,10)</td>
<td>Red</td>
<td>PMS 032</td>
</tr>
<tr>
<td>Extreme (11+)</td>
<td>Purple</td>
<td>PMS 265</td>
</tr>
</tbody>
</table>

Not all media will be able to integrate the variation in colour into their presentation. Television media generally use standardized maps and changing the colours may be due to technical limitations. Similarly, black and white print media will not be able to use the recommended colour scheme.

EMPHASIZING DANGEROUS HOURS

In countries where UV radiation levels are high and where knowledge about UV radiation and sun protection in the population is widespread, a further concept may be applied to increase variability. This was introduced in Australia in 2000.

The approach focuses on the hours of the day during which the UVI is above a given threshold value (Figure 5). While on one day the UVI may reach a value of above 3 for no more than 30 minutes, on another day it may remain above 3 for several hours. The advice to the public emphasizes the need to adopt sun-protective practices during these hours.

Figure 5: A graphic representing dangerous hours (Bureau of Meteorology, Australia)
Increased sun exposure has been identified as the main reason for the increase in skin cancer rates since the early 1970s, and only changes in lifestyle can stop this ongoing trend. Public education aims to improve people’s knowledge about the health risks of excessive sun exposure, and to achieve a change in attitudes and behaviour. Reducing the occurrence of sunburn and cumulative UV radiation exposure over a lifetime will eventually cause skin cancer rates to decline.

It is important that information be presented in a positive manner that enables people to enjoy the sun safely but at the same time makes them aware of the need to avoid overexposure. The UVI should form an integral element of programmes to educate the public about the health hazards of excessive UV radiation exposure. The sections below address key elements of effective education campaigns.

**MAIN TARGET AUDIENCES AND SUN PROTECTION SETTINGS**

A majority of a person’s lifetime exposure occurs before age 18, and sun avoidance during childhood has a greater impact on health risk reduction than sun protection during adulthood. Therefore, children and adolescents should be the primary target for education about the sun and how to avoid damage to health. An effective campaign can have an enormous impact on public health: a change in people’s behaviour towards effective sun protection could eliminate more than 70% of skin cancers in Australia.

Schools are essential for getting the message across to young people. Teachers and their associations should be encouraged to take up the cause and include UV radiation awareness and protection projects in the educational system. Furthermore, all outdoor recreational sites—beaches, sport centres and swimming pools, zoos and parks—provide a good setting for information about UV radiation levels and sun protection.

As a large percentage of many people’s lifetime exposure to UV radiation is received during vacations, tourists represent an important audience for UVI reporting and sun protection advice.

**BUILDING NETWORKS AND ALLIANCES**

In order to change people’s sun exposure habits and the current societal view that associates a tan with good health, long-term strategies are required. The cooperation of different sectors is necessary to implement far-reaching educational strategies and create a supportive environment for the integration of sun protection into the culture of a country. For this reason, campaigns in many countries are organized as a collaborative effort between different medical and scientific associations, government and specialized private institutions, and charitable societies.

Further partners in disseminating the message may include the tourism industry such as airlines, hotel chains and cruise liners, national weather bureaux and companies producing sun protection items such as sunscreen and sunglasses.

**THE ROLE OF NATIONAL GOVERNMENTS**

**EDUCATION**

- Encourage the use of the UVI as part of public awareness programmes.
- Supply health care professionals, teachers and carers of children with educational material for distribution to the public.
- Organize workshops for medical doctors and other health professionals.
- Establish education programmes for teachers.
- Establish education programmes for outdoor workers.
- Encourage and support the provision of shaded areas in schools, playgrounds and parks, and in public places such as bus stops and swimming pools.
- Recommend against the use of sunlamps and sunbeds for cosmetic purposes.
- Inform the community of drugs and cosmetics that sensitize the skin to the effects of UV radiation.
- Enlist weather broadcasters, health reporters and the media to provide the UVI service to the public.

**EVALUATION**

- Establish national statistics on UV radiation-induced skin and eye diseases.
- Encourage research on UV radiation-related health effects and protective measures.
- Support national programmes and international collaboration efforts on UV radiation monitoring and health education.
- Conduct research that monitors behavioural, knowledge and attitudinal trends related to sun protection.

**STANDARDS**

- Facilitate the development of standards related to sun protection products such as sunscreens, clothing, sunbeds and sunglasses to ensure clear and safe guidelines for manufacturers and consumers.
- Encourage the provision of information on the degree of UV radiation protection provided by sunscreens, eyewear, clothing and other protective measures.

**ENSURING MEDIA SUPPORT**

The media should be encouraged to report the UVI with their daily weather information, so that people begin to accept this as an important piece of information in addition to the news and weather report. The TV, radio and print media provide an essential medium for informing the public about the hazards of UV radiation and the need to adopt protective measures. They can support local and national programmes by highlighting health concerns, and can even promote research by making the results of new health effects or protective devices known to the public. To ensure continuing interest in the awareness campaign, it will be necessary to progressively develop short, clear messages that are tailored to the particular medium.
Health Effects of UV Radiation Exposure

ANNEX A

Human exposure to solar radiation may result in acute and chronic health effects on the skin, eye and immune system. It is a popular misconception that only fair-skinned people need to be concerned about overexposure to the sun. Darker skin has more protective melanin pigment, and the incidence of skin cancer is lower in dark-skinned people. Nevertheless, skin cancers do occur with this group and unfortunately they are often detected at a later, more dangerous stage. The risk of UV radiation-related health effects on the eye and immune system is independent of skin type. A comprehensive summary and review of UV radiation-related health effects can be found in the WHO Environmental Health Criteria Monograph Ultraviolet Radiation and in the Proceedings of an International Workshop on Ultraviolet Radiation.

SKIN

SUNBURN, SUNTAN AND SKIN AGEING
The best known acute effect of excessive UV radiation exposure is erythema, the familiar skin reddening termed sunburn. In addition, most people will tan from the UV radiation stimulation of melanin production, which occurs within a few days of exposure. A further, less obvious adaptive effect is the thickening of the outermost layers of the skin that attenuates UV radiation penetration to the deeper layers of the skin. Both changes are a sign of damage to the skin. Depending on their skin type, individuals vary greatly in their skin’s initial threshold for erythema and their ability to adapt to UV exposure. Chronic exposure to UV radiation also causes a number of degenerative changes in the cells, fibrous tissue and blood vessels of the skin. These include freckles, nevi and lentigines, which are pigmented areas on the skin, and diffuse brown pigmentation. UV radiation accelerates skin ageing, and the gradual loss of the skin’s elasticity results in wrinkles and dry, coarse skin.

USEFUL STRATEGIES INCLUDE:

• Encourage behaviour change through sign prompts and educational activities in community and recreation facilities and services. These could include programmes in schools and kindergartens, the distribution of brochures in public buildings, banks, shopping centres and health care centres, and sun protection fairs where health professionals participate in presentations and skin cancer screening.

• Promote creative activities on sun protection, e.g. fashion shows using UV radiation-protective designs and fabrics, science projects, and competitions.

• Modify the physical environment and promote the consideration of shade in urban planning and in the modification of public places.

THE ROLE OF LOCAL AUTHORITIES AND HEALTH AGENCIES

THE UVI CAN:

✓ save lives
✓ protect good health
✓ help preserve youthful complexion

EVALUATING THE EFFECTIVENESS OF A UVI CAMPAIGN

A sun awareness programme that uses the UVI as an educational tool aims to improve people’s knowledge, and change attitudes and behaviour with respect to sun exposure and sun protection. A well-designed evaluation survey should assess:

• whether members of the general public understand the meaning of the UVI and the message it carries;
• whether the campaign has changed people’s knowledge, attitudes and behaviour with respect to sun exposure.

THE UVI CAN:

✓ save lives
✓ protect good health
✓ help preserve youthful complexion

NON-MELANOMA SKIN CANCERS

Non-melanoma skin cancers (NMSC) comprise basal cell carcinoma and squamous cell carcinoma. These are rarely lethal but surgical treatment is painful and often disfiguring. The temporal trends of NMSC incidence are difficult to determine, because reliable registration of these cancers has not been achieved. However, specific studies carried out in Australia, Canada and the United States, indicate that between the 1960s and the 1980s the prevalence of NMSC increased by a factor of more than two. The risk of NMSC has been examined with respect to personal exposure, and the
• NMSC is most frequent on parts of the body that are commonly exposed to the sun such as ears, face, neck and forearms. This implies that long-term, repeated UV radiation exposure is a major causal factor.

• Within some countries there is a clear relationship between increasing incidence of NMSC with decreasing latitude, i.e. higher UV radiation levels.

• A large number of atypical nevi (moles) is the strongest risk factor for MM in fair-skinned populations.

• MM is more common among people with a pale complexion, blue eyes, and red or fair hair. Experimental studies have demonstrated a lower threshold erythema and more prolonged skin reddening in melanoma patients than in controls.

• High, intermittent exposure to solar UV radiation appears to be a significant risk factor for the development of MM.

• The incidence of MM in white populations generally increases with decreasing latitude, with the highest recorded incidence occurring in Australia, where the annual rates are 10 and over 20 times the rates in Europe for women and men respectively.

• Several epidemiological studies support a positive association with history of sunburn, particularly sunburn at an early age.

• The role of cumulative sun exposure in the development of MM is equivocal. However, MM risk is higher in people with a history of NMSC and of solar keratoses, both of which are indicators of cumulative UV radiation exposure.

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EYE
The eye is recessed within its orbit and shielded by the brow ridge, the eyebrows and the eyelashes. Bright light activates the constriction of the pupil and the squinting reflex to minimize the penetration of the sun's rays into the eye. However, the effectiveness of these natural defences in protecting against the dangers of UV radiation is limited under extreme conditions such as sunbed use or strong ground reflection from sand, water and snow.

Acute effects of UV radiation exposure include photokeratitis and photconjunctivitis. These inflammatory reactions are comparable to a sunburn of the very sensitive skin-like tissues of the eyeball and eyelids, and usually appear within a few hours of exposure. Both can be very painful, but are reversible and do not result in any long-term damage to the eye or vision. Extreme forms of photokeratitis are “arc-eye” and “snow blindness”.

Cataracts are the leading cause of blindness in the world. Proteins in the eye's lens unravel, tangle and accumulate pigments that cloud the lens and eventually lead to blindness. Even though cataracts appear to different degrees in most individuals as they age, sun exposure, in particular exposure to UVB, appears to be a major risk factor for cataract development.

IMMUNE SYSTEM
The immune system is the body's defence mechanism against infections and cancers, and is normally very effective at recognizing and responding to an invading micro-organism or the onset of a tumour. Although the data remain preliminary, there is increasing evidence for a systematic immunosuppressive effect of both acute and low-dose UV radiation exposure.

Animal experiments have demonstrated that UV radiation can modify the course and severity of skin tumours. Also, people treated with immunosuppressive drugs have a greater incidence of squamous cell carcinoma than the normal population. Consequently, beyond its role in the initiation of skin cancer, sun exposure may reduce the body's defences that normally limit the progressive development of skin tumours.

Several studies have demonstrated that exposure to environmental levels of UV radiation alters the activity and distribution of some of the cells responsible for triggering immune responses in humans. Consequently, sun exposure may enhance the risk of infection with viral, bacterial, parasitic or fungal infections, which has been demonstrated in a variety of animal models. Furthermore, especially in countries of the developing world, high UV radiation levels may reduce the effectiveness of vaccines. Since many vaccine-preventable diseases are extremely infectious, any factor that results in even a small decrease in vaccine efficacy can have a major impact on public health.

OZONE DEPLETION AND UV-RELATED HEALTH EFFECTS
Depletion of the ozone layer is likely to aggravate existing health effects caused by exposure to UV radiation, as stratospheric ozone is a particularly effective UV radiation absorber. As the ozone layer gets thinner, the protective filter provided by the atmosphere...
Computational models predict that a 10% decrease in stratospheric ozone could cause an additional 300,000 non-melanoma and 4500 melanoma skin cancers and between 1.6 and 1.75 million more cases of cataracts worldwide every year.
The Global Solar UVI is formulated using the International Commission on Illumination (CIE) reference action spectrum for UV-induced erythema on the human skin (ISO 17166:1999/CIE S 007/E-1998). It is a measure of the UV radiation that is relevant to and defined for a horizontal surface. The UVI is a unitless quantity defined by the formula:

\[
I_{\text{UV}} = k_\text{er} \cdot \int_{250 \text{ nm}}^{400 \text{ nm}} E_\lambda \cdot s_\text{er}(\lambda) \, d\lambda
\]

where \(E_\lambda\) is the solar spectral irradiance expressed in W/(m²·nm⁻¹) at wavelength \(\lambda\) and \(d\lambda\) is the wavelength interval used in the summation. \(s_\text{er}\) is the erythema reference action spectrum, and \(k_\text{er}\) is a constant equal to 40 m²/W.

The determination of the UVI can be through measurements or model calculations. Two measurement approaches can be taken: the first is to use a spectroradiometer and to calculate the UVI using the above formula. The second is to use a broadband detector that has been calibrated and programmed to give the UVI directly. Prediction of the solar UVI is achieved with a radiative transfer model that requires the input of total ozone and the aerosol optical properties. A regression model is used to predict the total ozone using the input from ground-based ozone spectroradiometers or from satellites. A good cloud parameterisation is also required unless only clear sky values are reported.
**SUNTANNING MESSAGES**

- Tanning does not stop much UV radiation! Even when your skin is tanned, limit your exposure during midday hours, and continue to protect yourself.

- Don’t UV OD. Sunburn is literally an indication that your skin has overdosed on UV radiation so Slip! Slop! Slap! and Save Your Skin.

**SUN PROTECTION MESSAGES**

- Wear sunglasses, a wide-brimmed hat and protective clothing, and frequently apply sunscreen of SPF 15+ to protect yourself.

- Applying sunscreen is not a means to prolong your stay in the sun but to reduce the health risk of your exposure.

- Taking certain medications as well as using perfumes and deodorants can sensitize your skin, causing serious burns in the sun. Ask your pharmacist for advice.

- Sun exposure increases skin cancer risk, accelerates skin ageing and causes damage to the eyes. Protect yourself!

**PERCEPTION OF UV RADIATION**

- Cloudy weather doesn’t mean you can’t get burnt. It’s the UV radiation in the sun’s rays that burns you and causes skin cancer, and UV radiation can penetrate through cloud.

- Remember the sun does not need to feel hot to damage your skin and eyes. The damage is done by UV radiation, which is not seen or felt – so don’t be fooled by mild temperatures.

**ACTIVITY-BASED MESSAGES**

- If you’re out to watch or participate in (name of event), don’t forget your sunscreen, hat and long-sleeved shirt. That should be all you need to make sure all you go home with are great memories of today’s events – and not a nasty dose of sunburn.

- This is a great time to head to the ski slopes. High altitudes and fresh snow can double your UV radiation exposure, so wear sunglasses and sunscreen!

- Going on a sunny vacation? Make sure to pack your wide-brimmed hat, sunglasses and sunscreen.

- School break means fun in the sun for the lucky ones. If you’re one of them, remember to pack a hat, sunscreen and sunglasses.
• Springtime, gardening time. While tending your flower beds, don’t forget to protect your skin.

ENVIRONMENT-BASED MESSAGES
• Identify risky situations. If your shadow is short or if you are exposed for a long time – protect yourself!

• Watch out! A lot of UV radiation can pass through clouds.

• In the mountains, UV radiation levels increase by approximately 10% with every 1000 metres in altitude. Snow reflection can double the quantity of UV radiation you are exposed to.

• Fresh snow can double your UV radiation exposure, so wear sunglasses and sunscreen!

MESSAGES FOR CHILDREN AS A SPECIAL RISK GROUP
• Extended sun exposure during childhood increases the risk of skin cancer later in life and can cause serious damage to the eye.

• All children below age 15 have sensitive skin and eyes – protect them and set a good example for them!

• Children below one year of age must never stay in direct sun.

• The sun is getting stronger and children are exposed to its damaging rays during lunch and recess. Encourage your children to use sun protection and to take a break in the shade.

• Most of our lifetime UV radiation exposure occurs before age 18. Protect your children … their skin will be healthier and look younger throughout their lives.

• Parents – protect your children from the sun. Teach them about avoiding sun exposure and the proper steps for sun protection.

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