Re: Sunscreen Use and Duration of Sun Exposure: a Double-Blind, Randomized Trial

Autier et al. (1) reported that sunscreen use seems to encourage longer recreational exposure to the sun. We wish to supplement their results with data on the effects of sunscreens and tanning on ultraviolet (UV)-induced DNA damage in human skin. Our data have become available through a recently developed method for measuring UV-induced DNA damage, i.e., cyclobutane pyrimidine dimers and pyrimidine (6-4) pyrimidone photoproducts, in human skin biopsy specimens (2–4). We used this method to test the effects of sunscreens on human skin in situ (2). Sunscreen was applied by one person, according to the manufacturer’s instructions. While protection against the erythemal response varied fivefold among nine subjects, protection against DNA damage differed by a factor of 10 and was independent of the erythemal response. On average, sunscreen protected users against DNA damage in accordance with the sun protection factor (SPF), but the protection was highly individual. Since SPF is based on average erythemal response, it is no guarantee against individual DNA damage.

Tanning provides an endogenous “sunscreen” with an SPF of 3–5 (5). These measurements are based on protection against erythema, and, to our knowledge, fundamental data on how well tanning protects genetic material are lacking. In unpublished studies, simulating the use of sunbeds, we investigated the effects of tanning on DNA damage in situ. We measured the protective effects of tanning by quantifying the levels of UV-induced photoproducts in the skin of eight healthy, fair-skinned Caucasians. The study was approved by the South Stockholm Ethical Review Board, which serves both institutions involved in the work, and subjects gave written informed consent to participate. Each subject was irradiated on a 2 × 4-cm area of skin on the lower back with ultraviolet B (UVB) at a dose of 0.3 J/cm² and on a second 2 × 4-cm area with a dose of 0.6 J/cm². A punch biopsy was performed immediately after irradiation. An additional biopsy was performed on unirradiated skin to provide a background control specimen. Next, tanning was induced by 10–13 sessions of UVA irradiation for 3 weeks. Tanning was observed by a clear change in skin color toward brown and measured with a reflectometer adjusted to record melanin pigmentation. In the course of ultraviolet A (UVA) treatment, the instrumental readings indicated an increase in pigmentation of 38.8 ± 16.7 reflectometer units (mean ± standard deviation [SD], n = 8). After the last UVA dose, a challenge with UVB was made, and three biopsy specimens were taken, as described above, except that the control biopsy specimen was from tanned skin. The samples were coded for blinded analysis. Photoprotection was defined as the difference in photoproduct levels before and after the UVA treatment.

In subjects who received 0.6 J/cm² of UVB, the levels of cyclobutane pyrimidine dimers were slightly lower than those in untanned skin (Fig. 1). The average tanning protection factor was 1.19 ± 0.17 (mean ± SD) (for four outcomes [two UVB dosage levels × two types of DNA damage]). Since tanning acts like a low-level sunscreen to suppress the erythemal response without the benefit of the unpredictable at best protection against DNA damage afforded by chemical sunscreen (2), people who have acquired a tan may prolong sun exposure, resulting in DNA damage and an increased risk of skin cancer. Tanning may provide a false sense of security that leads to inadvertently lengthened recreational sun exposure like that of the high-SPF sunscreen users studied by Autier et al. (1).

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**RESPONSE**

In their experiment, Hemminki et al. showed that a suntan offers little protection against UV-induced DNA damage. Because a tan moderately reduces the susceptibility to sunburn, acting similarly to the sunscreens used in our study (1), acquisition of a tan may encourage recreational sun exposure. Lengthening of sun exposure would largely overwhelm the minimal protection conferred by the tan, resulting in increased DNA damage and skin cancer risk. Furthermore, the results displayed in Fig. 1 of Hemminki et al. suggest that a tan would confer no protection against DNA damage induced by lower doses of UV radiation.

The experiment of Hemminki et al. is particularly relevant to the context of indoor tanning, since their study subjects were given 10–13 sessions of so-called UVA-tanning over a period of 3 weeks. Indoor tanning has become fashionable in North America and Europe, mainly among adolescents and young adults. Surveys in various fair-skinned populations show that 25%–50% of sunbed users report that they want to prepare their skin for holidays, apparently believing that acquisition of a tan before the start of a vacation confers protection against sunburns and other deleterious effects of the sun. A closer look at data from a study that we performed in Belgium, France, and Germany in 1991–1992 (2) showed that acquiring a tan was the principal reason given for sunbed use in the 1970s; citing sun protection as a motive for indoor tanning appeared in the 1980s. Before 1970, most exposure to artificial sources of UV light was occupational or medical (e.g., treating psoriasis or inducing vitamin D synthesis in Nordic countries) (2).

Messages of questionable scientific validity have spread the idea that a pre-vacation tan could be protective. The role of tanning in skin carcinogenesis remains unclear (3,4), but the tanning process seems to be a consequence of the UV-induced DNA damage (5). The experiment of Hemminki et al. supports the notion that a tan artificially acquired before holidays may promote prolonged sun exposure and thus may lead to increased DNA damage and skin cancer risk.

Although some epidemiologic data suggest that indoor tanning could increase the risk of melanoma, additional studies are needed to settle the issue (6). In any case, the experiment of Hemminki et al. indicates that the risks associated with indoor tanning would include not only the exposure to UV radiation emitted by tanning devices, but also the possibility of prolonging sun exposure during a subsequent holiday. Hence, in the light of available data, visiting tanning parlors before leaving for vacation is not advisable.

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