



FACT SHEET

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Ultraviolet Radiation

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A large body of research indicates that exposure to ultraviolet (UV) rays damages the body's largest organ, the skin. Sun exposure can be related to forty pathological skin conditions including phototoxicity (extreme sunburn acquired during brief exposure to UV light while on certain medications), photoallergy (skin rash), and basal cell and squamous cell carcinoma.

Yet, the sun product industry is a more than \$5 billion industry that markets tanning products, tanning salons, and other tanning enhancement goods. With such a large economic entity in direct conflict with health practice, it is important for individuals to understand the source of health recommendations. This fact sheet will examine UV exposure based on research about health and cancer risk reduction.

In addition, this fact sheet will define the different types of UV rays, outline health consequences that current research relates to sun exposure, and describe steps you can take to minimize your risk.

What Are Ultraviolet Rays?

The invisible ultraviolet spectrum makes up one specific portion of sunlight. This unique portion accounts for three percent of all solar radiation reaching the earth. UV light is measured as wavelengths of light in units of nanometers (nm). Three types of UV light have been identified:

- UVC—Many scientists rate wavelengths in the C range of the ultraviolet (UVC) solar spectrum, between 100 and 280 nm, as the most carcinogenic. The ozone layer absorbs most UVC rays. However, recent research indicates that the ozone layer may be depleted in certain areas by chlorofluorocarbons (CFCs, chiefly used in refrigerators, air conditioners, and Styrofoam insulation).
- UVB—Wavelengths in the B range of the ultraviolet (UVB) solar spectrum, measured at between 280 and 315 nm, is the primary cause of sunburn and skin cancers.

- UVA—Wavelengths in the A range of the ultraviolet (UVA) solar spectrum, between 315 and 400 nm, may be up to 1,000 times more intense than UVB. UVA light can penetrate to underlying tissues of the skin and cause photoaging or long-term skin damage.

UVB and UVA light exposure triggers the movement of skin pigment, or melanocytes, toward the surface of the skin, along with the production of additional melanocytes, producing a "tan." Within the health arena, some of the sunlight recommendations can be confusing and even contradictory. For example, limited exposure to sunlight has some beneficial attributes. The body makes vitamin D naturally from exposure to sunlight. Vitamin D is the nutrient responsible for strong bones. Researchers believe exposure to 15 minutes of sunlight in the morning and 15 minutes of sunlight in the afternoon will provide the body with enough sunlight for the adequate manufacture of bodily vitamin D.

However, research also indicates that extended exposure to UV radiation causes many health problems. Ultraviolet radiation alters the body's immune responses and makes it more susceptible to infections. Many genes and several viruses, from herpes simplex to HIV, are activated by ultraviolet radiation. So, UV exposure may speed up the development of AIDS in people who are HIV positive. Ultraviolet radiation also decreases the effectiveness of vaccines.

Medical evidence suggests that the sun's harmful ultraviolet rays damage the skin and eyes. Moreover, this harm accumulates during one's lifetime. UV radiation causes premature aging of the skin (wrinkles, dryness, and age spots), cataracts (a permanent clouding of the eye), and immunosuppression (lowered resistance to infection). It also causes cell mutation, a change in the gene of a cell, which is one of the fundamental premises of cancer cell generation in the skin, and, in fact, anywhere in the body. This year alone, more than one million cases of basal cell and squamous cell skin cancer will occur

in the United States, of which an estimated 90 percent could be prevented by better protection from the sun.

Research and Debate

Exposure to the ultraviolet component of sunlight may be associated with an increased risk for some skin cancers. The rise in skin cancer, which some experts are calling an epidemic, is the source of controversy. Among Caucasian Americans, the incidence of melanoma, a type of skin cancer, doubled from 1973 to 1991. But some experts are claiming that this apparent rise has been artificially inflated by positive steps in health care such as better record-keeping, increased reporting, and earlier diagnosis. However, if the incidence of skin cancer is actually increasing, some possible causes include ozone depletion, sun-worshipping behavior by Americans, and a general lack of understanding of risk factors.

Despite popular beliefs that a “tan” enhances appearance, “tanned” skin is damaged skin for Caucasians. The UVB range is thought to elicit most skin cancer, while the UVA range penetrates deeper, causing wrinkles. As early as 1987, a Harvard Medical School study indicated that melanoma may be related to intermittent blistering sunburns, particularly if the sunburns occurred before the age of 20. This study suggests that a serious sunburn may alter the genetic material of the pigment cells in the skin of a growing child, leading to the formation of unstable moles which have the potential to become malignant.

Is prevention of skin cancer even feasible? Researchers are working to determine what types of early detection programs will be most successful, and what obstacles need to be overcome.

Skin Cancer

Fifty percent of all individuals who reach age 65 will develop at least one form of skin cancer, making skin cancer the most common of all cancers. Furthermore, one in five adults alive today in the United States will develop skin cancer during his or her lifetime. Skin cancer linked to sun exposure comes in several varieties including those listed below.

Basal Cell Cancer

This most common type of skin cancer first appears as a hard, raised, red or red-gray pearly lesion most often on the head or the neck, rarely on the trunk. Basal cell cancer can bleed, scab, or crust over if injured. This form of cancer eats away at healthy tissue. Basal cell cancer seldom metastasizes (spreads). Virtually no one dies of basal cell skin cancer.

Squamous Cell Cancer

Most often occurring on exposed areas of the body, such as the ears, lower lip, backs of the hands, or the tip of the nose, squamous cell cancer usually appears as a red, rough, raised lesion, with crusting or scaliness. This type of cancer

sends out roots that can spread to other areas. Deaths from squamous cell carcinoma are exceedingly rare, accounting for only one-tenth of 1 percent of cancer deaths each year in the United States.

Keratoacanthoma

Keratoacanthoma is often difficult to distinguish from squamous cell cancer. A dome-shaped mass on a sun-exposed area may suddenly develop and enlarge rapidly. Keratoacanthoma frequently has a dark, thickened plug or a center of dead and decaying skin cells.

Malignant Melanoma

Melanoma consists of melanocytes, or pigment cells, which have been transformed into cancer cells that grow uncontrollably. This disease attacks the melanocytes of the skin, eye, and mucous membranes. Melanoma cells usually continue to produce melanin, or skin pigment, which causes these cancers to be mixed shades of tan, brown, and black. While melanoma may appear suddenly in the skin without warning, it may also begin in or near a mole or other dark spot in the skin.

Melanoma can spread rapidly and cause death within months of detection. A 1990 study conducted by the National Cancer Institute (NCI) found that rates of melanoma increased by nearly 80 percent between 1973 and 1987, or at a rate of about 4 percent each year. A person born today is 12 times as likely as someone born fifty years ago to develop malignant melanoma.

Fortunately, melanoma is highly curable when detected early and treated properly. While melanoma accounts for 75 percent of the nation’s skin cancer deaths, the five-year survival rate is 85 percent, up from 72 percent in 1973. Early treatment provides even better results. Patients treated when the melanoma is localized have a 93 percent survival rate.

Eye Damage

UV exposure can cause health concerns other than cancer. Cumulative damage from repeated UV exposure may contribute to chronic eye disease. UV rays can harm the cornea—the transparent front part of the eye. Because long-term sunlight is thought to cause cataracts or clouding of the lens of the eye, UV-protective sunglasses are recommended. UV exposure is also a risk factor in the development of pterygium, a fleshy growth that invades the corner of the eye; and degeneration of the macula lutea, the small yellowish area lying slightly to the side of the center of the retina that constitutes the region of maximum visual acuity.

The most dramatic example of eye damage from sunlight is solar retinopathy, caused by gazing directly into the sun. This condition results from irradiation of the retina by high-energy wavelengths of visible blue light (around 500 nm) and lower levels of UVA or near-UV radiation of 320

to 400 nm. Retinal injury may be reversible but can lead to permanent loss of vision.

Solar retinopathy can occur in sunbathers and people who attempt to view a solar eclipse directly. Since no sunglasses protect against this damage, children must be taught never to look directly at the sun, even when wearing sunglasses.

What Contributes to Risk?

The skin is able to tolerate only so much sunlight over the course of a lifetime. After absorbing a maximum lifetime amount, damage is inevitable. The amount of sun each person can tolerate is based on genetics and skin color, but it is best not to test one's tolerance level. A single sunburn can permanently damage skin and can result in skin cancer 10 to 40 years later. Because this early damage can have long-term effects, it is very important for children to wear protective clothing and sunscreen. Even if cancer does not result, sunlight eventually contributes to wrinkles, muddy skin color, and age spots. Lifestyle seems to be the most important factor in determining who will be most likely to develop illnesses related to UV exposure. Those who spend lengthy time in the sun, or those who live at a high elevation or near the equator where UV levels are increased, are at the greatest risk. In addition, people taking photosensitizing drugs, such as tetracycline, phothiazine, allopurinol, doxycycline, or psoralens, can be more sensitive to light. Cataract surgery patients can experience an increase in the effect of sun on their eyes.

High-risk population subsets are women and younger persons. While subtle damage occurs whether an individual burns or not, people living in areas with fewer sunny days may experience more sunburns, and more damage, due to their lack of experience with the sun. Also at particularly high risk are Caucasians or light-skinned persons living in areas where intentional tanning is an accepted practice.

External Conditions

Several external conditions influence the intensity of ultraviolet radiation that reaches our skin. One important factor is the time of year. For the northern hemisphere, radiation levels peak on June 21; lowest levels occur on December 21. Also influential is time of day. The maximum UV radiation level occurs when the sun reaches its highest point in the sky (solar noon), and decreases until it is about 50 percent of this level three hours before or after the sun reaches its peak.

Latitude causes locations nearer the equator to receive greater UV radiation due to the more direct angle of the sun. As one travels from north to south, the sun's intensity increases along with the rate of skin cancers related to UV rays. Remember, changes in latitude occur within the United States from north to south, so exposure can change in intensity while traveling on vacation, for example. Higher elevations receive greater levels because the thinner atmosphere screens

out less radiation. The intensity of UV rays increases four percent for every 1,000-foot increase in elevation.

Atmospheric ozone absorbs UV radiation, reducing the amount that reaches the earth. The level of ozone varies daily due to chlorofluorocarbons, stratospheric pressure, weather circulation patterns, and temperature changes. Thicker clouds cause less radiation to reach the earth. However, 60 to 80 percent of UV rays penetrate thinner clouds. Ultraviolet light penetrates through clouds, which is why farmers and others active outdoors can develop sunburns even on cloudy days. Reflective surfaces such as water and newly fallen snow increase UV levels. UV rays can penetrate water. UVA is not blocked by glass, while UVB is blocked. Air pollution can also reduce UV levels.

Minimizing Your Exposure

Because people receive 50 to 80 percent of their lifetime ultraviolet exposure by age 18, children are most vulnerable. Parents should be especially vigilant in protecting infants, toddlers, and young children from sun exposure. Persons with extra sensitive skin and all infants should always be protected from prolonged sun exposure.

Where there is snow cover, water, sand, or pavement, reflected UV may be quite strong. Sunscreen and sunglasses should be worn by individuals who must be in these locations.

For many, unprotected exposure can cause a burn in only 30 minutes. Using sunscreen of at least 15 sun protection factor (SPF) and wearing a hat are good precautions. Because a baseball cap affords only protection to the face, not the ears and neck, a full-brimmed hat is recommended.

Limit your exposure during the middle of the day, particularly at noon, when many people can burn in less than 15 minutes. Farmers, landscape/turf laborers, and people with other outdoor occupations who must be in the sun between 10:30 a.m. and 3:30 p.m. are at great risk. If you must be outdoors during midday, wear protective clothing, including a wide-brimmed hat and sunglasses, and apply a sunscreen of at least 15 SPF frequently.

Sunscreen

Sunscreens block both UVA and UVB rays either by reflecting them away or by absorbing the ultraviolet rays and converting them into harmless heat. Recent skepticism about the effectiveness of sunscreen centers on the fact there is no evidence sunscreen prevents cancer. While sunscreens may protect against UV-induced inflammation and other types of skin damage, they may not necessarily prevent UV suppression of immune processes that normally prevent development of melanoma. Furthermore, individuals wearing sunscreen may feel artificially safe and prolong their outdoor activities, resulting in excessive exposure to wavelengths of sunlight that sunscreen does not block. Better indicators for determining

an advisable length of time in the sun are an evaluation of family history for skin cancer and the individual's skin color, with lighter skin tones tolerating less exposure.

A sunscreen's SPF measures how well the product blocks the UVA range of light. The original thinking assumed that if your skin sunburns after one hour without protection, then an SPF of 15 would allow 15 hours of exposure before sunburn. Now dermatologists recognize that a number 15 blocks about 90 percent of UVA, while a number 30 blocks approximately 97 percent. Number 15 is considered the minimum effective sunscreen. Most dermatologists advocate a number 30 or higher for episodes of significant sun exposure. Though the recent SPF war among sunscreen brands has driven ratings to all-time highs, no scientific research supports sunscreens stronger than 30 SPF. Whatever type you use, apply sunscreen liberally and often.

For those participating in outdoor sports and for agricultural workers, all-day, six-hour or eight-hour, waterproof, sweatproof brands of sunscreen with SPFs of at least 30 are recommended. These won't sting the eyes, which is particularly valuable in sports such as shooting or fishing where precise vision is essential, and they are generally removed with soap and water. Only a few are "rubproof," which means in most cases simply wiping away sweat can remove needed protection. Therefore, don't completely rely on eight-hour protection. Reapply sunscreen every two to four hours.

Label claims regarding sunscreen products can be confusing. P-aminobenzoic acid (PABA), once a frequent ingredient in sunscreens, has virtually disappeared because it stains clothing and causes allergic skin reactions. PABA, by itself, is a poor sunscreen, so a "PABA-free" product will likely be as effective as a product containing PABA. PABA has been replaced by skin-friendly Parsol 1789, oxybenzone, Octyl Methoxycinnamate and a brand new ingredient, Mexoryl SX.

If duration of effectiveness is not listed, "water-resistant" simply means the sunscreen works for only 40 minutes in water or sweat. The term "waterproof" should yield 80 minutes of protection. Finally, be careful with products labeled "all-day," since the fine print may indicate that reapplication

is needed after water exposure. Six-hour or eight-hour waterproof brands appear to stay on the longest.

"Sport" sunscreen formulations include a special polymer that binds to skin and can stay on even if you sweat or go swimming. However, even these formulations need to be reapplied frequently. Most sport sunscreens are relatively odorless, especially gels.

None of the extended-wear sunscreens seem to attract wasps, mosquitoes, or bees. If stinging insects are a concern, be aware that sunscreens mixed with insect repellents, moisturizers, or tanning creams are not six-hour or eight-hour, waterproof, sweatproof products.

Individuals with skin sensitivities should choose "chemical-free" sunscreens, all of which have the words "titanium dioxide" on the label. These products have a micro-fine powder that coats the skin. However, most offer only a maximum SPF of 17 and are not six-hour or eight-hour protective.

Sun Safety Steps

- It is especially important to protect babies and young children from sun exposure.
- Wear sunscreen with number 30 SPF or above.
- Use six-hour or eight-hour waterproof brands.
- Remember waterproof or sweatproof sunscreens are not necessarily rubproof.
- Apply sunscreens liberally.
- Wear broad-brimmed hats, but remember hats and shade do not protect from reflected UV rays.
- Remember the sun is strongest from 10 a.m. until 3 p.m.
- Remember most sunscreens take 5 to 15 minutes to adhere; avoid water and sweating for that time.
- Do not use tanning beds because of the high levels of UV radiation involved.
- Tightly-woven fabrics, such as cotton denim, give the best protection from UV rays.
- Wear wrap-around sunglasses or sunglasses with side panels.

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