

## REVIEW ARTICLE

# ROLE OF ULTRAVIOLET RADIATION IN SKIN CANCER: A REVIEW ARTICLE

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### ABSTRACT:

UV radiation (UV) is classified as a complete carcinogen, because it is both a mutagen and a non-specific damaging agent and has properties of both a tumor initiator and a tumor promoter. In environmental abundance, UV is the most important modifiable risk factor for skin cancer and many other environmentally-influenced skin disorders. Skin cancer is the most common type of cancer in fair-skinned populations in many parts of the world. The incidence, morbidity and mortality rates of skin cancers are increasing and, therefore, pose a significant public health concern. Ultraviolet radiation (UVR) is the major etiologic agent in the development of skin cancers. UVR causes DNA damage and genetic mutations, which subsequently lead to skin cancer. A clearer understanding of UVR is crucial in the prevention of skin cancer. Several factors influence the amount of UVR reaching the earth's surface, including ozone depletion, UV light elevation, latitude, altitude, and weather conditions. The current treatment modalities utilizing UVR can also predispose to skin cancers. Unnecessary exposure to the sun and artificial UVR are important personal attributable risks.

Key words: Carcinogen, Ozone, Skin cancer, Ultraviolet radiation

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This article may be cited as: Parmar D, Shah J. Role of Ultraviolet Radiation in Skin Cancer: A Review Article. *J Adv Med Dent Sci Res* 2015;3(4):83-85.

### INTRODUCTION

Comprising roughly 16% of body mass, the skin is the largest organ of the body. Skin is organized into two primary layers, epidermis and dermis, which together are made up of epithelial, mesenchymal, glandular and neurovascular components. The epidermis, of ectodermal origin, is the outermost layer and serves as the body's point of contact with the environment. As such, epidermal biological and physical characteristics play an enormous role in resistance to environmental stressors such as infectious pathogens, chemical agents and UV<sup>1, 2</sup>. Keratinocytes are the most abundant cells in the epidermis and are characterized by their expression of cytokeratins and formation of desmosomes and tight junctions with each other to form an effective physicochemical barrier. The dermis, derived from mesoderm, underlies the epidermis and harbors cutaneous structures including hair follicles, nerves, sebaceous glands and sweat glands. The dermis also

contains abundant immune cells and fibroblasts, which actively participate in many physiologic responses in the skin. The epidermis, demarcated from the dermis by a basement membrane, is organized into functional layers defined largely by keratinocyte characteristics such as size, shape, nucleation and keratin expression.<sup>3</sup>

Skin cancer is the most common type of cancer in light skinned populations around the world.<sup>4</sup> Skin cancers are mainly divided into melanoma, and non melanoma skin cancers (NMSCs), the latter including basal and squamous cell carcinomas (BCC and SCC, respectively). Melanoma is responsible for most of the cancer related mortalities, and NMSCs are typically described as having a more benign course with locally aggressive features. Nevertheless, they represent "the most common type" of cancer in humans and they can result in significant disfigurement, leading to adverse physical and psychological consequences for the affected patients.

### **NON-MELANOMA SKIN CANCERS**

It is estimated that 2–3 million cases of NMSCs occur worldwide each year. The incidence varies with very high rates in the Caucasian populations of the world.<sup>5</sup> most commonly diagnosed cancer in this country. Basal cell carcinoma, which accounts for 80–85% of all NMSCs, rarely metastasizes to other organs<sup>5</sup>. It is the most common malignancy in white people. Its worldwide incidence is increasing by up to 10%, “with highest rates in elderly men and increasing incidence in young women.”<sup>6</sup> Basal cell carcinoma and SCC are usually found in sun exposed areas, especially the head and neck regions. They are both positively related to the amount of ultraviolet radiation (UVR) received and inversely proportional to the “degree of skin pigmentation in the population.” Women have higher occurrences than men for both types of cancers on the legs, consistent with greater sun exposure at this site.<sup>7</sup>

### **MALIGNANT MELANOMA**

Malignant melanoma is more destructive than either basal cell skin cancer or squamous cell skin cancer, and is the most severe and deadly of the three skin cancers. Melanoma is a disease in which malignant or cancerous cells form in the skin cells called melanocytes, which are the cells that are responsible for skin color. Melanocytes are found throughout the lower part of the epidermis and give rise to the dark, protective pigment called melanin. Upon onset, melanocytes continue to make melanin, which explains the cancerous cells emerging in mixed shades of tan, brown, and black, although melanoma can also appear as red or white. This type of skin cancer spreads very quickly to other tissues or organs, a process referred to as metastasis, which is why treatment is essential. Melanoma can appear as a new lesion on skin without warning, or it may begin in or near a mole, or another dark spot in the skin. Most important, malignant melanoma can occur anywhere on the body.

### **ULTRAVIOLET RADIATION**

Sunlight is a continuous spectrum of electromagnetic radiation that is divided into three major spectrums of wavelength: ultraviolet, visible and infrared.<sup>8</sup> The UV range is the most significant spectrum of sunlight that causes photoaging and skin cancer. UVR is subdivided into ultraviolet A [UVA (315–400 nm)], ultraviolet B [UVB (280–315 nm)] and ultraviolet C [UVC (100–280

nm)]. Approximately 90–99% of the solar UVR energy that reaches the earth’s surface is UVA, where only 1–10% is UVB (Table 1). One study indicated that about 65–90% of all melanomas are attributable to UVR exposure.<sup>9–11</sup>

### **UVR AND SKIN CANCER PATHOGENESIS**

The damaging effects of UVR on the skin are thought to be caused by direct cellular damage and alterations in immunologic function. UVR produces DNA damage, gene mutations, immunosuppression, oxidative stress and inflammatory responses, all of which have an important role in photoaging of the skin and skin cancer. In addition to this, UVR creates mutations to p53 tumor suppressor genes; these are genes which are involved in DNA repair or the apoptosis of cells that have lots of DNA damage. Therefore, if p53 genes are mutated, they will no longer be able to aid in the DNA repair process; as a result, there is “dysregulation of apoptosis, expansion of mutated keratinocytes, and initiation of skin cancer.”<sup>12</sup>

### **SKIN COLOR AND PHOTOPROTECTION**

The “low incidence of cutaneous malignancies in darker skinned groups is primarily a result of photo protection provided by increased epidermal melanin, which provides an inherent sun protection factor (SPF) of up to 13.4 in blacks. Epidermal melanin in blacks filters twice as much UVB radiation as does that in Caucasians. Black epidermis transmits 7.4% of UVB and 17.5% of ultraviolet A rays, compared with 24% and 55% in Caucasian epidermis, respectively.<sup>13</sup> This is because the larger, more melanized melanosomes in the epidermis of dark skin absorb and scatter more light energy than the smaller, less melanized melanosomes of white skin.

### **PROTECTION FROM ULTRAVIOLET RADIATION**

One of the most important places to start a prevention strategy is to start becoming familiar with who is at risk for skin cancer and knowing the statistics of the occurrence of the disease. Gaining knowledge in these areas not only helps determine if one is at risk, but the recognition of the statistics and risks make the threat of this preventable disease more real and urgent in an individual’s life. If one considers how serious skin cancer is and the deaths that it causes, one will be more motivated to prevent

and protect him/herself in the future. As stated before, basal cell carcinoma is the most common form of skin cancer. This form usually develops into the more serious malignant form of skin cancer when not treated. Thus, at the nonmalignant stage, skin cancer could be cured, if one would immediately seek treatment and prevent the disease from progressing. Early recognition of the disease and seeking immediate treatment is essential to survival in the case of malignant melanoma. Approximately, twenty-five percent of melanoma patients will be killed by their disease. Thus, this is a disease that definitely should not be taken lightly, and the number of people getting skin cancer is not decreasing due to disbelief and lack of knowledge of how deadly skin cancer can be. Along with this knowledge, it is also important for one to understand whether they have a high risk factor for developing skin cancer.

There is a wide range of risk factors that influence the development of skin cancer. One of the top risks is exposure to natural sunlight and its UV rays. The more one is subjected to the natural rays of the sun, the greater at risk he/she is when it comes to contracting a form of skin cancer. However, some of the additional risk factors that are usually unknown to most people are: a person with unusual moles, exposure to artificial ultraviolet light (tanning booth), and family or personal history of melanoma. Being exposed to sunlight is a great risk; but individuals with moles or a family history of skin cancer have an increased chance of getting skin cancer.

## CONCLUSION

By providing proper education, people will be more aware of the truths and consequences of excessive UV exposure and skin cancer. This will hopefully allow them to take preventive steps, to reduce their risk of skin cancer. Through public education, healthcare agencies/providers can increase the public's awareness of skin cancers, their causes and preventative measures, which may be both life-changing and life-saving.

**Source of Support:** Nil

**Conflict of interest:** None declared

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