For reprint orders, please contact:
reprints@future-drugs.com

A contemporary strategy for sun exposure

Brian Diffey

That excessive sun exposure is the principal cause of skin cancer is acknowledged universally. Yet emerging evidence that insufficient sun exposure may be associated with an increased risk of noncutaneous diseases, including some internal cancers, is leading to a reappraisal of the exact balance requried in terms of our solar UV exposure for optimum health. Some commentators have argued that current public health campaigns that advise people to limit their sun exposure may be resulting in more harm than good and calls have been made for these campaigns to be abolished. I will argue that this approach is not the way forward; rather we should promulgate different messages depending upon whether our exposure is elective (high dose) or adventitious (low dose).

Expert Rev. Dermatol. 2(2), 139–142 (2007)

CONTENTS

University of Newcastle, School of Clinical and Laboratory Sciences, Newcastle, UK
b.l.diffey@ncl.ac.uk

KEYWORDS:
cancer, sunlight, sun protection, vitamin D

Dermatologists need no persuasion that the UV component of sunlight, which comprises approximately 5% of terrestrial solar radiation, is largely responsible for the deleterious effects on the skin that are associated with sun exposure. These effects include sunburn, immunological changes, precipitation and exacerbation of photosensitive diseases, accelerated aging of chronically sun-exposed skin and skin cancer. In order to militate against these effects, UV exposure induces photoadaptive changes of tanning and hyperplasia.

The only thoroughly established beneficial effect of solar UV radiation on the skin is the synthesis of vitamin D and its role in maintaining bone health. But now there is emerging evidence implicating a low vitamin D status in a range of adverse health conditions, including cancer and certain autoimmune diseases [1], and this is leading to a reappraisal of the balance we require in terms of our solar UV exposure in order to approach the minimum of the conceptualized disease burden: the UV exposure curve (FIGURE 1).

The UV dose axis is deliberately qualitative, since the balance between the level and pattern of UV exposure that results in adequate vitamin D synthesis but does not increase the harmful consequences of exposure remains to be defined.

The rise of skin cancer

There is no question that the upward trend in the incidence of skin cancer has had a major impact on dermatological practice in many countries populated primarily by people with white skin. The incidence of cutaneous malignant melanoma, in particular, continues to rise [2] and this rise is predicted to continue for some years to come [3,4]. This increase is commonly attributed to changing lifestyles, resulting in increasing intermittent, high-dose rate exposure to sunlight, especially during childhood, as a consequence of vacations at sunny locations and outdoor pursuits [5,6]. To counteract the rise in melanoma, sun awareness campaigns have been introduced in a number of countries since the 1980s [7] with the object of encouraging people to limit their exposure to strong sunshine by a combination of shade, clothing and sunscreens [8], and to avoid sunburn.

Link between sunlight & cancer incidence & mortality

Reports continue to emerge that suggest that sunlight exposure and the resulting cutaneous synthesis of vitamin D might have a beneficial influence for certain major cancers [9], especially breast, colorectal and prostate cancer [10–13]. These studies have been based either on using ambient solar UV radiation as a proxy for

10.1586/17469872.2.2.139

ISSN 1746-9872

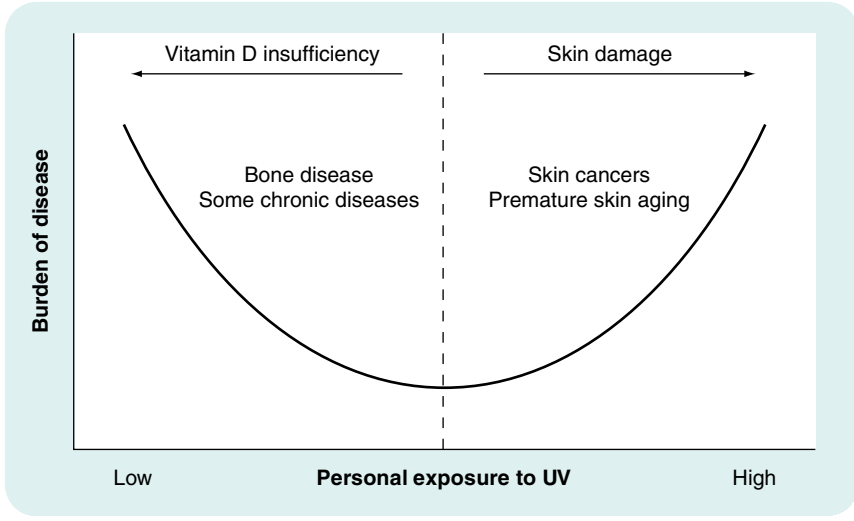

Figure 1. Representation of the health consequences of personal exposure to UV radiation.
Reproduced with permission from [19].

latitude in studies looking at the geographical incidence and/or mortality of cancer, or case–control studies using questionnaires in which individuals are asked to recall previous sun exposure [14,15]. From a recent review of many of the studies published to date, it is becoming clear that there is increasing evidence of sunlight having a preventative effect on the initiation and/or progression of different kinds of cancer [16].

In light of these and similar publications, reports have appeared in the British lay press encouraging people to seek more sun exposure, accompanied by calls for the main sun awareness campaign in the UK (SunSmart) to be abandoned as a means of reducing overall incidence and mortality from cancer [101]. Unsurprisingly, Cancer Research UK, the agency hosting the campaign, has rejected this call [17].

How much sun exposure do we currently receive?

Our solar UV exposure on any particular day depends primarily on three factors: the maximum solar altitude (height of the sun in the sky), the weather and our time spent and behavior outdoors. Broadly speaking, we can divide our sun exposure into two types, adventitious exposure, typified by the unavoidable exposure associated with activities, such as shopping and traveling to work, and elective exposure, when we deliberately seek the sun for recreational purposes, usually during summer weekends and holidays.

By combining values of measured ambient UV radiation in the UK with exposure (relative to ambient) on sites such as the face and hands together with estimates of time spent outside (but not in vehicles) during weekdays and at weekends, it is possible to give some indication of the range of daily exposures at different times of the year (FIGURE 2).

The data shown for holiday exposure in this figure relate to someone who is ambulant; for keen sunbathers who are prone or supine, daily exposures of 10 standard erythema dose (SED; an exposure of 2–3 SED is necessary for a minimal erythema in unacclimatized white skin that burns easily) or higher are readily achievable. What is evident is that for a population in temperate latitudes, such as the UK, there is more than a 1000-fold variation in our daily UV exposure throughout the year.

Should we increase our population's sun exposure?

Public health campaigns, such as the SunSmart program hosted by Cancer Research UK, are intended to advise people primarily to avoid excessive exposure in strong sunshine that can result in acute signs, such as skin reddening, and increase the lifetime risk of skin cancer. Where the program might justifiably be criticized is that some argue that the message could be interpreted as applying to sun exposure throughout the year [18], which for a country with the climate and latitude of the UK, would only be acted upon by a committed heliophobe.

The supposed gains in vitamin D that might be achieved by encouraging greater sun exposure [18] are speculative and may not actually achieve the desired end point of a worthwhile increase in

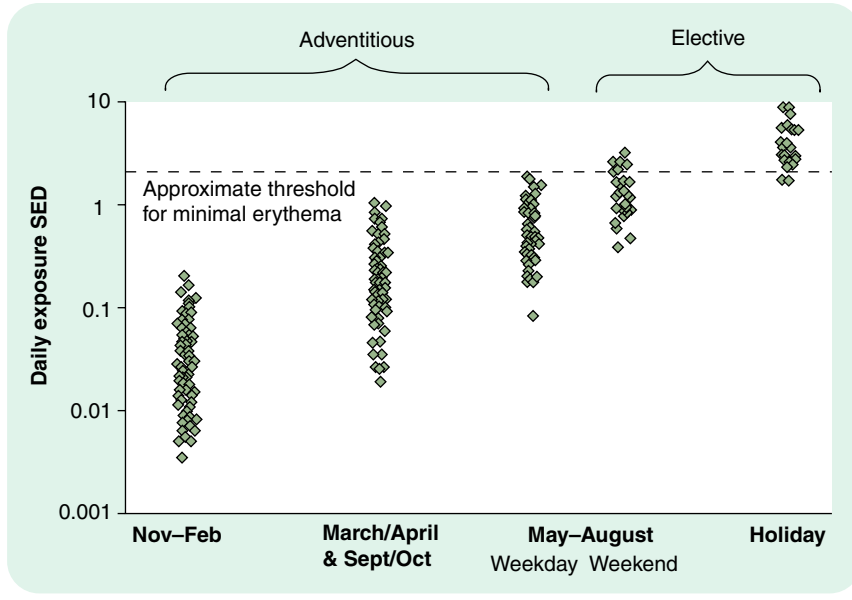

Figure 2. Representative daily UV exposure of an ambulant indoor worker in the UK.
SED: Standard erythema dose.
Reproduced with permission from [19].

population vitamin D status [19]. So, rather than advocate primary prevention of vitamin D insufficiency by prescriptive sun exposure, which, owing to the many confounding factors of time of day, season, latitude, weather, presence of nearby shade, behavior and area of skin exposed, is complex and could well lead to overexposure, it might be better to utilize what benefits there may be in secondary prevention by encouraging more outdoor physical activity. Not only would this be beneficial to our health, in terms of obesity, diabetes and heart disease, but we would also receive some subliminal UV exposure in the process.

However, what is likely to be more effective in situations where concerns exist regarding inadequate vitamin D status is oral supplementation [20], although it should be borne in mind that vitamin D is toxic in large doses. The current UK government recommendations are 10 µg vitamin D a day for adults at risk of deficiency [21] but more recently it has been argued that intakes should be between 20 and 25 µg a day to achieve optimal status [22].

Strategy for sun exposure

Public health campaigns that deliberately encourage an overall increase in population exposure to solar UV radiation, especially in people with white skin, as a means of reducing the incidence and mortality of cancer and other chronic diseases cannot currently be justified. This is particularly true for our elective, or recreational, exposure since the continuing popularity of overseas holidays fuelled by low-cost flights, coupled with the impact of climate change that will probably encourage people living in temperate latitudes to spend more time outdoors, will act as drivers for increasing population exposure to high levels of insolation, certainly for the UK population and possibly for others living in northern Europe and America [23].

It is important to remember, however, that since approximately 99 out of every 100 British people will not develop melanoma during their lifetime and nine out of ten will be free of nonmelanoma skin cancer, there may be a case for those populations living at temperate latitudes for making sun protection messages more specific to recreational exposure for extended periods in strong sunshine and targeting high-risk groups, such as children and adolescents, and those with susceptible phenotype and genotype characteristics.

In parallel with this, healthcare professionals may wish to consider adopting a relaxed approach to adventitious sun exposure, for example, lunchtime exposure during the working week, acknowledging the beneficial effects that may accrue from limited sun exposure coupled with the recognition that the most harmful effects of UV are mainly the result of high-dose rate exposure during recreational activities. Such a strategy would prevent sunburn and reduce the risk of skin cancer, especially melanoma, but still ensure a moderate exposure to less intense sunshine in late summer and early autumn that may go some way to help maintain vitamin D status during the winter months.

Expert commentary & five-year view

There is currently disharmony between many health professionals, whose role is to prevent, diagnose and/or treat sun-induced skin disease, especially skin cancer, on the one hand, and proponents of the perceived under-rated health benefits

Key issues

- The incidence of skin cancer continues to increase and this increase is predicted to continue for some years to come.
- Emerging evidence suggests that sunlight exposure and the resulting cutaneous synthesis of vitamin D might have a beneficial influence for some major cancers and certain autoimmune diseases.
- Reports have appeared encouraging people to seek more sun exposure, accompanied by calls for the SunSmart campaign in the UK to be abandoned as a means of reducing the overall incidence and mortality from cancer.
- For populations living in temperate latitudes, such as the UK, there is more than a 1000-fold variation in our daily UV exposure throughout the year.
- The supposed gains in vitamin D that might be achieved by encouraging greater sun exposure are speculative and may not actually achieve the desired end point of a worthwhile increase in the population's vitamin D status.
- We cannot currently justify public health campaigns that deliberately encourage a greater burden of solar UV radiation, especially in white populations, as a means of reducing the incidence and mortality of cancer and other chronic diseases.
- Sun protection messages should be specific to recreational exposure for extended periods in strong sunshine and should target especially high-risk groups such as children and adolescents, and those with susceptible phenotype and genotype characteristics.
- We should adopt a relaxed approach to adventitious sun exposure acknowledging the beneficial effects that may accrue from limited sun exposure.
- Such a strategy would prevent sunburn and reduce the risk of skin cancer, especially melanoma, but still ensure a moderate exposure to less intense sunshine in late summer and early autumn that may go some way to help maintain vitamin D status during the winter months.

of vitamin D on the other. If the literature continues to grow with carefully conducted case–control and other studies on the benefits of sun exposure, coupled with wide acknowledgement of the deleterious effects of excessive sun exposure, we can expect to see a coming together of these polarized views.

This has already started with a Position Statement on the risks and benefits of sun exposure issued in March 2005 by the Australian and New Zealand Bone and Mineral Society, Osteoporosis Australia, Australasian College of Dermatologists and The Cancer Council Australia, which read: "A balance is required between avoiding an increase in the risk of skin cancer and achieving enough UV radiation exposure to maintain adequate vitamin D levels". The challenge over the coming years will be to identify how much UV radiation exposure is 'sufficient' against a confounding background of environmental, climatic, behavioral and genotype influences.

Information resource

SunSmart website:
www.sunsmart.org.uk

References

1 Raiten DJ, Picciano MF. Vitamin D and health in the 21st Century: bone and beyond. Executive summary. *Am. J. Clin. Nutr.* 80(Suppl.), 1673S–1677S (2004).

▶2 Lends MB, Dawes M. Global perspectives of contemporary epidemiological trends of cutaneous malignant melanoma. *Br. J. Dermatol.* 150, 179–185 (2004).

▶3 Diffey BL. The future incidence of cutaneous melanoma within the UK. *Br. J. Dermatol.* 151, 868–872 (2004).

▶4 de Vries E, van de Poll-Franse LV, Louwman WJ, de Gruijl FR, Coebergh JWW. Predictions of skin cancer incidence in The Netherlands up to 2015. *Br. J. Dermatol.* 152, 481–488 (2005).

▶5 de Vries E, Coebergh JW. Cutaneous malignant melanoma in Europe. *Eur. J. Cancer* 40, 2355–2366 (2004).

▶6 Marks R. Epidemiology of melanoma. *Clin. Exp. Dermatol.* 25, 459–463 (2000).

7 Grob JJ, Bonerandi JJ. Attitudes and behaviour towards sun exposure: implications for melanoma prevention. In: *Epidemiology, Causes and Prevention of Skin Diseases.* Grob JJ, Stern RS, Mackie RM, Weinstock MA (Eds). Blackwell Science, Oxford, UK 144–151 (1997).

8 Diffey BL. What can be done to reduce personal ultraviolet radiation exposure? In: *Prevention of Skin Cancer. Cancer Prevention–Cancer Causes, Volume 3.* Hill DJ, Elwood JM, English DR (Eds). Kluwer Academic, Dordrecht, The Netherlands 241–258 (2004).

▶9 Lim H-Y, Roychoudhuri R, Peto J, Schwartz G, Baade P, Møller H. Cancer survival is dependent on season of diagnosis and sunlight exposure. *Int. J. Cancer* 119, 1530–1536 (2006).

▶10 Grant WB. An estimate of premature cancer mortality in the United States due to inadequate doses of solar ultraviolet-B radiation. *Cancer* 94, 1867–1875 (2002).

▶11 Freedman DM, Dosemeci M, McGlynn K. Sunlight and mortality from breast, ovarian, colon, prostate, and non-melanoma skin cancer: a composite death certificate based case–control study. *Occup. Environ. Med.* 59, 257–262 (2002).

▶12 Moan J, Porojnicu AC, Robsahm TE *et al.* Solar radiation, vitamin D and survival rate of colon cancer in Norway. *J. Photochem. Photobiol. B: Biology* 78, 189–193 (2005).

▶13 Bodiwala D, Luscombe CJ, Liu S *et al.* Prostate cancer risk and exposure to ultraviolet radiation: further support for the protective effect of sunlight. *Cancer Lett.* 192, 145–149 (2003).

▶14 Giovannucci E. The epidemiology of vitamin D and cancer incidence and mortality: a review (United States). *Cancer Causes Control* 16, 83–95 (2005).

▶15 Moon SJ, Fryer AA, Strange RC. Ultraviolet radiation: effects on risks of prostate cancer and other internal cancers. *Mut. Res.* 571, 207–219 (2005).

▶16 van der Rhee HJ, de Vries E, Coebergh JWW. Does sunlight prevent cancer? A systematic review. *Eur. J. Cancer* 42, 2222–2232 (2006).

▶17 Hiom S. Public awareness regarding UV risks and vitamin D – the challenges for UK skin cancer prevention campaigns. *Prog. Biophys. Molecular Biol.* 92, 161–166 (2006).

▶18 Gillie O. A new government policy is needed for sunlight and vitamin D. *Br. J. Dermatol.* 154, 1052–1061 (2006).

▶19 Diffey B. Do we need a revised public health policy on sun exposure? *Br. J. Dermatol.* 154, 1046–1051 (2006).

▶20 Weinstock MA. Controversies in the public health approach to keratinocyte carcinomas. *Br. J. Dermatol.* 154(Suppl. 1), 3–4 (2006).

21 Department of Health. Nutrition and bone health: with particular reference to calcium and vitamin D. London: The Stationery Office (1998).

▶22 Dawson-Hughes B, Heaney RP, Holick MF, Lips P, Meunier PJ, Vieth R. Estimates of optimal vitamin D status. *Osteoporos. Int.* 16, 713–716 (2005).

▶23 Diffey BL. Climate change, ozone depletion and the impact on ultraviolet exposure of human skin. *Phys. Med. Biol.* 49, R1–R11 (2004).

Website

101 Gillie O. Sunlight Robbery: Health benefits of sunlight are denied by current public health policy in the UK. London: Health Research Forum 2004 www.healthresearchforum.org.uk/reports/sunlightrobbery.pdf

Affiliation

- *Brian Diffey, PhD, DSc*
  Emeritus Professor of Photobiology, University of Newcastle, School of Clinical and Laboratory Sciences, Newcastle, UK
  b.l.diffey@ncl.ac.uk