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Review

Long-term health risk to the skin of ultraviolet radiation

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Abstract

The major well-proven long-term health risks of excessive exposure to ultraviolet (UV) radiation relate to the skin. Premalignant skin lesions are seen very much earlier in white skinned populations exposed to excessive sunlight, and over time these same individuals develop larger numbers of all of the three major skin cancers than individuals who do not experience excessive UV exposure. These three skin cancers are squamous cell carcinoma (SCC), basal cell carcinoma (BCC), and malignant melanoma. In the case of SCC the major aetiological pattern is chronic long-term exposure, but for BCCs the pattern appears to be slightly different with short-term burning episodes being more important. In the case of melanomas, there is evidence that for the 4 main types of melanomas, the pattern of excess UV exposure which is most injurious varies.

Keywords: Skin cancer; Ultraviolet radiation; Melanoma; Basal cell carcinoma; Squamous cell carcinoma

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1. Introduction

Ultraviolet (UV) radiation is essential for survival of man on planet earth. However, relatively rapid evolutionary changes have resulted in a human population which lacks any significant natural protection from body hair living in parts of the world where year round sun exposure can be intense. Cultural changes in the past 100 years have resulted in complex psychological reactions to natural skin colour, such that pale-skinned Caucasians regard some degree of tan as cosmetically highly desirable, while dark-skinned Africans use

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destructive and expensive bleaching techniques to lighten their skin. The most recent addition to this complex set of interacting variables is the easy and inexpensive availability of air travel, allowing white-skinned populations resident in temperate climates to accumulate many more hours annually of sun exposure than was the case even 20 years ago. Thus a situation already exists whereby those who wish more intense and greater cumulative sun exposure than their genetic evolution has allowed for to expose their skin to very much higher cumulative levels of natural UV radiation than their grandparents. The situation seems likely to continue.

In addition to the ready access to natural UV radiation, the use of artificial sources of UV for tanning purposes has over the past 15 years become widespread and reached epidemic proportions in many parts of the world. The output of these UV sources is extremely variable although in general the UVA content is high relative to UVB. Such sources have now been used for long enough for some early data to become available on the hazards of excess long-term exposure to these machines.

Excess exposure to natural UV radiation may be occupational as for example in agricultural workers, or recreational as in enthusiastic golfers or walkers. In assessing excess exposure, there are uncertain variables such as for example the age at which excess exposure takes place. There is some epidemiological data suggesting that childhood sun exposure increases the lifetime risk of future melanoma (Holman et al., 1980; Movschovitz and Modan, 1993), but the mechanism for this effect is not clear. It may be that malignant change is initiated in melanocytes at a young age, and that further events or "hits"—possibly further sun exposure—are required for promotion of the cells to the completely transformed state and melanoma. Alternative hypotheses include the idea that the young immune system is not able to handle the immunological events initiated by UV damage as well as the mature immune system, or that unscheduled DNA repair, a process essential for removing UV-damaged DNA is less effective in childhood. Neither of the above hypotheses has been adequately tested.

A further variable to be considered in defining excess UV exposure is the attenuating effect of natural pigmentation. Skin cancer, the main problem associated with excess chronic UV exposure, is predominantly a disease of Caucasians, and specifically a disease of pale-skinned Caucasians with so-called type 1 skin which tans poorly if at all, and burns readily on exposure to natural sunlight. However all types of skin cancer do occur on darker skin but in very much reduced numbers. The relative protection offered by darker Caucasian or Mediterranean skin relative to Asian, Indian or African is not clear.

The major hazards of chronic excess exposure to UV radiation are all types of cutaneous malignancy. The largest groups of these malignancies are basal cell carcinomas (BCCs), squamous cell carcinomas (SCCs), and malignant melanomas, but rarer conditions such as Merkel cell carcinomas are also sun-induced tumours.

For SCC, chronic sun-induced skin damage often referred to as photoageing, or traumatic damage resulting in scars is well-recognised predisposing factors. Photoageing may lead first to actinic keratoses (AK) which are a facultative precursor of SCC.

In the case of BCCs, there does not appear to a precursor lesion or evidence of predisposing environmentally induced skin damage.

In the case of melanoma around 30% of all tumours appear to arise on a pre-existing benign naevus, but the great majority of melanocytic naevi are non-progressor lesions.

1.1. Actinic keratoses

These lesions are extremely common on white skin in exposed body sites after the age of 50 in Europe and even earlier in sunnier climates such as Australia. They are usually multiple, and are facultative precursors to SCC. The likelihood of an AK transforming to SCC is debated, but appears to be very low. However, an argument for treating AK is that this will prevent future SCCs. It clearly would be valuable to compute the cost benefit of treating AKs for this purpose.

AK arise on visibly sun-damaged skin which is dry, wrinkled, and exhibits pigmentary irregularities. They are most commonly seen on the face, the scalp in males, and the backs of the hands in both sexes. They are seen as raised scaling lesions which may ooze or crust and on the male face are easily traumatised while shaving (Salasche, 2002).