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Narrative Review

Current Advances in Photoprotection

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ABSTRACT

The author provides an up-to-date overview of the best photoprotection strategies to adopt during childhood to prevent acute and long-term health damage related to inappropriate sun exposure.

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Introduction

The spectrum of solar light encompasses ultraviolets (UV), infrared rays and visible light. Damage of the skin due to sun exposure is mainly caused by ultraviolet A (UVA) and ultraviolet B (UVB) that have been shown to increase the risk of developing multiple skin damagies including photodistributed pigmentary alterations, nevi, and skin malignancies (1, 2). Ultraviolet C rays are almost fully absorbed by the ozone layer. UV levels are higher as altitude and sun height increases, and cloudiness and latitude decrease. Other environmental factors that increase UV levels are the ozone layer and the reflective capacity of the Earth's surface: for example, snow reflects 80% of UV rays and dry sand about 15% and sea water foam 25%. The photoprotection of the healthy child must also evaluate the Fitzpatrick skin phototypes (Table I) (3).

Table I. *Fitzpatricl Scale. A numerical system used to classify a person's skin type based on its response to ultraviolet light.*

Fitzpatrick Scale					
I	**II**	**III**	**IV**	**V**	**VI**
Very Fair Always burns Cannot tan	**Fair** Usually burns Sometimes tans	**Medium** Sometimes burns Usually tans	**Olive** Rarely burns Always tans	**Brown** Rarely burns Tans easily	**Dark Brown** Never burns Always tans

Moreover, children spend a lot of time outdoors They tend to stay in the sun longer than necessary. The daily exposure to UV rays during recreational activity of kindergarten children is higher than that of outdoor workers and retirees. At 18 they have consumed 50% of the sun quota of life.

Photoprotection and educational campaigns

Photoprotection is defined as the prevention against damaging effects of intense solar radiation. Photoprotection includes avoiding the sun, staying in the shade when outdoors, wearing photoprotective clothing including a wide-brimmed hat, and sunglasses, and the use of sunscreens (2). Photoprotection is particularly important in the pediatric age as the first sun exposures are essential for life. In fact, sunburn in childhood is an important risk factor for the future development of skin cancers and should be avoided. Avoidance of the use of tanning beds is an important component of education for teenagers. Children's skin is more susceptible to sun damage for a number of reasons, including certain anatomical and functional aspects in children under 2 years of age and habits that predispose to greater sun exposure during the first 2 decades of life. Unfortunately, the mothers most careful to avoid sunburns in their children are those whose children have already suffered a sunburn. It should also be noted that children's games in kindergartens and beaches are often located in the sun and this keeps them away from the shade. In order to raise awareness among children, families and teachers, educational campaigns have been proposed in primary and secondary schools such as " no hat no play"; "il sole per amico for kids and for young".

In adolescents between 13 and 15 years of age, the understanding of solar risk is modest and only about 15% know that the time between 11 and 16 should be avoided. On the contrary, this is their preferred time slot (60% of males and 85% of females). Adolescents after an educational campaign change their knowledge, but not their behavior. In Italy, a study of 746 young people between 16 and 22 years of age has shown good information on the risks associated with sun exposure, but a conduct completely careless of such information (4). So, education campaigns are to be provided during primary school which appears to be the most propitious period for communication.

Photoprotection with clothing (5)

Photoprotection with clothing is essential. In this regard, technologically advanced fabrics have also been produced in Italy to protect the skin from the pitfalls of the sun's rays. These are fabrics that contain zinc oxide and titanium dioxide molecules between the fibers. These natural or synthetic fabrics with different colors are able to effectively protect the skin from the action of the sun's rays. Their level of protection is indicated by the abbreviation UPF (Ultraviolet Protection Factor). The colors are mostly bright or dark and the degree of protection is indicated as UPF 50+ or 30+ or 15+ Below these values the clothing is no longer protective. These garments have the UPF number on the label, a yellow sun with shading and the law number (EN 13758-2).

Topical photoprotectors

Finally, let's talk about topical photoprotectors (6, 7). They are any product (oil, cream, gel, spray) intended to be placed in contact with the skin for the exclusive and main purpose of protecting it from UV rays by absorbing or reflecting them. The World Health Organization (WHO) states that topical photoprotectors are the last line of defense of the skin from the sun on areas that cannot be otherwise protected. However, prolonged exposure to the sun with topical photoprotectors induces false safety and this contributes to increased incidence of skin cancer and melanoma.

What characteristics should topical photoprotectors have? They must be harmless, pleasant, resistant to water and sweat, photostable and broad-spectrum against UVB and UVA.

The label of these products requires the following to be indicated:

1) Water proof (resistance to 4 baths of 20 minutes at a distance of 20 minutes from each other) or water resistent (2 baths);
2) Circles with the words UVA and UVB inside;
3) Extent of protection expressed by Sun Protection Factor - SPF (UVB) and Persistent Pigment Darkening - PPD (UVA) parameters (Fig. 1).

PPD must be at least one-third SPF

PPD (Persistent Pigment Darkening)	PA (Protection Grade of UVA)
2~4	PA+
4~8	PA++
8~16	PA+++
16~	PA++++

Fig. 1. *Relationship between PPD and UVA protection level.*

SPF is a measure of how much solar energy (UV radiation) is required to produce sunburn on protected skin (i.e., in the presence of sunscreen) relative to the amount of solar energy required to produce sunburn on unprotected skin. As the SPF value increases, sunburn protection increases (Table II).

Tabel II. *SPF value and relative exposure time needed to produce sunburn.*

Unprotected Exposure	SPF 15	SPF 30	SPF 50
10 minutes = 100% UV	150 minutes (≈ –93% UV)	300 minutes (≈ –97% UV)	500 minutes (≈ –98% UV)

Application of sunscreens

How do you apply sunscreen products?
1) Apply sunscreen all over the body at least 30 minutes before exposure;
2) Apply sunscreen in the right amount (2 mg/cm2) and uniformly so that it is effective;
3) Do not use the product after the Period After Opening (PAO) which must be indicated in the product and packaging

The use of a topical photoprotector does not appear to be indicated below 6 months (FDA), for some products under one year. Photoprotection in children, especially in early childhood, should include hats, clothing, spectacles and limitation of direct exposure to sunlight. Inorganic filters not in the form of nanoparticles should be preferred. These are the indications of the World Health Academy of Dermatology and Pediatrics (WHA-D&P) which hopes that sunscreens will be considered and regulated by health institutions as drugs to increase their efficacy and safety. It is also recommended to prefer fragrance-free and water-resistant products, biodegradable and in eco-sustainable packaging.

Sunscreen and children

Sunscreen and children:
1) there are no precise rules for children;
2) physical screens and safe filters should be used mainly (e.g. Tinosorb);
3) protection indices between 30 and 50;
4) optimal ratio of UVA to UVB protection;
5) apply sunscreens correctly every 2/3 hours.

Numerous substances are added to the real photoprotector to form the final product. They have an emollient, antioxidant and immunostimulant purpose. Among them we mention, among others: Vit A, C, E; Aloe vera; Sorbitol; Dimethicone; Glycerin; Arginine; Thermal waters; Hexylresorcinol and Panthenol.

Mexoryl 400 and UVMune 400 (8)

UV rays affect our skin to a greater or lesser extent depending on the time of day, the season, the altitude and the weather. According to their wavelengths, we distinguish between UVB (rays between 280 and 320 nm), short UVA (between 320 and 340 nm), long UVA (from 340-400 nm) and in this range the ultra-long UVA (between 380 and 400 nm). FDA approved Mexoryl 400 as a filter for 380-400 NM ultra long UV rays. This product is now approved in Italy in the formula UVMune 400. With UVMune 400, the solar filtration range is increased by 20 nm and this new generation of filter powered by Mexoryl represents the first product that filter the broad UV spectrum: it is a major scientific advance for lifelong protection from ultraviolet radiation. Previous generation sun filters have insufficiently protected skin against ultra-long UVA rays. These long UVA rays penetrate the epidermis the most and are among the main causes of skin aging. They also contribute to the development of skin cancer, along with other UVA and UVB rays. No sun filter was able to block efficiently ultra-long UVA rays from 380 nm which alone accounts for 30% of UV.

Sunscreens and Vitamine D (9)

Can sunscreens with high protection cause a Vitamin D deficiency? Although the question is legitimate, the answer is negative: no Vit D deficiency is observed using topical photoprotectors with a high degree of protection.

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