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Review

Risks and benefits of UV radiation in older people: More of a friend than a foe?

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ABSTRACT

Incident ultraviolet radiation from sunlight varies in intensity and spectrum with season and latitude and has both deleterious and beneficial effects on health in older people. Sunlight is the major preventable risk factor for skin cancer. Non-melanoma skin cancer is the commonest malignancy in a pale skinned older population, but the mortality is extremely low. Intermittent sun exposure is a risk factor for the more dangerous melanoma but chronic sun exposure and outdoor occupation may be protective. Public health advice has tended to concentrate on the dangers of sun exposure despite the absence of any data that increased sun exposure correlates with raised all-cause mortality.

Inadequate sun exposure carries its own risks, and the older population are particularly sun deprived as recorded by low serum Vitamin D levels and lack of outdoor activity. Sunlight has health benefits dependently and independently of vitamin D synthesis. Low serum vitamin D levels correlate with increased morbidity and mortality but the direction of association is not always clear. Vitamin D has a causal role in calcium and phosphate metabolism, in skeletal health and probably reduction of colorectal cancer. Evidence is weak for a role in cardiovascular health, but mobilisation of nitric oxide by UVA radiation from nitrate stores in skin, with consequent reduction in BP, may account for the observed reduction in cardiovascular disease and all-cause mortality with increased sun exposure. Advice on healthy sun exposure needs to be reconsidered, with reduction in all-cause mortality and morbidity as the primary end point.

Contents

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1. Introduction

Public health and advisory bodies currently advise that sun exposure (UV radiation) should be limited based on the associated adverse effects of which the most important is the development of skin cancer [1].

The risks from excessive UV exposure are well established but benefits on several markers of health are also emerging, in addition to the main effect of cutaneous vitamin D synthesis. The association between vitamin D deficiency and a number of serious non-skeletal conditions is well described in the literature. It is unclear if vitamin D itself is responsible for all these relationships or is a surrogate marker of UV exposure, and other mechanisms are implicated. Biological effects of UV separate to Vitamin D photosynthesis are now being explored due to the apparent reduction in all cause mortality in populations with increased UV exposure.

The mortality and morbidity associated with hypertension and vascular disease in the older population far exceeds that of skin cancer and we will review the hypotheses pertaining to the role of UV in blood pressure modulation, cardiovascular disease and stroke.

There is significant variation in UV exposure dependent on latitude and environmental factors. Sun exposure advice should thus be tailored to local ambient conditions and geographical location.

The objectives of this review are to explore the evidence for the harm and benefit of UV exposure in the older adult population. Some of these benefits will be vitamin D related but we also explore the benefits that may be independent of vitamin D levels.

1.1. Search strategy

Pubmed, Medline, Embase, Cinahl and The Cochrane Databases were searched. No date or language restrictions were placed on the articles origins. Bibliographies from papers were also analysed for additional relevant publications.

All the articles were obtained and evaluated for relevance. Only those with the most relevance were used in this review. Key search words used in combination were: Ultraviolet Rays, Ultraviolet, UV, UV radiation, sunlight, sunlight exposure, old age, elderly, geriatric, aged, Benefit and harm. Finally, 50 articles were selected for inclusion.

1.2. Ultraviolet radiation

Ultraviolet or solar radiation can be categorised according to its wavelength into UVA, UVB and UVC Figure 1. Sunlight is predominantly comprised of UVA – 90% and UVB – 10%. Less than 2.5% of the sun's radiation permeates through the earth's atmosphere and UVC is absorbed before reaching the Earth's surface [2]. Incident UV at the Earth's surface varies due to changes in atmospheric absorption, time of day, latitude, altitude, cloud cover and season.

Biological activity is wavelength dependant with UVA penetrating deeper into the dermis whilst UVB is largely absorbed within the epidermis. These wavelength differences determine the location and type of biological activity. Excessive exposure results in acute keratinocyte damage, apoptosis and mutation to p53 suppressor genes. UVA damages DNA indirectly through free radical formation and oxidative injury, while UVB radiation causes direct DNA damage with signature mutations predisposing to skin cancers. Other biological effects of UV include photo ageing, inflammation and burning in addition to Vitamin D synthesis [3].

2. Risk versus benefit

Policies strictly limiting sun exposure are now being challenged in older adults [4]. 20% of the UK population aged > 65 years cannot recall the last episode of any form of outdoor exercise [5] and vitamin D deficiency in the older population is widespread [6].

2.1. Vitamin D

The key role of Vitamin D is to optimise calcium and phosphate absorption from the gut, but it probably has beneficial health effects beyond this.

Once absorbed in the gut or produced in the skin, vitamin D is hydroxylated to 25OHD by the liver Figure 2. Serum levels of 25OHD are used as indicators of Vitamin D status. 1, 25 OHD – (calcitriol) – the biologically active form is produced in the kidney. Renal production of calcitriol is regulated by calcium via PTH.

There is a general consensus that a level of 25(OH) D – < 25 nmol/l (or 10 ng/ml) is deficient but there is less agreement with regard to what the optimal level of circulating 25(OH) D should be. Despite this, specific serum levels have been recommended with respect to bone health and also suggested to reduce the risk of non skeletal illnesses [8].

Skin production of vitamin D is governed and influenced by a number of racial and environmental factors [9]. Vitamin D deficiency is linked to an increasing number of pathological processes although controversy regarding the causality in these associations continues particularly as Vitamin D "deficiency" is very prevalent.

Recommendations regarding the optimal duration of sun/UVB exposure to enable "adequate" vitamin D synthesis are complicated by variations in UV intensity relating to latitude, time of day, season, cloud cover, skin pigmentation and clothing [10]. Pigmented skin requires longer UV exposure to synthesise vitamin D due to UVB absorption by melanin.

Attempts have been made to take into account environmental and racial differences when recommending sun exposure time [11]. Prolonged sun exposure does not cause Vitamin D levels to continue to rise indefinitely. With age, human skin atrophies and there is a resultant reduction in dermal synthesis of vitamin D after exposure to UVB [12]. This reduction in vitamin D photosynthesis is compounded by older adults also spending less time in sunlight due to attitudes, opportunity and frailty [13].

Lower serum levels of Vitamin D are unsurprisingly linked with multimorbidity and ill health but the direction of the association is unclear. A large number of intervention studies with oral Vitamin D supplementation have been performed to resolve this question. These have recently been meta-analysed, although different trial designs of the underlying studies (dose of vitamin D; concomitant

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