At What Time Should One Go Out in the Sun?

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Abstract
To get an optimal vitamin D supplement from the sun at a minimal risk of getting cutaneous malignant melanoma (CMM), the best time of sun exposure is noon. Thus, common health recommendations given by authorities in many countries, that sun exposure should be avoided for three to five hours around noon and postponed to the afternoon, may be wrong and may even promote CMM. The reasons for this are (1) The action spectrum for CMM is likely to be centered at longer wavelengths (UVA, ultraviolet A, 320-400 nm) than that of vitamin D generation (UVB, ultraviolet B, 280-320 nm). (2) Scattering of solar radiation on clear days is caused by small scattering elements, Rayleigh dominated and increases with decreasing wavelengths. A larger fraction of UVA than of UVB comes directly and unscattered from the sun. (3) The human body can be more realistically represented by a vertical cylinder than by a horizontal, planar surface, as done in almost all calculations in the literature. With the cylinder model, high UVA fluence rates last about twice as long after noon as high UVB fluence rates do.

In view of this, short, nonerythemogenic exposures around noon should be recommended rather than longer nonerythemogenic exposures in the afternoon. This would give a maximal yield of vitamin D at a minimal CMM risk.

Introduction
In evaluations of positive and negative health effects of sun exposure, the human body is usually modeled as a horizontal, flat surface. Since ultraviolet B (UVB, 280-320 nm) is much more scattered in the atmosphere than ultraviolet A (UVA, 320-400 nm) is and has widely different health consequences, the choice of geometric representation for the human body is of fundamental importance. This holds for evaluations of latitudinal as well as of time effects, both being related to zenith angles of the sun. A vertical cylinder surface represents the human body much better than a horizontal planar surface. As we will demonstrate, the choice of geometry plays a major role for health evaluations of solar radiation and should be paid more attention to.

Methods
The radiative transfer model used in the calculations are described in another chapter in this book (Ultraviolet radiation and malignant melanoma). Whenever possible, the calculations were checked and evaluated by comparisons with measurements and found to agree well. In the present calculations a vertical cylinder was used as a model for the human body. When different wavelength regions are to be compared, these two models give widely different results as shown here.

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There are at least five types of observation which indicate that UVA plays a major role in CMM induction by the sun and that melanin may be a cromophore for this: 1) CMM can be induced in the fish Xiphophorus by UVA; 2) Albino black people who lack melanin have very low incidence rates of CMM in spite of the fact that they have high incidence rates of non-melanoma skin cancers; 3) The latitude gradient of CMM is much smaller than those of non-melanoma skin cancers, just as the latitude gradient of annual doses of UVA is smaller than that of annual doses of UVB; 4)