Public Health Reviews

Is the current public health message on UV exposure correct?

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Abstract Current sun safety messages stress the importance of sun protection in avoiding the consequences of excessive exposure to ultraviolet radiation (UVR), such as skin cancers, cataracts and other eye diseases, and viral infections caused by UV-induced immunosuppression. However, adequate exposure to UVR has an important role in human health, primarily through UV-induced production of vitamin D, a hormone essential to bone health. Vitamin D insufficiency may be associated with increased risks of some cancers, autoimmune diseases and mental health disorders such as schizophrenia. Here, we review the evolution of current sun exposure practices and sun-safe messages and consider not only the benefits, but also the detrimental effects that such messages may have. UVR-induced vitamin D production can be inhibited by factors such as deep skin pigmentation, indoor lifestyles, older age, sun avoidance behaviours and clothing habits that limit skin exposure, with deleterious consequences for health. There is some early evidence that sun-safe messages are beginning to cause a decrease in skin cancer rates in young people. After the widespread promotion of sun safety, it may now be appropriate to refine public health messages to take better account of variations between groups and their susceptibility to the dangers and benefits of sun exposure.

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Introduction: development of current sun exposure messages

Human evolution began at low latitudes in a setting of high ambient ultraviolet radiation (UVR). Furred primates derived their relatively high vitamin D requirements from their constant grooming and ingestion of oils rich in vitamin D precursors that were secreted by skin onto their fur.[1] With the adoption of a savannah habitat and a hunter-gatherer lifestyle, thermoregulation was improved by the gradual loss of protective fur. This loss, in turn, may have created evolutionary pressure to develop deeply pigmented skin to avoid photodegradation of micronutrients (such as folic acid) and protect sweat glands from UVR-induced injury.[2]

Both thermoregulation abilities and maintenance of folic acid levels (through the prevention of neural tube defects) would have been powerful drivers of natural selection. By contrast, skin cancers from excessive sun exposure, which are uncommon in deeply pigmented populations and are low-mortality diseases arising in the post-reproductive period, would have been of little evolutionary importance. With human migration to higher latitudes, however, strong evolutionary pressure favoured the development of fairer skin that allows more efficient UVR-induced vitamin D production, to avoid vitamin D deficiency and associated rachitic deformities, in the lower ambient UVR environment.[2,3] Cool temperatures at higher latitudes encouraged the use of clothing for warmth. With the shorter winter days and insufficient solar radiation in the UVB wavelengths to stimulate the production of vitamin D, even in exposed fair skin, dietary vitamin D would have become increasingly important.

Over time, clothing became a norm and then a social attribute in many societies. For some, movement to urban centres meant that rural lifestyles were abandoned. As European societies became aware of the rest of the world, fair skin became highly prized, since it identified the owner as someone who did not need to toil in the sun.[4] By the 1600s, skin was covered, sun was avoided and rickets was prevalent.[5] During the Industrial Revolution, indoor factory work became common and rickets emerged as a disease of working class children. Holick estimates that by the end of the 19th century, 90% of children who lived in the sunless narrow alleyways of industrialized North America and Europe had manifestations of rickets.[6] But, as the 20th century dawned, social and medical attitudes to sun exposure began to change. Only the wealthy could afford to take holidays by the sea, and to participate in sports such as skiing and sailing. A tan became the new status symbol signifying money, time and health. In 1910, an editorial in the *Lancet* noted that "Rightly or wrongly, the face browned by the sun is regarded as an index of health."[7] Phototherapy became a popular medical treatment for chronic ulcers and wounds, tuberculosis, leukaemia, rheumatism, gout and diabetes.[4]

In the early 1900s,[1] the discovery of the link between rickets and a deficiency in the sunlight-derived factor, vitamin D,

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helped to ensure that sunbathing and sunlamps became popular as a preventative medical intervention and also to allow their owners to develop a "healthy" tan. Early reports of an association between sun exposure and skin cancer in the dermatology publications in the late 19th century attracted little attention from the medical profession or the general community.[4] But by 1932, the US Public Service was issuing warnings about sun-induced health risks. The new health message was one of moderation: people were advised to avoid the midday summer sun, protect their heads from direct sunlight, and gradually increase the time of sun exposure from an initial 5–10 minutes per day.[8]

Over the next 30 years, the skin cancer hazard of excessive sun exposure became well established. Scientists began to understand the mechanisms of sun damage[9] and the increasing incidence of skin cancers was documented.[10] Coincidentally in the early 1970s, scientists recognized that chlorofluorocarbons (CFCs) used as refrigerants or in aerosols, when released into the atmosphere, could cause the chemical destruction of the stratospheric ozone that blocks much of the harmful UVB radiation from reaching Earth's surface.[11] One logical consequence of this increase in UVB radiation would be an increased incidence of skin neoplasms. The dramatic notion that CFCs were breaking down the protective ozone "shield" led to international governmental action to limit the use of CFC-containing aerosols and then to phase-out CFCs via the Montreal Protocol and its subsequent amendments.

Skin cancer is particularly common in Australia; "one of the penalties", according to Norman Paul[4] "to be paid for inhabiting a country normally destined (in geographical location) to be occupied by a coloured race".[4] And Australia led the way in the development of programmes to limit excessive sun exposure with the "Slip [on a shirt], Slop [on some sunscreen], Slap [on a hat]" initiative, developed in the early 1980s.[12] This programme and the subsequent SunSmart campaign[12] have been highly influential in Australian society — informing the public of the risks and providing simple, clear instructions on how to avoid excessive UVR exposure. Sun protection campaigns in other countries now also provide advice to schools and the community on how to decrease sun exposure.[13,14]

United Nations involvement

The trigger for the United Nations (UN) to become involved in work to understand the health effects of UVR exposure was the recognition that the ozone layer was being depleted and that the risk of diseases resulting from excessive exposure to UVR, particularly skin cancers, would probably increase. UN involvement was established at the United Nations Conference on Environment and Development in 1992. Under Agenda 21 the Conference made recommendations: "to undertake as a matter of urgency, research on the effects on human health of increasing ultraviolet radiation reaching the Earth's surface as a consequence of depletion of the stratospheric ozone layer"; and "on the basis of the outcome of this research, to consider taking appropriate remedial measures to mitigate the above mentioned effects on human beings".

In response, WHO, in collaboration with the United Nations Environment Programme, the World Meteorological Organization, The International Agency for Research on Cancer and the International Commission on Non-Ionizing Radiation Protection, established INTERSUN, the Global UV Project.[15] The project's mission is to reduce the burden of disease resulting from exposure to UVR, under the mandate of the 1992 UN Conference.

In 1999, INTERSUN was relaunched by WHO[16] and was expanded to cover a range of new activities, including children's health. A key objective was to promote the reduction of unnecessary UVR exposure and to counter the potential threat of increased UVR exposure resulting from depletion of the ozone layer. WHO's INTERSUN activities can be seen on their website ((http://www.who.int/uv/en/) and have included:

- the development of an internationally recognized UV Index, now used in many countries around the world, to facilitate sun protection messages related to the daily intensity of UVR;
- special programmes for schools to teach children about protecting themselves against UVR;
- guidance for tour operators providing services to customers travelling to sunny climes;
- recommendations to limit sunbed use;
- guidance on decreasing occupational UVR exposure for outdoor workers.

All these activities encourage people to enjoy the sun safely and to protect themselves against UVR in situations where excessive exposure is likely to occur.

Is the UVR message balanced?

With increasing skin cancer rates, and greater travel and leisure times of fair-skinned people in sunny climes, advice on sun safety is essential. Children have been targeted by the sun safety campaigns not only because of their sensitive skins and longer life-time exposure, but also because they are more likely than adults to receive the message and act accordingly. The message to protect against excessive UVR exposure is still seen to be correct in countries with abundant sunshine, populated by fair-skinned inhabitants. However, sun protection messages may need to be tailored to different countries, in recognition of the importance of skin pigmentation, cultural and behavioural sun-seeking or sun-avoidance practices, and diversity in susceptibility to both the adverse and beneficial effects of UVR exposure.

WHO is now addressing the issue of whether current sun protection messages are too strong. What is the balance between healthy sun exposure that provides the body's requirements for vitamin D, and excessive exposure that leads to skin cancers in later life? Is it possible to recommend dietary supplements in countries that lack sufficient sunshine (i.e. high latitude countries in winter) to account for the loss of natural vitamin D production? Are there UVR-mediated beneficial effects on health, other than those stemming from the production of vitamin D?

Arguments for the current sun protection message

Reduction in the rate of adverse UVR-induced health effects

Skin cancers caused by excessive exposure to UVR are extremely common in many countries.[17] Excessive UVR exposure also causes cataracts, pterygia and rare cancers of the eye, and reactivation of certain viral infections.[18] Current public health messages have been important in increasing awareness of these adverse health effects of excessive UVR exposure and producing changes in sun-related behaviour. Results of the Victorian Sun-Survey[19] show that between 1988 and

1995 educational interventions were moderately effective in improving at least short-term knowledge and behavioural intentions. Responses to the survey showed that the avowed desire to suntan had decreased, and use of hats, sunscreen and shade had increased.[20] Furthermore, there is evidence that the incidence of skin cancers is beginning to plateau in some countries. Skin cancers, especially the non-melanoma skin cancers, are marked by a long latent period between excessive UVR exposure and clinically evident skin cancer. Therefore, there will be a long time lag between the implementation of sun-safety programmes and a drop in the incidence of skin cancer. In most developed countries, incidences for the three UVR-induced skin cancers continue to increase.[21] For example, in New Mexico (1977/78–1998/99) the age-adjusted incidence (per 100 000 non-Hispanic whites) for cutaneous squamous-cell carcinoma rose from 71.8 (95% confidence interval (CI) = 56.3–87.3) to 150.4 (95% CI = 135.3–165.5) for women and 187.5 (95% CI = 157.7–217.3) to 356.2 (95% CI = 329.3–383.1) for men.[22] However, data from recent studies in Australia and Switzerland show a decrease in the incidence of non-melanoma skin cancers in people younger than 50 years, despite increases in the overall age-standardized incidence.[23,24] In Canada, Northern Europe, Australia and New Zealand the incidences of cutaneous malignant melanoma (CMM) have reached a plateau.[25–28] These changes probably reflect the effectiveness of sun-avoidance programmes over the past 50 years. However, the age-standardized incidences of cutaneous malignant melanoma in Southern and Eastern Europe are now increasing sharply in all age groups.[28]

Global collaboration

Recognition of the potential health risks of stratospheric ozone depletion was important in the rapid international cooperation to decrease the release of CFCs to the atmosphere and in global collaboration to develop the INTERSUN programme. Although it may not be possible to accurately apportion blame for increases in skin cancer rates between stratospheric ozone depletion, sun-seeking behaviours or other factors, ground-level monitoring (1978–2002) has shown an increase in the noon-time UVR index in association with falling average summertime ozone.[29] Thus, although an actual link from ozone depletion, through increased ambient UVB, to rising skin cancer incidence is not proven, the theoretical link from ozone depletion to adverse effects on human health continues to drive international collaboration to protect and restore the ozone layer and to provide appropriate messages about sun exposure.

UVR research investment

The focusing of a global spotlight on UVR-related diseases has prompted investment into UVR research. The mechanisms behind the development of UVR-induced skin and eye damage have been elucidated and epidemiological studies have allowed refinement of education messages about sun exposure.

The global disease burden attributable to excessive UVR exposure is modest.[30] Approximately 0.1% of the total global burden of disease is due to death and disability from UVR-induced skin cancers, cataracts, cancers and pterygia of the eye, sunburn and reactivation of viral infections. This figure will increase if a causative role for excessive UVR exposure becomes more established for other diseases and disorders such as ocular melanoma, other types of cataracts, impairment of vaccination effectiveness and other risks related to UVR-induced immunosuppression. Notably, this disease burden is completely avoidable with appropriate sun-safe behaviour.

There is no doubt that excessive UVR exposure is harmful — especially to those whose sun exposure patterns are unsuited to their skin type and pigmentation, either as a result of relocation from their traditional habitat or use of artificial UVR exposure, such as sunbeds.

Arguments against current public health message

Negative consequences of sun avoidance

Until very recently, sun education has emphasized the importance of protection from harmful UV radiation. The focus on the risks of excessive exposure to such radiation has distracted research into the health effects — both behavioural and physiological — of inadequate sun exposure. One consequence of avoiding possibly harmful sun exposure could be a reduced amount of physical activity, especially when school, work and recreational activities are usually scheduled outdoors between 10:00 and 16:00. Sun protection messages may, thus, inadvertently increase health risks related to physical inactivity such as obesity and cardiovascular disease. Furthermore, there is growing recognition that adequate sun exposure is important for maintenance of vitamin D levels, especially in at-risk groups such as those who are elderly, who avoid the sun for medical reasons, who suffer from malabsorption or who have dark skin (particularly if they wear a veil).[31] A 2005 position statement from the Cancer Council Australia is the first by a national cancer council to recognize the importance of balance in recommendations about sun exposure — i.e. to avoid an increased risk of skin cancer, but to have sufficient UVR exposure to maintain adequate vitamin D levels.[31] However, the incorporation of this position statement into a public health message is complex, since the point at which "adequate" sun exposure becomes "excessive" will vary between people depending on their age, skin pigmentation, and the type of clothing that they wear.

Importantly, maintaining current sun protection messages while implementing programmes of dietary vitamin D supplementation might not be sufficient, since there could be independent beneficial effects of UVR exposure that are not mediated through vitamin D. We will examine evidence for these direct and indirect (via enhanced vitamin D synthesis) benefits of UVR exposure.

Direct beneficial effects of UVR exposure

Recent studies have suggested that high levels of sun exposure may protect against the development of Hodgkin and non-Hodgkin lymphomas.[32,33] And while excessive sun exposure is an accepted risk factor for cutaneous malignant melanoma, continued sun exposure may be associated with increased survival rates in patients with early-stage melanoma.[34] This protective effect may be mediated through the anti-proliferative effect of vitamin D,[35] but sun-induced melanization[34] or UVR-induced enhancement of DNA-repair capacity[36] may also reduce further mutational changes in a melanoma. UVR exposure also has direct immunosuppressive effects that may be important in reducing the risk of autoimmune disorders such as multiple sclerosis and type 1 diabetes, in susceptible people.[37]

Vitamin D insufficiency

In most populations, vitamin D is derived mainly from exposure to ultraviolet radiation in the UVB wavelengths, with a small amount (<10%) from dietary sources.[38] During winter months, at high latitude, or in areas with high levels of air pollution or cloud cover, the occurrence of UVB wavelengths in ambient UVR may be limited. In addition, physical sun blocks such as clothing or shade and adequately applied sunscreen limit UVB exposure and, therefore, vitamin D production.[39]

An adequate level of vitamin D is essential for bone health — a severe deficiency (<12.5 nanomol/l, although definitions vary) is associated with rickets in children and osteomalacia in adults. Insufficiency (<50 nanomol/l) is a risk factor for osteoporosis[40] and falls in populations of elderly people, due to muscle weakness.[41]

However, vitamin D receptors are found in many tissues besides bone, including the skin, lymph nodes, pancreas, adrenal medulla, brain and colon.[42] There is evidence from ecological, observational and experimental studies that vitamin D insufficiency is a risk factor for the development of breast, prostate and colon cancers[43–45] but the evidence is not yet convincing.

Vitamin D insufficiency may also increase the risk of autoimmune diseases. This link may explain the well established, although not ubiquitous, positive latitudinal gradient in incidence of both multiple sclerosis and of type 1 diabetes.[46,47] More specifically, observational epidemiological studies have shown a protective effect for the development of type 1 diabetes,[48] rheumatoid arthritis[49] and multiple sclerosis[50] with oral vitamin D supplementation. In addition, low circulating serum levels of vitamin D show a positive correlation with measures of type 2 diabetes such as insulin resistance and pancreatic beta-cell dysfunction.[51]

Adequate vitamin D during the prenatal period may decrease the risk of later development of schizophrenia[52] and lack of sun exposure may have a role in seasonal affective disorder,[53] mood disturbances[54] and on circadian rhythms (i.e. sleep/wake cycles).[55]

Is vitamin D deficiency a global problem?

Vitamin D insufficiency and deficiency are often considered to be a problem of deeply pigmented populations living in low ambient UVB environments. However, there is growing evidence that even in sunny countries and in lightly pigmented populations, vitamin D insufficiency is not uncommon.[56,57] Furthermore, it seems likely that even in sunny countries at low latitude, with increasing urbanization (and the rise in office-based work and concomitant reduction in outdoor leisure time that accompany "development"), we should expect to see a rise in the rates of inadequate vitamin D levels.

How much sun exposure do we need?

The dose of UVR required to provide adequate vitamin D depends on the amount of skin exposed, skin pigmentation, a person's age and the amount of ambient UVB. However, one full-body exposure to one MED (the amount of UVR exposure to cause minimal erythema of the skin) is estimated to release about 10 000–20 000 IU of vitamin D_3 into the circulation within 24 hours of exposure.[58] Thus, for a person with moderately fair skin, exposure of hands, face and arms for 6–7 minutes at 10:00 or 14:00 in summer (or 9–12 minutes in winter) in northern Australia (latitude 17° south), should produce around 1000 IU of vitamin D, an amount sufficient to maintain vitamin D concentrations in the normal range. The equivalent exposure required in high latitude Tasmania (41–43° south) is 7–9 minutes in summer, but 40–47 minutes in winter.[59] There remains however, some controversy over the range of concentrations of vitamin D in blood that is considered "normal", with 50 nanomol/l currently accepted as marking the lower limit of sufficiency. Recent work, however, suggests that at least 80 nanomol/l is required to prevent physiological changes associated with vitamin D insufficiency.[60]

In assessing how much sun exposure is needed for adequate vitamin D production, the following should be noted.

- There is a threshold level of UVB required to induce vitamin D production[61] which is not generally reached during the winter in areas above a latitude of 40°. Adequate stores of the vitamin need to be built up during the spring, summer and autumn months, or vitamin D supplementation should be used to maintain vitamin D levels during winter, since even full body sun exposure during winter at high altitude will not lead to vitamin D production.
- Previtamin D concentration reaches equilibrium within 20 minutes of UVR exposure. Excessive sun exposure does not lead to more vitamin D — instead, excess UVR exposure degrades vitamin D into inert photoproducts.[58]
- Skin pigmentation affects the time taken to produce a certain level of vitamin D, but it does not alter the level that is achievable. With the amount of sun that would require 10–12 minutes of exposure in a fair-skinned person to achieve maximum vitamin D levels, it may take three times longer for an Asian Indian and up to ten times as long in a deeply pigmented African American.[58]
- A low level of casual sun exposure, (e.g. only arms and face exposed), even during summer, will result in only very small amounts of endogenous vitamin D_3 production,[58] especially at higher latitudes, for non-midday exposures and for people who do not have fair skin.
- Vitamin D fortification of milk and other food products should be considered, particularly in countries at high latitudes where there is insufficient winter UVB to promote adequate vitamin D levels.
- The use of sunbeds remains unsafe because of its link to an increased risk of skin cancer. Sunbeds emit mostly UVA rather than vitamin-D-inducing UVB, thus increasing the adverse risk of skin damage without the concomitant increases in beneficial vitamin D production.[62] Vitamin D levels can be maintained by safe sun exposure and/or dietary supplementation.

Where is the balance?

Both skin cancers and vitamin D insufficiency are prevalent around the world. Even in populations that remain in physical environments for which they are evolutionarily suited, marked changes in the social environment now predispose people to diseases associated with under- or over-exposure to UVR. And in populations that have moved from their traditional habitats, problems of both excess sun exposure and vitamin D insufficiency are clearly evident.

The 2005 position statement released by the Cancer Council Australia[31] still has a strong message to limit UVR exposure, but the message stresses moderation. While the statement provides some guidance on optimum levels of exposure, much debate remains about the appropriate level of sun exposure and even what constitute normal serum levels of vitamin D.[58] Globally, this matrix of considerations is even more complex, with skin pigmentation, ambient UVR levels and a diversity of cultural and social environments to be taken into account. Therefore a "one message fits all" approach is not appropriate.

The substantial challenge for health workers is to translate this complex combination of considerations into a readily understood public health message and, subsequently, to take account of the accrual of future research findings. ■

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Résumé

Le message de santé publique actuellement diffusé à propos de l'exposition aux UV est-il correct ?

Les messages de mise en garde à l'égard du soleil diffusés actuellement insistent sur l'importance de la protection solaire pour éviter les conséquences d'une exposition au rayonnement ultraviolet (UV) tels que les cancers de la peau, la cataracte et d'autres affections de l'œil, ainsi que les infections virales dues à une baisse des défenses immunitaires sous l'effet des UV. Cependant la santé humaine est également tributaire d'une exposition suffisante aux UV, en raison principalement de l'induction par ce rayonnement de la production de vitamine D, hormone essentielle à la santé osseuse. Les carences en vitamine D peuvent être associées à une augmentation des risques d'apparition de certains cancers, de maladies auto-immunes et de troubles mentaux comme la schizophrénie. Le présent article analyse l'évolution des pratiques en matière d'exposition solaire et des messages de mise en garde contre le soleil en considérant non seulement les bénéfices mais aussi les effets préjudiciables que ces messages peuvent avoir. La production de vitamine D induite par les UV peut être inhibée par des facteurs tels qu'une pigmentation profonde de la peau, des modes de vie privilégiant les activités d'intérieur, le vieillissement, des comportements d'évitement à l'égard du soleil et le port de vêtements limitant l'exposition cutanée, avec des conséquences néfastes pour la santé. On commence à récolter des preuves d'une baisse débutante des cancers de la peau chez les jeunes grâce aux messages de mise en garde contre le soleil. Après avoir largement promu la protection contre le soleil, il pourrait maintenant s'avérer utile de nuancer les messages à l'intention du public pour mieux prendre en compte les différences entre les groupes de population et notamment de leur sensibilité aux dangers et aux bénéfices de l'exposition solaire.

Resumen

¿Es correcto el actual mensaje de salud pública sobre la exposición a la radiación UV?

Los actuales mensajes sobre protección solar subrayan la necesidad de tomar ese tipo de medidas para evitar las consecuencias de una exposición excesiva a la radiación ultravioleta (UV), como son el cáncer de piel, la catarata y otras enfermedades oculares, y las infecciones virales causadas por la inmunodepresión UV-inducida. Sin embargo, una exposición suficiente a los rayos UV tiene un papel importante en la salud humana, principalmente a través de la producción de vitamina D mediada por la radiación UV. El déficit de vitamina D -una hormona esencial para la salud- puede acarrear un mayor riesgo de algunos cánceres, enfermedades autoinmunes y problemas de salud mental como la esquizofrenia. En este artículo examinamos la evolución de las actuales prácticas de exposición al sol y protección solar, y consideramos no sólo los beneficios, sino también los efectos perjudiciales que pueden tener tales mensajes. La producción de vitamina D UV-inducida puede verse inhibida por factores como una fuerte pigmentación de la piel, la permanencia en espacios interiores, una edad avanzada, los comportamientos de evitación del sol y los hábitos indumentarios que limitan la exposición de la piel, con consecuencias nocivas para la salud. Algunos datos preliminares parecen indicar que los mensajes de fomento de la protección solar están empezando a reducir las tasas de cáncer de piel en los jóvenes. Tras una fase de promoción generalizada de las medidas de protección solar, en adelante tal vez haya que perfeccionar los mensajes de salud pública para tener más en cuenta las diferencias entre grupos y su distinta sensibilidad a los riesgos y beneficios de la exposición al sol.

ملخص

هل الرسالات الصحية الحالية حول التعرض للأشعة فوق البنفسجية مناسبة؟

تؤكِّد الرسالات المتعلِّقة بالسلامة من أشعة الشمس على أهمية اتِّقاء التعرض لها لتجنب عواقب التعرض المفرط للأشعة فوق البنفسجية، مثل سرطان الجلد، والساد (الكاتاراكت) وغيره من أمراض العين، والعدوى الفيروسية الناجمة عن الكبت المناعي المحرَّض بالأشعة فوق البنفسجية. غير أن التعرض بقدر مناسب للأشعة فوق البنفسجية له دور مهم في صحة البشر، ولاسيَّما لإنتاج الفيتامين د المحرَّض بالأشعة فوق البنفسجية، وهو هرمون ضروري لصحة العظام. وقد يرتبط نقص الفيتامين د بزيادة مخاطر حدوث بعض أنماط السرطان، وأمراض المناعة الذاتية، والاضطرابات الصحية النفسية مثل الفصام. وتستعرض هذه الورقة تطور الممارسات الحالية المتعلِّقة بالتعرض للشمس، والرسالات المتعلِّقة بالسلامة منها، وتتناول كلا من فوائد هذه الرسالات وآثارها الضارة. ومن الممكن أن يحدث تثبيط لإنتاج الفيتامين د المحرِّض بالأشعة فوق البنفسجية، بفعل بعض العوامل ذات العواقب المؤذية للصحة، مثل التصبُّغ الشديد للجلد، وأنماط الحياة داخل المنازل، والتقدُّم في العمر، والسلوك المتعلِّق بتجنب أشعة الشمس، والعادات المتعلِّقة بالملابس التي تحد من تعرض الجلد. وثـمَّة بعض البيِّنات المبكرة على أن الرسالات المتعلِّقة بالسلامة من الشمس قد بدأت تؤتي ثمارها في خفض معدلات سرطان الجلد بين الشباب. وبعد تعزيز مسألة السلامة من الشمس على نطاق واسع، قد يكون من المناسب الآن تنقيح الرسالات الصحية لتراعي بشكل أفضل الاختلافات بين الفئات السكانية ومدى حساسية هذه الفئات لمخاطر التعرُّض للشمس ولفوائدها.

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