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IMPACT OF UV RADIATION ON HUMAN HEALTH

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ABSTRACT
UV radiation is everywhere in the environment and it influence the human's life. It is also an established human carcinogen. UV radiation can induce sunburn, inflammation, photo-immunosuppression, premature ageing, skin cancer and several health effects also. Additionally, UV light is also having some advantage in medical field like treatment of inflammatory diseases, solid tumours and some other medical condition. This paper is covering all the effect cause by UV exposure to human being. Also, how artificial UV rays have been used in medical field.
Keywords: UV rays, Artificial UV source, Skin cancer.

I. Introduction

Solar radiation is the dominant source of energy for the Earth, carrying a significant amount of UV rays. Its essential form is electromagnetic energy, invisible and imperceptible to human senses, with positive and negative impacts on human health. Traditionally, UV radiation was considered a proven human carcinogen due to its mutagenic and nonspecific damaging properties. UV light was discovered for the first time by German physicists in the year 1801. The range of UV radiation falls in the wavelength from 100 to 400 nm. UV radiation has higher frequency, and lesser wavelength when compared with visible light. Earlier it was divided into three basic types: UVA (320–400 nm), UVB (280–320 nm), and UVC (100–280 nm). More recently, the UVA and UVB bands have been further classified into narrowband UVB (311–313 nm), UVA2 (320–340 nm), and UVA1 (340–400 nm) [1]. Some people are exposed to artificial sources of UV radiation (e.g., medical, industrial, disinfectant and cosmetic uses), while all individuals are necessarily exposed to solar UV radiation. Artificial UV consists mainly of arc lamp, fluorescent lamp, TL-01 UV lamp, black-light ILTs, UV light-emitting diodes, shortwave UV lamp, UV lasers and narrow band UV band C lamp. (Fig. 1)

UVA rays have the longest wavelengths, followed by UVB and UVC. UVC rays have the shortest wavelength and are completely absorbed by the atmosphere, hence never reaching the Earth's surface. The Earth's atmosphere protects us from most UVB rays; however, it offers very little protection from these rays [2,3,4,5]. Consequently, the UV radiation that the most people are exposed to is principally composed of UVA with a small fraction of UVB. The amount of solar UV radiation that reaches the Earth's surface depends on several variables: angle of sun in the sky; latitude, or the position of the Earth refers to the equator of the Earth; cloud coverage; altitude; thickness of the ozone layer and ground reflection. Small doses of UV are, however healthy and play a critical part in vitamin D synthesis [6]. However, some CFC chemical emissions have been increasing globally over the past years, thereby increasing the rate of ozone layer destruction over the years [7].

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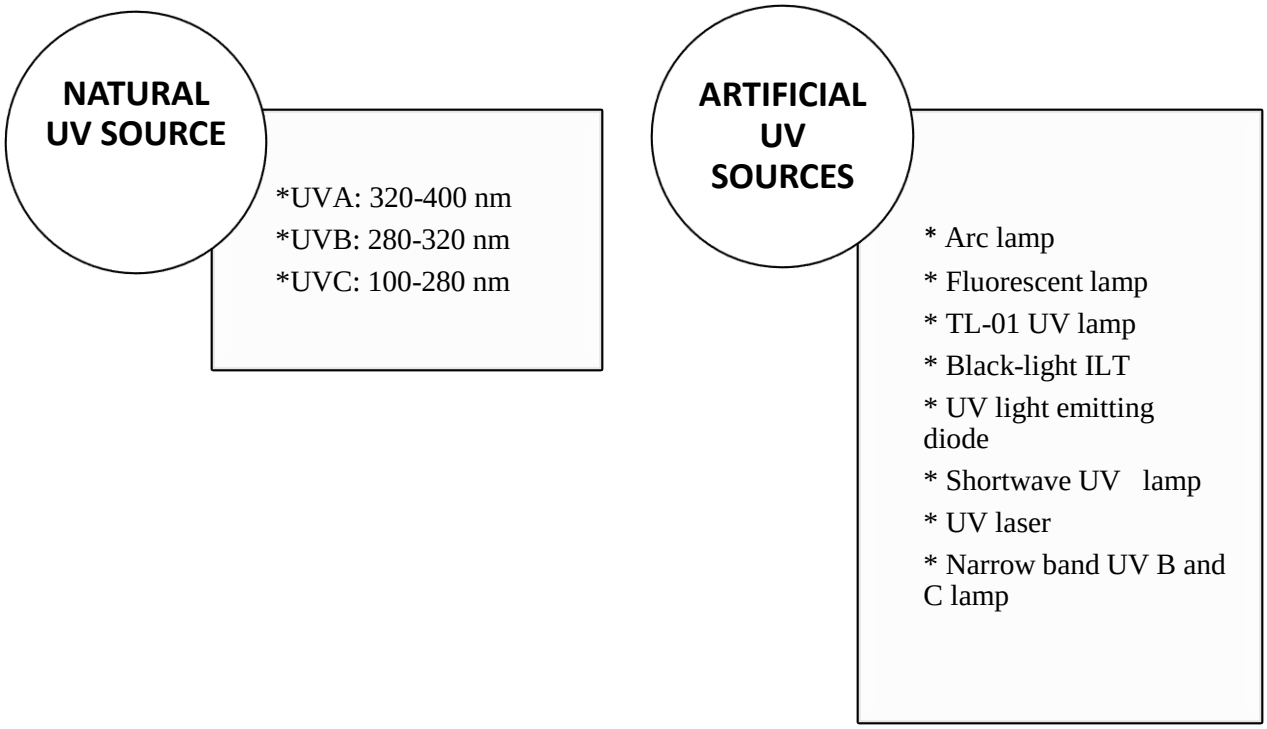

Figure 1: Natural and artificial sources of UV radiation

II. Harmful effects of UV radiation to human being

UV radiation effects human being in so many ways some of them remains for short duration and some other may remain with human for longer duration. Human eyes also effected by the UV rays. In fig. 2 it is explained through a chart.

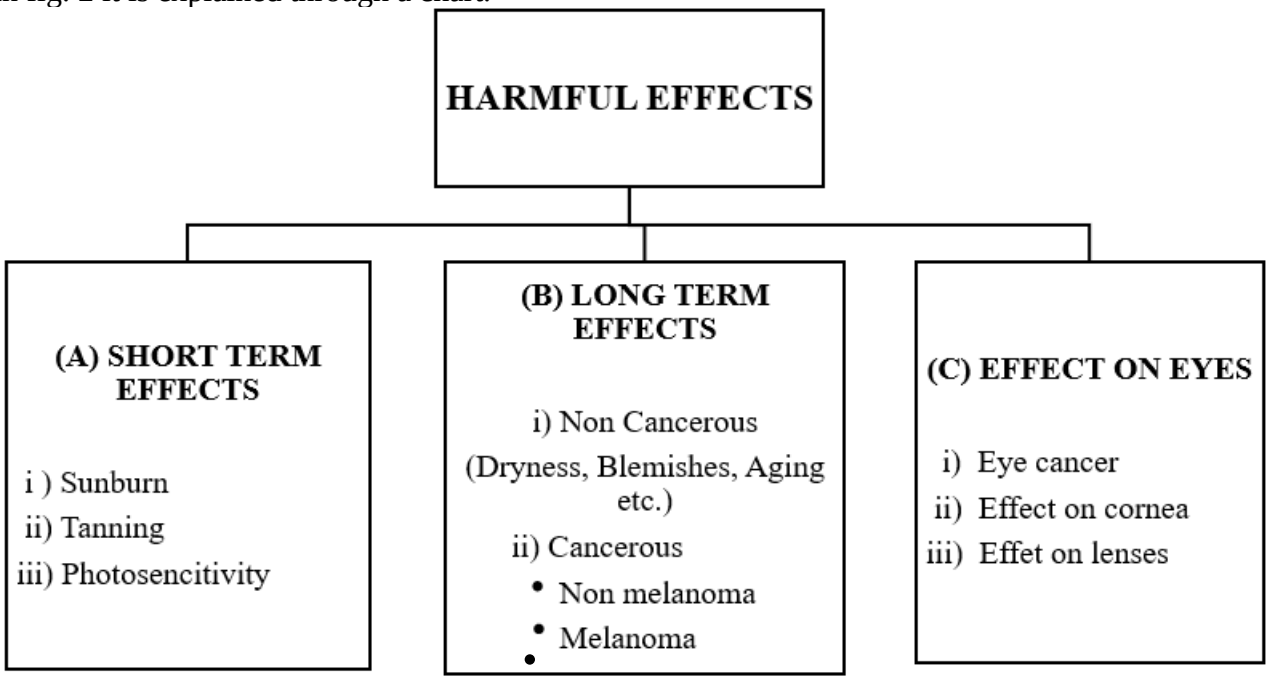

Figure 1 Harmful effects of UV exposure•

(A) SHORT-TERM EFFECTS

Short term effect basically remains for few hours or a day with the human being. Some effects generate due to chemical cosmetic applications and their reaction with rays. Short term effect can be sunburn, tanning and photo sensitivity.

(i) Sunburn

In its mildest form, sunburn consists of a reddening of the skin (erythema) that appears a few hours after UV exposure and reaches a maximum intensity between 8 and 24 hours, then fades over a few days [8].

(ii) Tanning

When skin is exposed to UV, two distinct types of tanning reactions ensue. Firstly, immediate pigment darkening occurs, where melanin already in the skin darkens on exposure to UV and begins to fade within a few hours after cessation of exposure. Delayed tanning then occurs over about 3 days and can persist for several weeks. Exposure to UVB also results in an increase in the thickness of the epidermis [8,9].

(iii) Photosensitivity

A small minority are suffering from a skin condition that renders them especially sensitive to the UV portion of the sun's spectrum; this is termed photosensitivity. Photosensitivity disease (porphyria) and photo-aggravated disease (e.g. lupus erythematosus) are induced by minimal UV exposures. Moreover, certain medications, foods, and cosmetics contain substances that can induce photosensitivity. This interaction of chemicals or drugs with UV produces an unfavourable response in the skin in the form of a rash or exaggerated sunburn.

(B) LONG-TERM EFFECTS

These effects remain for longer duration on human and can be long lasting till life span. It can be cancerous and non-cancerous.

(i) Non-cancerous

The most usual long-term effects of UV exposure to the skin are dryness, blemishes and aging. Dryness happens when the top layers thicken to safeguard it from the sun, the skin loses moisture. A blemish is basically blotchy discoloration from breakage of tiny blood vessels that can be an early sign of sun damage. Aging does happen because UV devastates the elastin and collagen fibres in the inner layers of skin causing loss of the skin's natural elasticity (wrinkles), mostly from UVA. Excessive wrinkling from sun exposure produces the appearance of aged skin.

Freckles and solar brown spots (lentigines) are flat pigmented spots (usually no more than 0.5 cm) that frequently develop on the sun-exposed skin of lightly pigmented individuals (e.g. Caucasians). They are more frequent in individuals with very sun-sensitive (type 1) skin. Freckles are most frequent in children. The frequency of solar lentigines rises with age and is highest in the over 60-year-olds (estimated at 75% in the USA). Melanocytic naevi (moles) are benign tumours of pigmented skin cells, usually originating in the lower layer of the epidermis and later extending into the dermis. They are frequent in lightly pigmented or white-skinned populations and uncommon in black and Asian populations. In whites they develop primarily on body sites that receive most or are intermittently exposed to the sun and are associated with an increased risk of melanoma. Solar keratosis is a pre-cancerous growth of skin cells. Keratoses are very common on exposed body sites in lightly pigmented, older people living in areas of high levels of sunlight. Their number on the skin is strongly associated with the risk of non-melanocytic skin cancer [8].

(ii) Cancerous

Skin cancer is the most common human cancer and it can be of two type non-melanoma and melanoma skin cancer. About 95% of these are basal and squamous cell carcinomas commonly referred to as "non-melanoma skin cancers", the remaining 5% are malignant melanoma. The scientific evidence that sunlight is an important factor in the cause of skin cancers is convincing. While it is not unusual to have some moles or freckles, it is important to watch for any moles that change in color, increase in size, itchiness or redness, bleed. These could be signs of melanoma or another kind of skin cancer [8,10].

- **Non-melanoma Skin Cancer (NMSC)**

NMSCs are not usually fatal but can be very disfiguring if left untreated **[11]**. A number of facts have emerged from investigations of NMSCs like it is most prevalent as squamous and basal cell

carcinomas. The head and neck receive the most solar exposure, accounting for around 75% of basal cell carcinomas and more than 50% of squamous cell carcinomas. They can also appear on the forearms and hands, as well as any other part of the body that is frequently exposed to sunlight. People with light pigmentation (group 1 skin) are far more prone to develop NMSC than individuals with more pigmentation. Freckles and the presence of solar lentigines (brown spots) in children have been linked to an elevated risk of non-melanoma skin cancer. Light-coloured eyes, fair skin, light hair, a propensity for sunburn, and a poor ability to tan are all hereditary markers linked to an increased risk of developing skin cancer. There is strong evidence from surveys of skin cancer incidence in different nations that those who live closer to the equator are at higher risk. If the population has the same genetic variables, the incidence roughly doubles for every 10° drop in latitude, or roughly every 1000 km from the equator. Research indicates that individuals over 50 who have spent the majority of their lives outside are at a higher risk of developing skin cancer compared to those who work indoors.

- **Melanoma Skin Cancer**

Malignant melanoma is the least common but most dangerous form of skin cancer, followed by death of approximately 25% of the diagnosed melanomas. The number of cases of melanoma is increasing at an alarming rate worldwide and at a considerably higher rate compared to the other skin cancers. Research has documented

Incidence of melanoma are in areas of the body that are partially exposed to sunlight (trunk, arms, and legs) the back (for men) and lower legs (for women). Therefore, it is believed that UV exposure is just one of the elements that raise a person's risk of melanoma. Even though persons with lighter skin tend to live in warmer locations, melanoma is far more common among those with lighter skin. However, melanoma is more closely linked to genetic characteristics like the quantity of moles or naevi than to pigmentation. Childhood freckling has been linked to an increased incidence of melanoma. A tendency to sunburn is a risk factor in developing melanoma, as is a history of infrequent, intense exposure resulting painful, blistering sunburn, particularly during childhood. Although there are some exceptions, generally speaking, the incidence of melanoma is inversely correlated with latitude of residence; for instance, in Europe, the incidence is higher in Scandinavia than in Mediterranean countries. This apparent paradox may be explained by the stark differences in skin sensitivity and by extensive sun exposure during vacations in sunnier locations. The risk of developing melanoma is approximately one-quarter that of individuals of European origin born in those countries, but the risk is comparable for those who migrate from Europe to sunnier countries after childhood [8].

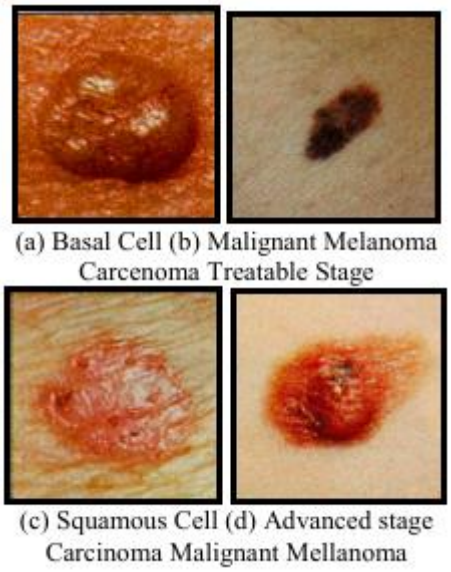

Figure 2 skin cancer [12]

(C) EFFECT ON EYES

UV radiation can cause various effects on eyes like cancer of eye, photokeratitis, pterygium, climatic droplet keratopathy and cataract (effect on lens). Long term sun exposure is a key factor in development of the conditions stressing the need for protective eye care. These effects can categorise in three parts as cancer of eyes, effect on cornea and effect on lens.

(i) Cancer of the Eye

Every year, approximately, 3millionpeoplelosetheirsight because of UV-related damage such as cataracts, which underlines the need to incorporate photo protective measures for the care of the eyes [13]. Malignant melanoma is the most common malignant cancer of the eyeball and occasionally requires its surgical removal. A common site for basal cell carcinoma is on the eyelids. There is evidence that these cancers are related to lifetime doses of sunlight.

(i) Effects on the Cornea

Photo keratitis is the key acute effect of radiation of intense UV from the sun or welding arcs. The outer layer of the cornea sustains damage, leading to severe pain and impaired vision due to a corneal haze that develops as a result of the injury, causing the eyelids to shut. Generally, photokeratitis results from exposure to sunlight in an environment that is highly reflective, for example snow so it terms as "snow-blindness". Photo keratitis is caused by artificial light sources only when there is a significant UV component, such as from arc welding (where it is commonly known as "welders' flash" or "arc eye"). Like sunburn, photo keratitis occurs several hours after exposure and is reversible. Symptoms usually fade within a day or two.

Pterygium is a vascular growth on the surface of the eye and is a common cosmetic blemish with a tendency to become inflamed. When pterygium extends over the centre of the cornea it reduces vision. It is amenable to surgery but tends to recur. Pterygium is likely to be caused, at least in part, by prolonged exposure to UV. Climatic droplet keratopathy is a blinding degeneration of the cornea that occurs in areas of the world characterized by a harsh climate.

In these regions climatic droplet keratopathy is a major cause of blindness which is intimately associated with exposure of the eye to UV. Diseases of the retina among adults, only small amounts (1% or less) of UV reach the retina because of absorption by the cornea and lens. However, because UV is known to damage tissue, the importance of this small amount as a cause of retinal damage cannot be ignored. It has been suggested that age-related macular degeneration (a loss of central reading vision) is associated with light exposure. This disease is a common cause of untreatable blindness in the developed world.

(iii) Effects on the Lens

Cataract is the most common cause of blindness in the world. It is a loss of transparency of the lens of the eye. Cataract shows up to greater extents in most people as they get older. It is amenable to surgical removal, and with insertion of an intraocular lens or other means of optical correction, vision can be restored. There is general agreement that lifelong exposure to UV is associated with the formation of certain types of cataracts [8].

III. UV Light as a Therapeutic Treatment

UV light is a double-edged sword for health. Although UV light can damage the body's health, it can also be involved in the synthesis of some beneficial substances and can be used as a means of treating some diseases. UV involved in the synthesis of vitamin D in the human body, which is not deficient in the right amount of sunlight exposure [14].

Specifically, UV therapy, often referred to as phototherapy, is a common treatment for various skin conditions. Phototherapy is a safe treatment option for babies. Babies who are born with jaundice have too much bilirubin in their bodies, which makes their skin and eyes look yellow. Blue UV light therapy helps babies get rid of the bilirubin so it doesn't become harmful to them. UV phototherapy also remains the treatment of choice in dermatology, including psoriasis, dermatophytosis, atopic dermatitis, and cutaneous T-cell lymphoma [15,16,17,18]

IV. Conclusions

UV rays effect the human being and can be hazardous to health. UV-B cause skin cancer which can also leads to death. UV rays have very dangerous effects on eyes. So, one should avoid the UV exposure in extreme temperature or use protective ways to save themselves from adverse effect of it. Apart from harmful effects of UV rays it also has some medical application and it is used for phototherapy in dermatology and blue-rays therapy for babies to treat jaundice.

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