A LOOK AT THE SAFETY AND EFFICACY OF SUNSCREENS

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ABSTRACT

Many health care professionals advise the use of sunscreen products to prevent skin damage caused by ultraviolet radiation (UVR) from sunshine. Given the continuing effort to promote sunscreen usage, there is a need to learn more about the effectiveness and safety of these products. The sun protection factor (SPF), which is used to determine sunscreen effectiveness, is a good way to evaluate UVB (290-320 nm) filters. The SPF test, on the other hand, does not properly evaluate sunscreens' entire photoprotective profile, particularly against long wavelength UVAI (340-400 nm). Furthermore, despite the immediate and apparent consumer demand for sunscreen products that offer broad-spectrum UVB and UVA photoprotection, there is no one, agreed-upon technique for assessing UVA effectiveness. The following list of widely used organic and inorganic sunscreens has good toxicological profiles based on acute, sub chronic, and chronic animal or human research. Furthermore, sunscreens have been proven to protect against the harmful effects of UVR exposure in the majority of investigations. As a result of this analysis of presently available evidence, it has been determined that sunscreen components or products do not pose a risk to human health. Furthermore, as part of a larger plan to decrease UVR exposure, frequent use of suitable broad-spectrum sunscreen products may have a substantial and positive effect on public health.

KEYWORDS: *Efficacy, Safety, Sunscreens, Sun Protection, Short Wavelength, UVR.*

1. INTRODUCTION

For decades, the incidence of non-melanoma and melanoma skin cancers has been rising in most areas of the globe. UV radiation (UVR) from the sun is a factor in both acute and chronic skin damage, as well as skin malignancies. As a result, the medical profession and other health care providers have pushed for a photo avoidance approach that includes minimizing sunlight exposure between 1100 and 1500 hours, wearing protective clothes, and using sunscreens. Because sunscreens protect against sunburn and their usage is promoted, it has been proposed that sun exposure may be increased because users think they are protected and therefore spend more time in the sun. This possible outcome raises a number of additional issues(1–4). Because most sunscreens are mainly UVB (290-320 nm) and, in some instances, short wavelength UVAII (320-340 nm) filters, the UVR spectrum to which the skin is exposed alters as a result of their usage. As a consequence, if sunscreen usage alters behavior, resulting in longer durations of sun exposure, the dosage of long-wavelength UVR, 340 nm and higher, will rise(5,6).

Furthermore, although sunscreens protect against sunburn, nothing is known about the threshold or dose-response for UVR-induced effects on other endpoints including immunosuppression or DNA damage. Finally, as sunscreens become more widely used and accessible, concerns about their long-term safety, especially in the presence of UVR, have arisen. The goal of this study is to address these issues with concrete evidence wherever feasible and to explore strategies to enhance sunscreen products(7–9). To that aim, it seems that certain fundamental ideas about the complexity of UVR and its effects on skin are required. Following an examination of the effects of UVR on exposed skin, the implications of incorporating sunscreens into this complex interplay will be examined. UV (100400 nm), visible (400-780 nm), and infrared (780-5000 nm) are all types of non-ionizing electromagnetic radiation (EMR) emitted by the sun. UVR is the most important and worrying type of EMR in terms of human health (4-6). UVC (100-290 nm), UVB (290-320 nm), and UVA (300-400 nm) are the wavelengths of ultraviolet light, which are further split into UVC (100-290 nm), UVB (290-320 nm), and UVA (300-400 nm) (320400 nm). UVC from sunlight is of little practical significance since wavelengths below 290 nm are absorbed by atmospheric ozone and do not reach the earth's surface(10).

As previously mentioned, the sun is the main source of UVB and UVA radiation, and exposure to it is generally inevitable. Seasonally, regionally, and diurnally, the quantity of UVR reaching a particular place on Earth fluctuates. UVR intensity, for example, is greatest near the equator and at high altitudes, and diminishes as latitude increases. UVB intensity is greatest during the summer months and between 1100 and 1500 hours on a daily basis(11). UVA intensity, on the other hand, is more constant throughout the day and from season to season than UVB. Cloud cover, pollution, humidity, and temperature, as well as meteorological and atmospheric variables, alter the spectrum and intensity of terrestrial sunlight, especially the UV component(12).The majority of people in industrialized nations are exposed to solar UVR in brief, repeated episodes to the face, neck, and hands as a result of daily living. This unintentional exposure may account for up to 80% of an estimated annual UVR exposure, and it's no coincidence that over 60% of no melanoma skin cancers (NMSC) develop at these locations. UVR exposure has immediate, long-term, and delayed impacts on the skin. UVR-induced skin impacts include acute reactions such as sunburn, pigmentation, hyperplasia, immunosuppression, and vitamin D production, as well as long-term consequences such as photo carcinogenesis and photo aging(13–15).

The spectrum and cumulative dosage of UVR determine these acute and chronic effects; however, the full action spectrum for the majority of UVR-induced effects in human skin has yet to be identified. Furthermore, and perhaps most significantly, these responses have distinct thresholds, such that preventing UVR-induced alterations for one endpoint does not ensure the same degree of protection for another. Regardless, it's important to remember that UVR exposure causes greater skin damage in unprotected skin than in sunscreen-protected skin since UVR's acute and chronic effects are dosage, duration, and wavelength dependent, and sunscreens, in the most empirical terms, decrease UVR exposure(16). The following research suggests that exposure to UVR from sunshine induces NMSC. In contrast to NMSC, the evidence supporting sunlight exposure as a risk factor for the development of malignant melanoma is more complicated. Nonetheless, epidemiological data supports the significance of UV exposure as a risk factor for melanoma, especially severe sunburn in infancy. Sun sensitivity, which includes pigmentation characteristics like eye, hair, and skin color, as well as skin response to sun exposure, such as failure to tan and intermittent exposure to strong sunlight, are significant predictors of melanoma risk. UVB-mediated mutations are almost absent in melanomas, in contrast to NMSC, suggesting different processes are responsible for the formation of these skin malignancies(17). Chronic exposure to solar UVR is believed to hasten the aging of human skin, similar to skin cancer. Dryness, roughness, uneven pigmentation such as freckling lent genes, actinic keratosis, wrinkling, elastosis, inelasticity, and sebaceous hyperplasia are all signs of skin photo aging(18).

2. DISCUSSION

According to human and animal research, the incidence and severity of skin photo aging is a function of cumulative UVR exposure. Caucasian women with a history of high UVR exposure, for example, have a greater incidence of photo aging than women with a history of low UVR exposure. Furthermore, indications of photo damage on the face are absent in unexposed skin, such as the inside part of the arm, of the same person. Importantly, photo aging is distinct from chronological or intrinsic skin aging, and it may be delayed or reversed by lowering UVR exposure, as with sunscreens, or by alternative therapies like all-trans-retinoic acid. The decrease of UVR exposure, particularly UVB and UVA, mainly from the sun, is the focus of sunscreen-mediated photo protection. Organic and inorganic sunscreen agents are divided into two groups. Soluble or chemical sunscreens are the names given to organic sunscreens. Physical, mineral, insoluble, natural, and nonchemical are all terms used to describe inorganic sunscreens. Despite the fact that the word "nonchemical" is a clear misnomer, it has acquired some consumer acceptance. Although the difference between these two types of sunscreens is rather arbitrary and dependent on mechanism, we will adopt it for the purposes of this review and examine each individually.

Organic sunscreens have been the standard for decades, and although inorganic sunscreens are becoming more popular, organic sunscreens are still used in larger quantities. Anthranilates, benzophenones, camphor’s, cinematic, dibenzoylmethanes, p-aminobenzoates, and salicylates are all common ingredients in organic sunscreens. These aromatic compounds absorb a particular section of the UVR spectrum, which is then re-emitted at a less energy, longer wavelength, such as heat or light, or utilized in a photochemical process like cis-trans or ketone photochemical isomerization. Five of the nine sunscreens are used worldwide, and five of them account for the bulk of sunscreen products. Because no single organic sunscreen ingredient can offer a high UV protection factor at the levels presently permitted by the US Food and Drug Administration, organic sunscreens are nearly always used in combination (SPF).

Furthermore, individual organic sunscreens have a limited absorption range, which may be widened by combining them. Depending on the intended product use, recreational or everyday photo protection, and desirable characteristics such as waterproof or sweat-proof, certain mixtures of organic sunscreens are commonly employed. In recent years, sunscreen solutions that combine organic and inorganic sunscreens have grown more popular. Inorganic sunscreens have been more popular in beach and everyday UV protection products during the last decade. This is due in part to their safety and efficacy, especially in blocking UVA, as well as concerns about organic sunscreens' possible side effects.Organic sunscreens may be influenced by light energy, while inorganic sunscreens are usually regarded as innocuous pigments that cannot penetrate the skin and are mostly unaffected by it. Titanium dioxide (Ti02) and zinc oxide are the two most frequently used inorganic sunscreens (ZnO). Although the appearance and attenuation spectra of these two metal oxides are quite different, they have certain common characteristics that are briefly described. Zinc oxide and titanium dioxide are odorless white powders with a Gaussian or normal particle size distribution. Micro fine powders, which are employed in sunscreens, have an average particle size of 0.20 pm (micron) or less and a narrow, well-controlled distribution. Micro fine powders, in contrast to conventional pigment grades of these metal oxides that have been used in beauty goods for years, do not include smaller particles; instead, the lower end of the usual particle size distribution is enhanced via specific production methods.

In other words, micro fine powders have always existed in ZnO or Ti0-containing products, but they were visually obliterated by bigger particles. As a result, micro fine particles are just a refinement of the current particle size distribution, rather than a completely new particle size.Each particle has a maximum scattering size for visible light. This is the perfect size for white or colorful pigments. Any color imparted to the product by an ingredient, on the other hand, is undesired in a sunscreen. As a result, the average particle size of a metal oxide is decreased below the optimum light scattering size, enabling visible light to pass through and making it almost undetectable on the skin. This feature has been exploited to produce the micro fine metal oxides that are now extensively used in sunscreen and everyday skin care formulations. To assist in dispersion, zinc oxide or TiOz is often coated with other compounds such as silicones, fatty acids, or oxides of aluminum, silicon, or zirconium. Paint manufacturers created the coatings to minimize particle agglomeration, which optimizes particle dispersion when applied as a thin layer on a surface.

The appropriate coating increases particle compatibility with the dispersion medium, resulting in improved aesthetics and lower processing costs. Furthermore, covering the metal oxides may minimize any possible light reactivity. Sunscreens are one-of-a-kind products in that their effectiveness is guaranteed if correctly applied. This guarantee is based on their capacity to prevent sunburn, which has previously been the criteria used to assess these goods. However, as described in this article, this single criterion does not seem to be adequate for future sunscreen product assessment. The requirement for broad spectrum UVB and UVA photo protection products supports this viewpoint. Nonetheless, unlike any other OTC medication, the finished sunscreen product is effectiveness evaluated before being distributed to consumers. The techniques for evaluating the effectiveness of sunscreens will be discussed briefly.

The effectiveness of the product is undeniable: sunscreens prevent sunburn. For this aim, the selection of a sunscreen or combination of sunscreens, as well as the resulting formulation, is developed and assessed. The ratio of sun exposure that skin can take before blistering or mild erythema is seen with and without sunscreen protection is defined as the SPF for a sunscreen. As a result, SPF is the true sunburn protection factor. Because the action spectrum for UVR-induced sunburn is comparable to that for a particular measure of DNA damage, it's been assumed that sunburn protection is the same as DNA damage protection and a variety of other endpoints(19). As previously stated, each biological reaction has its own action spectrum, and even when various responses have similar action spectra, the threshold, dose-response, or both to UVR may vary significantly. As a result, although SPF is useful for sunburn prevention, its use for other endpoints is limited, and it may be deceptive(20). When the SPF system was created, it was widely assumed that the UVR-related skin alterations or damaging action spectrum was comparable to that of erythema in human skin. The action spectrum of NMSC in rats, for example, is comparable to that of erythema in human skin. Of course, we now know that other endpoints, such as photo aging and perhaps melanoma, have different action spectra than erythema.

Because SPF measures erythema and UVA is only slightly erythrogenic, it's clear that SPF alone is insufficient to characterize a sunscreen's protective profile. In practical words, an SPF 15 sunscreen that blocks just a small amount of UVAII (320-340 nm) and practically no UVAI is feasible (34MOO nm). Surprisingly, the majority of sunscreen products on the market in the United States currently fit this description. The ideal UVA photo protection test would include a biological event that is known to be mediated by these wavelengths as an outcome. Unfortunately, no endpoint has been agreed upon as a suitable surrogate for UVA occurrences to yet. Several in vivo tests have been suggested, however they have not been generally accepted. For instance, instantaneous pigment darkening. In vitro experiments have also been reported, the majority of which are based on spectrophotometric data that have been manipulated. Based on the techniques described, one of them, the critical wavelength (CW), has been suggested to assess sunscreens for their UVA absorption.Using a light source with a constant output throughout the terrestrial UVR spectrum, the transmission through a substrate, both with and without the sunscreen, is measured on a wavelength-by-wavelength basis.

The sunscreen's attenuation spectrum is then calculated. Importantly, prior to attenuation testing, the sunscreen may be exposed to a preirradiation phase, which will evaluate the product's photo instability. The CW is the wavelength that yields 90% of the entire area under the attenuation spectrum between 290 and 400 nm. This technique offers a qualitative method for determining a sunscreen product's UVA attenuation.

Given the present need for broad-spectrum UVB/UVA sunscreens and the lack of a meaningful and clinically viable biologic marker, it would seem prudent to demonstrate, at the very least, that the sunscreen attenuates the appropriate range of radiation. To that aim, proponents of the CW technique emphasize its ease of use, repeatability, and ability to account for product photo instability. However, opponents argue that the test's human relevance is questionable since it is an in vitro test with no biological goal. Sunscreens are rapidly being incorporated in a variety of consumer goods, in addition to conventional recreational and everyday photo protection solutions. As a result, concerns have been expressed about their long-term safety, especially in the context of UVR exposure. As a result, the purpose of this section is to address some contemporary concerns about sunscreen safety. This is not a complete assessment of all published research on sunscreen safety; rather, it is an effort to compare and contrast in vitro and in vivo findings. It's critical to understand the difference between long-term safety issues and short-term unfavorable responses. Organic sunscreen sensitivities, both photo- and non-photo induced, are extensively reported and seem to be uncommon occurrences, but there is few published research, making it impossible to determine the true frequency.

3. CONCLUSION

UVR exposure is related to NMSC and may play a role in the development of melanoma. Sunscreens consistently and unambiguously reduce the quantity of UVR that the skin is exposed to. UVB protection is good in the past and most contemporary sunscreens, but UVA, particularly

UVAI, attenuating chemicals are lacking. By integrating newly accessible long UVA blocking chemicals, newer sunscreens are being developed that cover nearly the full UV spectrum. Although more research is needed, current in vivo animal and human studies are surprisingly similar in their conclusions that sunscreens are both safe and effective. Sunscreens, once again, have been criticized for blocking just a part of the UVR spectrum. This should no longer be a problem now that genuine broad-spectrum protection is available. Sunscreens, on the other hand, may be dangerous because of their potential to alter our behavior and transform us into "mad dogs and Englishmen" who walk out in the midday heat. As a result, sunscreens are just one component of a comprehensive sun protection plan that includes appropriate clothes, hats, sunglasses, avoiding the sun during peak hours, and, most importantly, education. We think the present skin cancer pandemic will continue until the concept of a good tan is eradicated from the western mind.

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