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The Relation between Sunscreen and Skin Pathochanges Mini Review

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ABSTRACT :*Nowadays, cosmetic products represent the most important non food market sector for producers. Consumers are in continues demand to products for beauty, antiageing, wellness, skin care and sunscreen. Sunscreen help to protect skin from UV rays, either chemically or physically. UV rays are generally consists of three forms UVA, UVB and UVC, and excessive exposure of these radiation may lead to pigment changes, pre-cancerous, cancerous skin, wrinkles and skin aging , along with triggering other adverse light sensitive reactions based on disease etiology and skin prototypes.The possible pathological changes due to use of sunscreen has been reviewed during the exposure to the UV rays. It is vital to protect skin and eyes from damaging effects as the skin is an integral part of our immune system. Moreover, artificial sources of UV rays should be avoided including tanning beds and sunlamps unless use of sunscreen. Surfaces such as sand, snow, concrete and water can reflect up to 85% of UV radiation, when around these surfaces, even when cloud weather because it filters less than 40 % of UV radiation. The used sunscreen products should contain SPF of at least 15 and it is advisable to have enough vitamin D and beta carotene and antioxidants such as vitamin C, vitamin E and Selenium when heavily exposed to sun radiation.*

KEYWORDS :*Sunscreen, Light spectrum, Pathology, UV radiation, Skin prototype*

I. INTRODUCTION

In the last few years a dramatic increase of the importance of cosmetic products has been seen. Cosmetic products represent the most important non food market sector for producers all over the world. Consumers are demanding more and more to products for beauty, anti ageing, general wellness and skin care based on ingredients issued from different sources. The cosmetics in general may be existed in natural and synthetic approach whether it is traditional cosmetic products with high concentration of active natural materials, semi-synthetic and synthetic (1). Natural cosmetics, body care, ecological detergents and sunscreens also of much higher interest of consumers shopping, with general trend of labels that include approval from national and international medical associations. The medical seal or logo on cosmetic products may be offered against money likewise, use of the seals is granted to manufacturers who have paid an amount of money to the groups for their cancer fighting campaigns. "The idea is to increase public awareness of sunscreen use in general and to show that we are an entity that cares about this issue (2).

The first archaeological evidence of cosmetics usage is found in ancient Egypt around 4000BC. The ancient Greek and Romans also used cosmetics; the use of kohl and Henna has their roots in Africa even they were not realizing their possible dangerous properties like containing mercury and lead percentage in their structure or as environment accumulation (3, 4, 5). Cosmetics were used in Persia and what is today the Middle East from ancient periods after Arab tribes converted to Islam and conquered those areas, in some areas cosmetics were only restricted if they were to disguise the real look in order to mislead or cause uncontrolled desire henna has been used in India since around the fourth or fifth centuries, and used either a hair dye, or in the art of mehndi in which complex designs are painted on to the hands and feet, especially before a Hindu wedding. In the middle age, renaissance and up until the industrial revolution, colored light European skin was darkened by exposure to the sun (6, 7, 8). During the early years of the twenty century, make-up became fashionable in the United State of America and Europe owing to the influence of

ballet and theatre stars but the most influential new development of all was that of the movie industry in Hollywood. Modern synthetic hair dye was invented in 1907 by Eugene Schuler, founder of L'Oreal he also invented sunscreen in 1936 (9). The awareness of cosmetics, fragrances, hair and skin products every day use was influenced by advertisements in print, on television and now the turn to the Internet (10, 11). A large variety of cosmetics and organic body care is generally available today like cold cream emulsion which is used to soften the skin. Face powder and dusting powder, based on talcum and Zinc Oxide, are used to dry and give the skin a stain-like texture, bath salts and many bath preparations combine powdered clay (12).Cosmetics are of medical significance for their ability to function as camouflaging. The formulation and efficacy of cosmetics is grounded firmly in the science of chemistry and skin physiology. Yet, cosmetics are valued for their appearance enhancing capability and the intangible aspects of well being that their use imparts (13). The first effective sunscreen product has been developed was called Gletscher Crème (Glacier Cream), it was developed during the World War II by chemist Franz Greiter who discovered the concept of Sun Protection Factor (SPF) in 1962, which then became a worldwide standard for measuring the effectiveness of sunscreen, when applied at an even rate of 2 milligrams per square centimeter (mg/cm2), and now days SPF is the system used worldwide to determine how much protection a sunscreen provides, applied to the skin at a thickness of 2 mg/cm2 (14).

II. SUNSCREEN

Sunscreen (also known as sun block) is a topical product (cream, lotion, spray, etc) that help to protect the skin from UV rays. It is used to deflect UV rays based on their mechanism of action and product type. There are two main types of products of sunscreen, the chemical which reflects UV light absorption and blocking the penetration of UV radiation through the epidermis by acting as filters absorbing high energy UV and then release this energy as lower energy rays (heat). The physical type is able to absorb UV light and inconspicuous on the skin 1999 FAD sunscreen (15). The chemicals that are most often found in chemical sunscreen include Para-amino benzoic acid (PABA) products, Benzophenones, Cinnamates, and Salicylates. The majority of the commercially available sunscreen these days is combination of agents from several chemical groups. PABA was an early chemical sunscreen agent, with effective UVB block, however, until recently provide low UVA protection. The other ingredients, such as Benzophenones (Oxybenzone) and Avobenzone work stronger against UVA rays. SPF rate does not adequately measure protection from all the damaging radiations, but could determine the protection from one specific wavelength of UV radiation. The UVB (290nm - 320nm) unfortunately, there is no currently approved standard to rate the quality of a sunscreen UVA protective capabilities, UVA (320nm - 400nm) is the deeper penetrating wavelength more often associated with skin changes of wrinkling, pigmentation and long term skin damage. Moreover, the SPF rating system does not accurately or completely define sunscreen protective capabilities from any other harmful UV radiation, except the UVB wavelength. UVB creates a red, painful irritation first experienced during early sun exposure, but UVB is not the only UV wavelength damaging to the skin in fact, UVB has only a minimal effect upon the deeper depth of skin, UVB and UVA radiations are both recognized as causing skin cancer (16, 17, 18).
Since the appearance of an ozone hole over the Antarctic in the early 1980s, Many countries all over the world have became aware of the health threats posed by ozone depletion, which decrease our atmospheres natural protection from the sun harmful UV rays (19).

How it works?

Sunscreens work in two main ways; the non chemical sunscreens such as Titanium Dioxide and Zinc Oxide would be reflect UV light and block out sunlight. This is less likely to cause problems in some people with sensitive skin. Micro fine Titanium Dioxide is cosmetically more acceptable than older preparations, though in high concentrations it can still give the skin a milky quality. Chemical barrier sunscreen can absorb UV light (e.g. UVB and/or UVA); they contain chemicals such as cinnamates, benzophenones and dibenzoylmethanes (salicylates). Chemical sunscreens are not able to be seen once they have been applied to the skin and do not give a milky appearance. Sunscreen may be chemical or physical agents that protect the skin from sunburn and erythema by absorbing or blocking UV rays and available often in the form of a cream or lotion topical preparations. In addition to their photo protective attributes, these substances also assist in preventing windburns and skin damage from wind driven micro particles of dirt and grime.

Physical blockers may be direct physical photo blockers, and most of prominent structure metal compounds (iron, chromium, zinc, titanium, etc) that occur naturally, while some compounds are manmade such as bismuth. There are important photo protective blockers, Titanium Dioxide the white pigment powder and widely used in cosmetics. The purpose of large particle titanium is to give opacity to the products containing it and to lighten (or whiten) their color. Opaque titanium dioxide highly reflects and strongly scatters all UV and visible rays. It also reflects much of the skin damaging Infra Red (IR) waves, and keeping the skin cooler, reducing heat damage and its subsequent photo aging, to achieve cosmetic elegance and usefulness, micro coating the Titanium Dioxide is common; designing a vehicle to assure good, even application to the skin is

essential. Large particle Titanium Dioxide products produce a very white, opaque appearance on the skin when applied (20, 2).Recent interest has focused on the creation of many oxide materials like titania in nanostructure due to their exceptional electronic, chemical and mechanical properties which make fabricated with unique characteristics (21).

Zinc Oxide has been known and used topically for centuries as a skin protectant and wound healing adjuvant and is a recognized as mild antimicrobial agent. More than 50 years ago, Zinc Oxide was indicated as a block for UVB/UVA light. It also reflects IR from the skin, and the ability to protect in the long UVA range (300 - 400 nm) is much higher than Titanium Dioxide. Zinc Oxide absorbs, rather than scatters, most UVA, while Titanium Dioxide primarily scatters these wavelengths. Thus, formulated in combination with Titanium Dioxide, ultra fine Zinc Oxide closes the possible gaps in the UVA range. Zinc Oxide may works as complement to Titanium Dioxide protection and extends photo protection to the skin where Titanium Dioxide is insufficient. The optimal particle size range for UV blocking Zinc Oxide without blocking visible wavelengths is approximately 80 to 150 nm (22, 23).

Iron Oxides most commonly seen in two areas, one as rust on exposed iron and in cosmetics to give the cover up color desired. Although is not approved by the FDA as an active ingredient in sunscreens, many companies use them in their sunscreen products. Cosmetic Iron Oxides are manmade to very high purity, desired color and particle size. Iron Oxide pigments for cosmetic use are micronized powders. These cosmetic pigments, if incorporated at adequate concentration and when properly dispersed in well designed vehicles, not only add color to the lotion (or cream, powder, etc.), but could contribute significant protection of the skin from multiple wavelengths of sun light (24).

Physical blockers may be indirect physical blocker aids, examples of these particles can be natural talc or mica, with flat and oval appearance in shape. They are very small particles, though they are much larger than direct physical blockers. A portion of very small physical blocker particles will coat the larger flat talc (mica, etc.). Being flat and smooth, the coated talc will easily slide over each other, overlapping themselves and effectively increasing protective coverage on the skin.

The Chemical Absorbers/Organic Filters chemical sunscreens (or Organic Filters) are usually soluble in oils or water. These filter either/or UVB and UVA irradiation to varying efficiency. No organic filter completely blocks the UVB and/or UVA rays from the skin. Furthermore, the actual protection offered by any and all sun protective products relates directly to their level of concentration, the film thickness applied to the skin, as well as the careful, total coverage of the exposed skin sites, and the most common chemical absorbers used in sunscreens Octyl Salicylate even is strictly UVB absorber and weak one, it offers several positive qualities, including nonirritating and no sensitizing to skin. Cosmetically, it is an easy to handle emollient oil and acts as a good solvent (solubilizer) for other such as the benzophenones (24, 25).

Octyl Dimethyl PABA (Padimate O) is an oil like UVB absorber used in sunscreen and the most comfortable for this UV range, absorbing best at the maximum sunburn frequencies from 310nm to 312nm.

Octyl Methoxycinnamate is an oily liquid most widely utilized in UVB, and considered as a second in efficiency to Padimate O, but offers broader protection from 300nm to 315nm in the sunburn region of UVB. It has a very good safety record and is relatively easy to formulate, moisturizing and water insoluble, adhering tenaciously to the skin (26).

Menthyl Anthranilate an old and safe absorber and it is absorbed moderately in the UVB range from about 300nm to 340nm. 5-Oxybenzone (Benzophenone-3) and Sulisobenzone (Benzophenone-4) are closely related solid (powder) absorbers. Oxybenzone is water-insoluble, while the acid form sulisobenzone can be made soluble in water when it is neutralized. While these compounds are classified as UVA absorbers they are also UVB absorbers. They offer only moderate protection through both the UVB range and part of the UVA (320nm - 360nm) and quite stable and can enhance effectiveness of stronger UVB absorbers (26).

Avobenzone (Parsol™1789) is a solid (powder) absorber that exhibits good UVA absorption from about 330nm to 340nm and very good absorption in the UVA range up to about 370nm, where it loses effectiveness and can convert to its inactive form in the presence of sunlight. Octocrylene is an emollient and water resistant UVB/UVA absorber, and is considered a relatively weak sunscreen. It is very stable absorber and both protect and augment other UV absorbers. Moreover, it can improve their uniform skin coating (20, 2).

Rays of sunlight

Sunlight consists of three forms of rays ranging from wavelengths of 100 nanometers (nm) to beyond one million nm (infinity). These radiation wavelengths are what cause excessive pigment changes, pre-cancerous and cancerous skin lesions, wrinkles and skin aging, along with triggering other adverse light sensitive responses. Furthermore, there are two forms of radiation emitted from artificial sources (mercury vapor lamps and welding arcs) that play a role in damaging skin too. UV generally consists of three types, the UVC wavelengths are the shortest UV rays, extending from 100nm to 290nm, and may be considered the most carcinogenic, while the sun generates UVC, the atmospheric ozone layer screens out virtually all UVC from

reaching us (27). The UVB is the intermediate wavelength of UV rays from 290nm to 320nm, and causes the initial appearance of redness, commonly called sunburn. UVB creates painful irritation, even less damage than the UVA, which causes the pigmentation changes associated with tanning. UVB primarily damages the outer superficial layer of the skin and lead to skin redness, and excessive exposure to UVB is the foremost promoter of premature aging of the skin (27).The most risky UV radiation is UVA which extends from 320nm to 400nm, UVA induces cutaneous photo damage, usually seen as dryness, uneven pigmentation, inflammation, skin darkening (tanning), and the adverse effect of UVA is the deep dermis far more than the superficial sunburn caused by UVB rays, resulting in a loss of the elastic quality of its supportive collagen, causing premature aging, UVA easily penetrate window glass unlike UVB.

Another form of sun rays is Visible Light (400nm - 760nm) and nearly 50% of the sunrays are reaching us and their wavelengths that humans can see such as violet, indigo, blue, green, yellow, orange, and red. IR (greater than 760 nm - 1,000,000 nm), is comprising more than 40% of the sun rays reaching us at sea level and their wavelengths warm us when we stand in the sun, Figure 1 represented diagram for light spectrum (28).

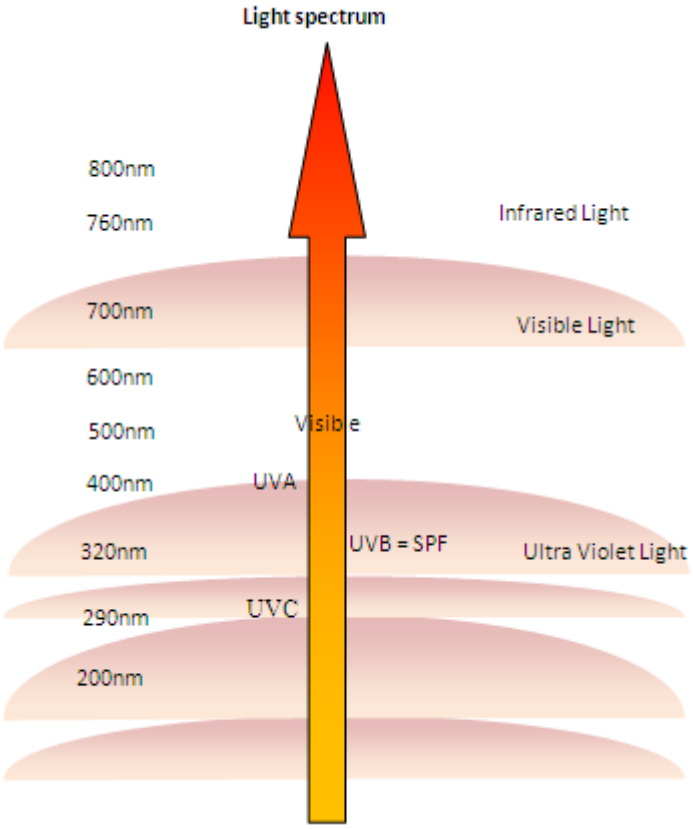

Figure 1 Sun lights radiation spectrum by nanometer scale, where UVA= ultraviolet A, UVB = ultraviolet B, UVC= ultraviolet C.

Factors affecting UV level

The sun has the most powerful rays between the hours of 10 am to 4 pm. At noon, the sun is at its highest point in the sky, at this time the sun rays have the least distance to travel through the atmosphere. In the early morning and late afternoon, the sun rays pass at an angle through the atmosphere and the intensity of UVB radiation is significantly reduced. The UV intensity varies throughout the year, which varies with the season. The UVB intensity is the highest during the summer months, but UVA reaches the earth surface all year round. The sun is strongest at the equator, where the sun is most directly overhead. In higher latitudes the sun is lower in the sky, which causes the UV rays to travel a greater distance through the atmosphere, resulting in less intense UV radiation. At higher altitudes, UV intensity increases due to the reduced amount of atmosphere that is able to absorb the damaging rays. Clouds can reduce UV levels, but not entirely. The amount of protection depends on the thickness of cloud cover, so it is possible to burn on a cloudy day even if it does not feel too warm (29). UV rays is a powerful stimulus to melanin pigmentation and a destructive agent on the melanocytes, UV rays can stimulate skin melanocytes to increase epidermal melanin content, which then as very effective density photo protective filter of UV rays and many other health environmental factors are provided at Figure 2.

In contrast, mutations caused by UV rays result in disfiguring changes related to pigmentation and may induce fatal malignancies (malignant melanoma in white persons), and/or visible melanin pigmentation in human skin is directly related to the number of melanization of transfer and degradation of the metabolic unit of specific melanocyes organelles, melanosome production, size degree of melanization, and transfer to keratinocytes of melanosomes (30).

UV rays elicit a response in direct relation to the tanning potential of the epidermal melanin unit which is representing the melanocyte and its cluster of keratinocytes. In cultured melanocytes from different skin proto types, melanin content is five times higher in SPTs IV to VI than in SPT s I to III, and the melanocytes maintain their phenotype according to their original skin prototype. After UVB irradiation, a stronger induction of end nuclease sensitive sites was found for melanocytes with a lower level of total melanin and a high content of pheomelanin. By measuring the clone forming ability in different melanocyte cultures, two type of normal melanin pigmentation form the basis of the skin, normal skin and color constitutive skin. The genetic factor determines the color (light brown, medium brown, and dark brown or absence of color (white) in skin unexposed to solar irradiation, Moreover, facultative skin color is the skin color that results from an increase in the intensity of skin color as result of UV rays exposure and as the reflect genetically predetermined the capacity of the skin to darken in response to UV rays (31, 32).

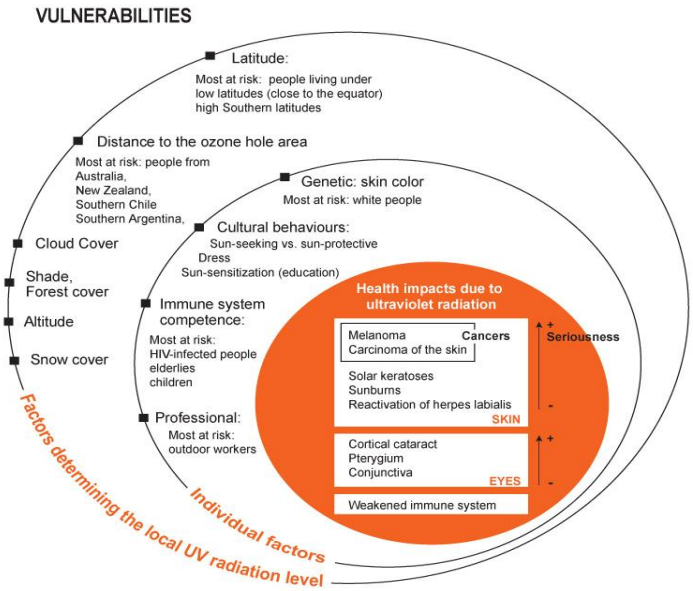

Figure 2 Health impacts due to UV radiation according to WHO (33).

III. THE SKIN

Many active substances of cosmetic use, such as sunscreen act at the corneum layer level. The control of the concentration and distribution is very important, that to avoid the penetration of active materials. Sunscreen products must protect the skin against UV radiation damages. Moreover the active ingredient in sunscreen preparations should remain on the skin for a reasonable period of time, conserving their activity despite perspiration and bathing (34). Skin is an integral part of our immune system, and it is considered our primary line of defense against external environmental insult, the skin is the body largest organ, in adult cover an area about 1.5 to 2.0 square meter and account for about 15 % of the body weight. Therefore, it is critical to protect our skin from any injury and damage from sunlight. The natural protective capacity against radiation is skin type dependent. The sun UV rays have a tremendous immunosuppressive effect and are known to cause skin cancer (35). Within one square inch of skin, varying from 1mm to 4 mm in thickness there are 650 sweat gland, 65 hair follicles, 19 yards of capillaries, 78 yards of nerves, thousand of sensory cells, nerve endings, langerhans cells. Melanocyte cells and Tyrosinase enzymes responsible for producing the melanin structure of skin (36). The hormone alpha-melanocyte stimulating hormone is made when the body is exposed to sunlight and is responsible for the development of the pigment melanin. Face skin can be divided into various types according to its texture and it is essential to know the various type of skin and the management can be done accordingly (15).

Normal skin It has a fine even texture with a supple and smooth surface and the proper balance, between oil and moisture contents are existed. Therefore its moist and neither greasy nor dry. It is looking clear and does not develop spots and blemishes. The pores of the skin are fine and barely visible and reflect good health and needs gentle treatment.

Dry skin Dry skin has a dry parched appearance and a tendency to flake easily. It is prone to wrinkles and lines due to the inability to retain moisture as well as the insufficiently production of sebum by the sebaceous gland. Dry skin often has problem in cold weather and ages faster than normal or oily skin and constant protection is very important.

Oily skin This type of skin is caused by the over secretion of sebum making the skin surface oily. The excess oil on the surface of the skin attracts dirt and dust from the environments because oily skin exist for quite long time and need to be cleansed thoroughly.

Combination skin This type of skin is very common; it is a combination of both oily and dry skin with certain areas of the face oily and the rest dry. Usually there is a central greasy panel consisting of the forehead, nose and chin and a dry panel consisting of cheeks and the areas around the mouth. In such cases, each part of the face should be treated accordingly the dry areas as for dry skin and the central panel as for oily skin (37, 14). Many pathological changes may be encountered in association with or without use of sunscreens, Table 1 provide brief meaningful information about the diseases etiology.

Sunburn

UV may cause sunburn, the sunburn is almost exclusively a UVB, however the SPF system measures UVB protection and exclude UVA (the ageing rays). During sunburn skin turns red, swells and in severe cases blisters. Sunburn will continue to develop for 12 to 24 hours after the exposure, burn or erythema (reddening) and edema (swelling) on your skin from excessive exposure to the sun rays. Sunburn may also occur from exposure to other UV light sources such as solaria or tanning salons. At a cellular level, sunburn is associated with microscopic changes in the skin, and is the formation of UV induced sunburn cells and a reduction in Langerhan cells and mast cells, which play an essential part of the body immune defense system (33).

Skin prototyping categories people into one of six groups based on baseline skin color which is the tendency to tan and burn, exposed to UV rays people with type I skin are at much greater risk of sunburn than type VI counterparts as provided in the table 2.

The amount of UV radiation, measured in energy per unit area, which may produce erythema at an exposed site, is called the minimal erythema dose (MED) and this is significantly lower in people with a low skin prototype grading. The signs and symptoms of sunburn differ for each individual according to their skin prototype and length of exposure to UV rays, fifteen minutes of midday sun exposure may cause sunburn in a white skin person, while a darker skinned person may tolerate the exposure for an hours. Continue to expose to sun light for 2-6 hours may result of sequence of symptoms depend on nature of skin, Erythema, Edema, tenderness and/or irritation, skin feels hot to touch, pain, blistering, chills and fever (severe cases) all were experienced. Around 4-7 days after exposure, skin may start to peel and flake off. In severe cases of second-degree burns, dehydration, electrolyte imbalances, secondary infection, shock or even death are observed (39, 40).

Table 1 Health Problems and Disease Etiology (38)

DISEASES	NOTES
ECZEMA	Refers to a distinctive reaction pattern of the skin showing combination of signs which depends on the duration of the rash and the type of eczemas
PSORIASIS	Is a non–infectious, inflammatory disease of the skin characterized by well–defined erythematous plaques with large, adherent, silvery scales; The main abnormality in psoriasis is increased epidermal proliferation due to excessive division of cells in the basal layers and a shorter cell cycle time.
Vitiligo	Is an acquired condition, affecting 1% of all races, in which circumscribed depigmented patches develop. There is complete loss of melanocytes from affected patches. There is a positive family history and this type is associated with autoimmune, such as diabetes, adrenal disorders and pernicious anemia. Trauma and sunburn may precipitate the appearance of vitiligo.

SKIN CANCER	Are the most commonly occurring cancers in terms of incidence in the world; The deleterious effects of UV-B rays on individuals is related to prolonged, deliberate and inadvertent sunlight exposure, this exposure leads to the skin cancer, exposure to UV rays is thought to be an important factor in the cancers incidences.
DAMAGE TO THE EYES	To blindness Melanoma, a type of skin cancer, can also develop within the eye UV rays can also damage the eyes as more than 99% of UV rays is absorbed by the front of the eyes.
Premature Aging of the Skin	One of the chronic effects resulting from repeated exposure to UV rays is premature aging of the skin, which is clinical signs that reflect structural changes in the dermis, include dryness, loss of elasticity, and mottled pigmentation, and are the result of degenerative changes in elastin and collagen; the degenerative changes accumulate over time and are largely irreversible.
Tanning	Refers to delayed pigmentation of the skin, results from an increase in the number of functions melanocytes resulting in increased activity of the enzyme tyrosinase, leads to the formation of new melanin and an increase in the number of melanin granules.

Table 2 Various Skin Prototypes (39, 40)

Skin Prototypes	Typical Features	Tanning ability	MED (mJ/cm^2)*
I	Pale white skin, blue/hazel eyes, blond/red hair	Always burns, does not tan	15-30
II	Fair skin, blue eyes	Burns easily, tans poorly	25-40
III	Darker white skin	Tans after initial burn	30-50
IV	Light brown skin	Burns minimally, tans easily	40-60
V	Brown skin	Rarely burns, tans darkly easily	60-90

VI	Dark brown or black skin	Never burns, always tans darkly	90-150

*Minimal erythema dose (MED)

IV. CELL PROTECTANTS

UVA Radiation Penetrates Deeply Into Our Skin And Initiates Oxidation Processes At The Cellular Level. Exposure To UVA Causes Pigmentation Changes Such As Tanning Or Burning And Variety Of Cell Damaging Free Radical Oxygen Species, Including Superoxide (*O2), And Hydroxy Radicals (*OH) Are Released Vice Versa UVA Induction And Cellular Damage Then Occurs, Particularly By Membrane Lipids Per Oxidation, And Hydrogen Peroxide May Add To Cellular Damage.The primary action of UVA is to add energy to molecules in our skin, including ubiquinones (Coenzyme Q10) that go on to interact with oxygen to produce the highly reactive oxygen forms mentioned above. These oxygen moieties degrade DNA in the cells. Evidence of UVA damage becomes visible first as sunburn, then inflammation and skin darkening, and later as photo aging and skin cancers. The Skin Cancer Foundation has reported that depletion of Vitamin A in the skin by UVA exposure may contribute to both photo aging and cancers of the skin (41).

Protecting the skin from the adverse effects of UVB and UVA is the first line of defense and adequate concentrations of approved sunscreens will achieve a protection factor (SPF) of 30 plus. Supplementary cellular protectant is not intended to act as primary UV absorbers rather they act to prevent damage to the cells directly and indirectly. There are many examples of cellular protectant used in sunscreens. Vitamin E pure active natural state as tocopherol, protects products from oxidizing even it is too reactive to retain adequate activity within the skin when topically applied. As an oil-soluble antioxidant, it gives considerable protection to the skin cells.

Vitamin E breaks the chain reaction of free radicals before they can cause lipid per oxidation induced destruction of the cellular membranes. However, it requires a regeneration agent, a substance that prevents it from being rapidly depleted.

Vitamin C (ascorbic acid) is one of the most effective antioxidants available and used in sunscreen to regenerate the lipid soluble vitamin E and cellular membrane protective activity. vitamin C is available in many forms, some of which are water-soluble (ascorbyl acid phosphate) while others are lipid-soluble, such as ascorbyl palmitate ascorbyl palmitate, topically applied has also been reported to exhibit some protection against UVB burns, and has anti-inflammatory activity combinations of vitamin C compounds with vitamin E appear to offer greater protection against cellular insult from UVB and/or UVA exposure than either antioxidant alone.

Sun protection

It is vital to protect skin and eyes from the damaging effect of the sun because exposure to UV radiation contributes to ageing skin and is the main cause of skin cancer, particularly people of photosensitivity. The protection provided by a sunscreen is expressed by SPF, and popularly interpreted as how much longer skin covered with sunscreen takes to burn compared with unprotected skin.

A SPF number of 30+ provide a high degree of UV light protection and broad spectrum means the sunscreen will filter both UVA and UVB rays.The test works out how much UV radiation (mostly UVB) takes to cause barely detectable sunburn on a given person with and without sunscreen applied. For example, if it takes 10 minutes to burn without a sunscreen and 100 minutes to burn with a sunscreen, then the SPF of that sunscreen is 10 (100/10). A sunscreen with a SPF of 15 provides >93% protection against UVB. Protection against UVB is increased to 97% with SPF of 30+. The difference between a SPF 15 and a SPF 30 sunscreen may not have a noticeable difference in actual use as the effectiveness of a sunscreen has more to do with how much of it is applied, how often it is applied, whether the person is sweating heavily or being exposed to water. Hence a sunscreen with SPF 15+ should provide adequate protection as long as it is being used correctly. However, most people apply their sunscreen at about one third the thickness used for testing; they fail to apply it to all exposed areas of skin and forget to reapply it every couple of hours. Therefore, the actual protection may be a lot less than the tests indicate. Currently there is no internationally agreed test for measuring UVA protection in human skin. An estimate is made by a laboratory test in which the proportion of radiation passing through a measured amount of sunscreen is determined (1, 36, 43). Mathematically, the SPF is calculated from measured data as equation:

$$\mathrm{SPF} = \frac{\int A(\lambda)E(\lambda)d\lambda}{\int A(\lambda)E(\lambda)/\mathrm{MPF}(\lambda)\,d\lambda},$$

Where:
E (λ) is the solar irradiance spectrum,
(λ) erythemal action spectrum
MPF (λ) the monochromatic protection factor, and all functions of the wavelength λ. (42, 43).

Persistent Pigment Darkening (PPD), Immediate Pigment Darkening (IPD), Boots Star System and Japanese PA system are methods of measuring UV protection. The PPD method is a method of measuring UVA protection similar to the SPF method of measuring UVB light protection. Theoretically, a sunscreen with a PPD rating of 10 should allow you to endure 10 times as much UVA as you would without protection. The PPD is used as part of guidelines for EU sunscreens to provide the consumer with a minimum of UVA protection in relation to the SPF.

The PPD should be at least 1/3 of the SPF to carry the UVA seal. The implementation of this seal is in its phase-in period, so a sunscreen without may offer this protection (35). The Japanese PA system ranges from PA+ to PA+++, with the + sign indicating increased UVA protection. However, studies have found the PA system to be inadequate, since the maximum PA (PA+++) is equivalent to a minimum protection of PPD.
Finally, addition of Antioxidants to sunscreen may provide additional protection against many of the deleterious or damaging effects of UV light and further research is required that antioxidants may become a valuable addition to sunscreens (28, 44).

V. SUMMARY

Overall, the current brief review focused onto the sunscreen and possible pathological changes may be encountered during the exposure to the UV rays. It is an important to emphasize that artificial sources of UV rays should be avoided including tanning beds and sunlamps. Surfaces such as sand, snow, concrete and water can reflect up to 85% of UV radiation, extra precautions should be taken when around these surfaces, even when cloud weather because it filters less than 40 % of UV radiation. The used sunscreen products should contain SPF of at least 15 and applied before 20-30 minutes of sun exposure. It is advisable to have enough vitamin D and beta carotene and antioxidants such as vitamin C, vitamin E and Selenium when heavily exposed to sun radiation.

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REFERENCES

[1] Damiani E, Rosati L, Castagna R, Carloni P, Greci L. Changes in ultraviolet absorbance and hence in protective efficacy against lipid peroxidation of organic sunscreens after UVA irradiation. Journal of Photochemistry and Photobiology B: Biology, 82(3), 2006, 204-13.
[2] Botta C, Labille J, Auffan M, Borschneck D, Miche H, Cabié M, et al. TiO2-based nanoparticles released in water from commercialized sunscreens in a life-cycle perspective: Structures and quantities. Environmental Pollution, 159(6), 2011, 1543-50.
[3] Chen W, Vermaak I, Viljoen A. Camphor—A Fumigant during the Black Death and a Coveted Fragrant Wood in Ancient Egypt and Babylon—A Review. Molecules; 18(5), 2013, 5434-54.
[4] Murube J. Ocular Cosmetics in Ancient Times. The Ocular Surface, 11(1), 2013, 2-7.
[5] Mahmood Z, Zoha SM, Usmanghani K, Hasan MM, Ali O, Jahan S, et al. Kohl (surma): retrospect and prospect. Pak J Pharm Sci., 22(1), 2009, 107-22.
[6] Barel AO, Paye M, Maibach HI, Hand book of cosmetics sciences and technology (Marcel Dekker: New York, 2005).
[7] Zhang M, Chen S. Review of current situations and prospects of research and development on traditional Chinese medicine cosmetics. Zhongguo, 32(23) 2007, 2457-60.
[8] Hardy A, Rollinson G. Brown cosmetics in ancient Egypt. Pharm Hist (Lond) 41(2), 2011, 24-7
[9] Jerard R. Time for a putsch of the l'oréal consultants? BMJ, 2013,347.
[10] Ibrahimi OA, Bangash H, Green L, Alam M, Armstrong AW, Eisen DB. Perceptions of Expertise in Cutaneous Surgery and Cosmetic Procedures: What Primary Care Physicians Think. Dermatologic Surgery, 38(10), 2012, 1645-51.
[11] de Vries H, Mudde A, Leijs I, Charlton A, Vartiainen E, Buijs G, et al. The European Smoking prevention Framework Approach (EFSA): an example of integral prevention. Health Education Research, 18(5), 2003, 611-26.
[12] Elmarzugi NA, Keleb EI, Mohamed AT, Elenshasy HA, Hamza AM, Dlim MM, et al. Face powder problems perception survey. International Journal of Pharmaceutical Science Invention, 2(6), 2013, 09-18.
[13] Brand RM, McMahon L, Jendrzejewski JL, Charron AR. Transdermal absorption of the herbicide 2,4-dichlorophenoxyacetic acid is enhanced by both ethanol consumption and sunscreen application. Food and Chemical Toxicology, 45(1) 2007, 93-97.
[14] Garoli D, Pelizzo MG, Bernardini B, Nicolosi P, Alaibac M. Sunscreen tests: Correspondence between in vitro data and values reported by the manufacturers. Journal of Dermatological Science, 52(3), 2008, 193-204.
[15] Kim SM, Oh BH, Lee YW, Choe YB, Ahn KJ. The relation between the amount of sunscreen applied and the sun protection factor in Asian skin. Journal of the American Academy of Dermatology, 62(2), 2010, 218-22.
[16] Lautenschlager S, Wulf HC, Pittelkow MR. Photoprotection. The Lancet, 370(9586), 2007, 528-37.
[17] Sarkany RPE. Ultraviolet Radiation and the Skin. In Jerome ON (Ed.), Encyclopedia of Environmental Health. (Burlington:Elsevier, 2011) 469-82.

[18] Lowe NJ. An Overview of Ultraviolet Radiation, Sunscreens, and Photo-Induced Dermatoses. Dermatologic Clinics, 24(1), 2006, 9-17.
[19] Wargent JJ, Jordan BR. From ozone depletion to agriculture: understanding the role of UV radiation in sustainable crop production. New Phytologist, 197(4), 2013, 1058-76.
[20] Botta C, Di Giorgio C, Sabatier A-S, De Méo M. Genotoxicity of visible light (400–800nm) and photoprotection assessment of ectoin, l-ergothioneine and mannitol and four sunscreens. Journal of Photochemistry and Photobiology B: Biology, 91(1), 2008, 24-34.
[21] Neupane MP, Park IS, Lee MH, Bae TS, Watari F. Influence of heat treatment on morphological changes of nano-structured titanium oxide formed by anodic oxidation of titanium in acidic fluoride solution. Bio-Medical Materials and Engineering, 19(1), 2009, 77-83.
[22] Lee W-M, An Y-J. Effects of zinc oxide and titanium dioxide nanoparticles on green algae under visible, UVA, and UVB irradiations: No evidence of enhanced algal toxicity under UV pre-irradiation. Chemosphere, 91(4), 2013, 536-44.
[23] Elmarzugi NA. Nano Level Characterization of Gene Delivery Biocomplexes, Microscopic Study. (Lambert Academic Publisher: Berlin, 2012).
[24] Passemard S, Staedler D, Učňová L, Schneiter GS, Kong P, Bonacina L, et al. Convenient synthesis of heterobifunctional poly(ethylene glycol) suitable for the functionalization of iron oxide nanoparticles for biomedical applications. Bioorganic & Medicinal Chemistry Letters 2013(0).
[25] Santos P, Machado M, Watkinson AC, Hadgraft J, Lane ME. The effect of drug concentration on solvent activity in silicone membranes. International Journal of Pharmaceutics, 377(1–2), 2009, 70-75.
[26] Santos P, Watkinson AC, Hadgraft J, Lane ME. Oxybutynin permeation in skin: The influence of drug and solvent activity. International Journal of Pharmaceutics, 384(1–2), 2010, 67-72.
[27] Lin S-W, Wheeler DC, Park Y, Spriggs M, Hollenbeck AR, Freedman DM, et al. Prospective Study of Ultraviolet Radiation Exposure and Mortality Risk in the United States. American Journal of Epidemiology, 178(2), 2013, 01-13.
[28] Garoli D, Pelizzo MG, Nicolosi P, Peserico A, Tonin E, Alaibac M. Effectiveness of different substrate materials for in vitro sunscreen tests. Journal of Dermatological Science, 56(2), 2009, 89-98.
[29] Fukunaga A, HorikawaT, Yamamoto A, Yamada Y, C. N. The inhibition spectrum of solar urticaria suppresses the wheal-flare response following intradermal injection with photo-activated autologous serum but not with compound 48/80. Photodermatol Photoimmunol Photomed, 22(3), 2006, 129-32.
[30] Luo C, Sheng J, Hu MG, Haluska FG, Cui R, Xu Z, et al. Loss of ARF Sensitizes Transgenic BRAFV600E Mice to UV-Induced Melanoma via Suppression of XPC. Cancer Research, 73(14), 2013, 4337-48.
[31] Liu Y, Wang Y, Rusinol AE, Sinensky MS, Liu J, Shell SM, et al. Involvement of xeroderma pigmentosum group A (XPA) in progeria arising from defective maturation of prelamin A. The FASEB Journal 22(2), 2008, 603-11.
[32] Zubaran C, Foresti K, Thorell MR, Franceschini PR. Anxiety symptoms in crack cocaine and inhalant users admitted to a psychiatric hospital in southern Brazil. Revista da Associação Médica Brasileira 2013(0).
[33] Ferias T. From Australia to Brazil: Sun worshippers beware. Bull World Health Organization, 87(8), 2009, 574-75.
[34] Lowe JN, Shaath NA, Pathak MA, editors. Sunscreens development, evaluation, and regulatory aspects. second ed. New York: Marcel Dekker, 1997.
[35] Anselmi C, Centini M, Rossi C, Ricci M, Rastrelli A, Andreassi M, et al. New microencapsulated sunscreens: technology and comparative evaluation. International Journal of Pharmaceutics, 242(1–2), 2002, 207-11.
[36] Gaspar LR, Maia Campos PMBG. Evaluation of the photostability of different UV filter combinations in a sunscreen. International Journal of Pharmaceutics, 307(2), 2006, 123-28.
[37] Funasaka Y, Abdel-Daim M, Kawana S, Nishigori C. Effect of chemical peeling on the skin in relation to UV irradiation. Experimental Dermatology, (21), 2012, 31-35.
[38] Barankin B, Freiman A. Misnomers in Dermatology. J Cutan Med Surg, 9(6)2005, 284-88.
[39] Nandini A, Talwar A, Gopal M, Kumar S. Spectrum of purpura fulminans: Report of three classical prototypes and review of management strategies. Indian Journal of Dermatology, Venereology, and Leprology, 78(2), 2012, 228.
[40] Bissonnette R, Allas S, Moyal D, Provost N. Comparison of UVA protection afforded by high sun protection factor sunscreens. Journal of the American Academy of Dermatology, 43(6), 2000, 1036-38.
[41] Newman MD, Stotland M, Ellis JI. The safety of nanosized particles in titanium dioxide– and zinc oxide–based sunscreens. Journal of the American Academy of Dermatology, 61(4), 2009, 685-92.
[42] Finlay-Jones JJ, Hart PH. Photoprotection: sunscreens and the immunomodulatory effects of UV irradiation. Mutation Research/Fundamental and Molecular Mechanisms of Mutagenesis, 422(1), 1998, 155-59.
[43] Lott DL, Stanfield J, Sayre RM, Dowdy JC. Uniformity of sunscreen product application: a problem in testing, a problem for consumers. Photodermatol Photoimmunol Photomed, 19(1), 2003, 17-20.
[44] Mihm MC, Kibbi A-G, Murphy GF, Wolff K. Basic Pathologic Reactions of the Skin. In: Goldsmith L, Katz S, Gilchrest B, Paller A, Leffel D, Wolf K, (Ed). Fitzpatrick's Dermatology in General Medicine. 8ed. (NewYork: McGraw Hill, 2012).