Comments on the “SCCP Opinion on biological effects of ultraviolet radiation relevant to health with particular reference to sun beds for cosmetic purposes”.

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The SCCP Opinion was given in response to six questions posed by the EU Directorate-General Health and Consumer Protection in relation to standards for sun beds. Here follow a few comments on aspects relevant to such standards.

**Limit values on the maximum irradiance**

An important issue in this connection is posed in Question 3, about the validity of the Bunsen-Roscoe law. That “law”, as applied to photochemical reactions, states that an effect depends only on the dose of UV radiation, and not also on the irradiance (the UV-dose is the product of UV-irradiance and exposure time). The SCCP Opinion discusses this topic for acute photobiological effects such as sunburn and chronic effects such as skin cancer. It formulates as a general conclusion from the literature: “In almost every case the law was shown to hold”. That was based on the literature data collected in their Table 2. For erythema all answers were indeed Y (yes), for tumorigenesis, however, three of the answers quoted were “yes”, the other three “no”. Two of the positive answers were the oldest (1941 and 1942); the newer ones (1943-1982) had three times “no”, and one “yes”. The latter “yes” was attributed to a paper by de Grujil and van der Leun (1982), but that was a misquote. That paper was on skin thickening, and it did not show data that would support the “law” for UV-tumorigenesis, not at least for the UV radiation as it comes out of the lamps. One year later a paper appeared that was on tumorigenesis, with the same first author (de Grujil et al., 1983). That paper reported data showing that in mouse experiments a halving of the daily UV doses did not result in a doubling of the time for the tumors to come (as would be expected under the “law”), but to an only 50% longer exposure time. Apparently the reduced exposure regimen made the carcinogenic effectiveness of the radiation markedly greater, as was emphasized in a recent publication directed towards this very issue (van der Leun and Forbes, 2005). This latter publication was also written in answer to the six questions under discussion now, and it cites a series of experimental findings all pointing in the same direction: that the UV radiation becomes more carcinogenically effective if administered slowly, or more fractionated. This van der Leun and Forbes publication may have appeared too recently for inclusion as such in the SCCP review. A much earlier paper by Forbes and Davies
(1986) discussed this issue at length, and certainly would have been useful to be considered by the SCCP review board.

What does this mean for setting limit values on the irradiance? For acute effects such as sunburn, there is good reason to limit the irradiance: if that is very high, and users are not aware of it, they may have a serious sunburn. But by limiting the irradiance, the carcinogenic effectiveness of the exposure increases. So, the many well-intentioned proposals to reduce the limit of the irradiance do not just reduce the risks; they do reduce one risk but at the same time increase the other. Setting a limit becomes a choice, depending on a responsible weighing of two very different risks. We are inclined to recommend weighing the tumorigenic risk comparatively high, because the acute risk can be dealt with, in several steps: by setting a low limit to the first exposure, then prescribe a day without exposure and for the remainder of the course a limit to the percentage increase per exposure and, if considered necessary, define a maximal exposure per session. In this way, the acute risk can be kept limited, and practically restricted to the first exposures. Further up in the course it becomes very unlikely. But the carcinogenic risk keeps adding up all the time. This state of affairs suggests the following strategy: do not reduce the irradiance more than is really necessary for limiting the risk of the first exposures. That avoids an unnecessary increase of the long-term risk.

**Action spectra**

For several decades, the only action spectrum available in this context was that for erythema (sunburn). So, that was used also as a surrogate for estimating the carcinogenic risk. The erythema weighting function is available, and used in the SCCP Opinion, in a form standardized by the Commission Internationale de l’Éclairage (CIE 1987, CIE 1998). Now, after a long time of research in several centers, and through the deliberations of a substantial panel of international experts, there is also an action spectrum for human non-melanoma skin cancer (NMSC). It was published in a report of the Commission Internationale de l’Éclairage (CIE, 2000) and promoted by that agency as a draft standard (CIE 2006). This “CIE NMSC action spectrum” was proposed for use (ICNIRP Statement 2003) in the UV lamp standard of the International Electrotechnical Commission (Document IEC 61/864/DIS).

At this point we return to the SCCP Opinion document which appears to ignore or overlook the existence of the NMSC action spectrum and its importance in risk assessment for UV exposures; it proposes to use only the CIE erythema action spectrum. The rationale offered is that “it is similar to the mouse SCC (squamous cell carcinoma) action spectrum and is likely to represent the wavelength dependency of human SCC and possibly BCC (basal cell carcinoma)”. Is it indeed so similar? There are similarities as well as differences between the two action spectra. In fact, weightings of lamp spectra with the two standardized action spectra show appreciable quantitative differences. In particular, any erythema action spectrum tends to *overestimate* carcinogenic effectiveness of short UVR and to *underestimate* effectiveness of long UVR, thus providing an incorrect estimate of carcinogenic effectiveness of certain classes of lamps.

Thus there appears to be good reason not to leave out the weighting for the most important effect for which an action spectrum is available now, non-melanoma skin cancer. If an action spectrum for melanoma would become available, consideration might be given to incorporating that risk factor as well.
Conclusion

The SCCP Opinion document is a very substantial review of material that addresses the six questions, and it provides a serious effort at making the subject understandable. In the process, however, there is a tendency to condense some of the issues to the point of oversimplification. In particular, there are two types of risks to be considered (short-term and long-term effects) and the two cannot easily be made to fit one simple formula. The skin cancer response is too different from that of erythema (in action spectrum as well as dependence on dose-delivery) to provide the same limiting criteria as those set by erythema considerations. The SCCP Opinion document would be significantly improved by reconsidering that aspect, in line with WHO, IEC, ICNIRP and other international bodies.

References


CIE Publication CIE-DS-019.3E 2006 [Draft Standard: Action Spectrum for Photocarcinogenesis (Non-Melanoma Skin Cancers)].


IEC Document 61/864/DIS, Particular Requirements for Appliances for Skin Exposure to Ultraviolet and Infrared Radiation.