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Editorial

Sunscreens: some practical issues

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The concept of sunscreen was first introduced in 1928. In 1972, the US Food and Drug Administration (FDA) changed the status of sunscreens from cosmetics to over-the-counter (OTC) drugs. Since then it is regarded as an integral part of photoprotection strategy (**Box 1**).[1] As the public awareness about role of ultraviolet light in the causation of sunburn, facial dyschromia, photoaging and oncogenesis is on rise, sunscreens are being increasingly prescribed for photoprotection.

Box 1 Complete photoprotection strategy

- Shade
- Protective clothing
- Wide-brimmed hat
- Sunglasses
- Sunscreen

The quest for an ideal sunscreen still continues. An ideal sunscreen should provide uniform protection across the range of ultraviolet B light (UVB) and ultraviolet A light (UVA). This property is called spectral homeostasis.[2,3] It should also have aesthetically pleasing composition and acceptable sensory and tactile profile that enhances user's compliance.

Ultraviolet filters are broadly of two types, inorganic (physical) or organic (chemical). Organic filters are further categorized as UVB and UVA filters. In order to absorb ultraviolet radiation (UVR), an organic ultraviolet (UV) light filter must contain a suitable chromophore. Absorption of a UV photon transfers the chromophore into an excited electronic state. If the absorbed energy is not sufficiently and speedily dissipated into heat, chemical bonds of the UV absorber may break resulting in degradation of UV filter.[4] Larger the chromophore, the more absorption will be shifted towards longer wavelength. This is the reason that UVB light filters have smaller molecular weights compared to UVA or broad spectrum filters.[5] These UV filters include titanium dioxide (TiO_2) and zinc oxide (ZnO). They act mainly by absorbing UV light with some scattering effect.[6] These UV filters were introduced to allow high sun protection factor (SPF) products to be developed with relatively lower concentrations of UV filters. Examples are methylene bis-benzotriazolyl tetramethylbutylphenol (biscotriazole) and tris biphenyl triazinc.[7] Better film forming of sunscreen on skin leads to a more uniform distribution and therefore to a higher SPF.

Many UV filters e.g. avobenzone, padimate O, octinoxate etc. are photounstable and degrade on UVR exposure. The addition of photostable organic UV filters to stabilize photounstable UV filters leads to a higher SPF and better UVA protection. The emollients, photostablizers and other ingredients are also UV absorbers.

Due to removal by rubbing, water and sweat

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exposure and uneven distribution due to movement of sunscreen towards follicular openings, FDA recommends a 2-hourly reapplication of sunscreen.

In a study on antiinflammatory properties of UV filters the authors concluded that many of common UV filters e.g. oxybenzone have antiinflammatory properties which may independently contribute to reduce UVR-induced erythema.[8] Similarly, antioxidants incorporated into sunscreens have potential to neutralize cytotoxic effects of reactive oxygen species generated by UV exposure.[9]

The SPF and the UVA-protection factor (UVA-PF) are the two common indices used to quantify the efficacy of sunscreens. SPF is calculated as the ratio of minimal erythema dose (MED), the smallest UVB dose that produces perceptible erythema with clearly defined borders at 16 to 24 hours after UV exposure, of a patient's sunscreen protected to that of unprotected skin.[10] UVA-PF is measured as dose of UVA required to induce persistent pigment darkening observed 2-24 hours after exposure of sunscreen-protected skin compared to that of sunscreen-unprotected skin. Practically, however, patients apply sunscreen in concentration of 0.5-0.8mg/cm^2, much lower than the recommended concentration i.e. 2mg/cm^2. Hence, the in-use SPF is much lower than the label SPF.

To maximize advantage, sunscreens should always be used in conjunction with other photoprotective measures (**Box 1**) and in sufficient density i.e. 2mg/cm^2. It is advisable that one teaspoonful of sunscreen be used over face/head/neck, one teaspoonful each upper extremity, a total of two teaspoonful to front and back torso and two teaspoonful to each lower extremity.[11] In addition sustained efforts in imparting public education are essential to avoid unnecessary sun exposure even after proper application of sunscreen.

Although meant for protection, UV filters can cause both allergic and photocontact dermatitis, latter condition occurs more frequently, but these side effects are very uncommon. Photoallergic contact dermatitis from sunscreens occurs from organic UV filters, with benzophenone-3 (also known as oxybenzone) being the most common cause.[12]

Still remains there a theoretical concern about inadequate vitamin D synthesis following sunscreen use. Strict photoprotection and adequate use of sunscreens may be associated with vitamin D insufficiency. However, normal usage of sunscreen does not generally result in vitamin D insufficiency, probably for the reason that individuals do not apply adequate amount of sunscreen (i.e.<2mg/cm^2).[13] For elderly patients and those showing strict photoprotection, a balanced diet and daily 600 IU vitamin D along with 1g calcium supplementation is recommended.

Another debatable issue in the past had been that sunscreen use may increase incidence of melanoma; however, no credible evidence supports this notion. Presently, nanoparticle forms (<100nm size) of ZnO and TiO2 have replaced microparticle forms. These nanoparticles can generate free radicals in the presence of UVL and cause cell damage. The current data do not support this; nonetheless, this issue needs further exploration.

According to epidemiologic data the childhood sun exposure increases the risk of cutaneous carcinogenesis in adulthood.[14] American Academy of Pediatrics recommended that prevention is the first line strategy against solar

UVR damage with sunscreen used as adjuvant measure.[15] Because of higher body surface area-volume ratio of children and unique microstructure of immature skin suggest that children especially infants absorb a greater fraction of topically applied sunscreen.[16] Their capacity to metabolize and excrete absorbed substances is not fully developed hence putting them at risk for side effects not seen in adults. Due to the lack of penetration of inorganic UV filters,[17] it is suggested to use the sunscreen with only inorganic UV filters in children of less than 2 years of age.

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