# Risk of Skin Cancer Associated with the Use of UV Nail Lamp

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## TO THE EDITOR

Research and media have highlighted carcinogenic dangers of tanning bed exposure. Skin cancer risk of other sources of artificial UV radiation has been discussed, but not researched in detail. UV nail lamps, a source of artificial UV radiation (UVR), are increasingly used for professional and personal nail techniques. UV nail lamps contain either fluorescent bulbs or light-emitting diode lights and are used to cure, harden, and dry nails at home and in the salon. In 2010–2011, over 87% of nail salons reported using a UV light (2010–2011, Industry Statistics). Patrons typically receive UV nail lamp services 1–4 times monthly for durations of 6–10 minutes (Schoon *et al.*, 2010). Such repeated exposure to UVR from nail lamps raises concern regarding users' possible skin cancer risk. We sought to better quantify the effect of UVR emitted by UV nail lamps at nail salons and compare their carcinogenic potential with that of commonly used phototherapy devices.

We elected to compare UV nail lamp irradiance with exposure of narrowband UVB (NBUVB) used for phototherapy, in order to provide a perspective with respect to a common and well-known exposure. NBUVB is a commonly used dermatological treatment, viewed as low risk, although not as zero risk, for the development of keratinocyte carcinoma (KC, i.e., basal cell and squamous cell carcinoma). We first measured the spectral irradiance of the nail UV devices. We then used the action spectrum for photocarcinogenesis (Skin Cancer Utrecht–Philadelphia human (SCUP-h)) to determine the ratio between carcinogenic potential of the UV nail lamp and the single NBUVB phototherapy course.

There are over a few hundred UV nail lamp devices on the market and we elected to evaluate the former three devices because of their widespread availability in nail supply stores and commonalities with reported wavelengths (365–370 nm) and wattages of the majority of other devices. The nail industry (Schoon *et al.*, 2010) also previously tested many UV nail lamps to determine the highest UV output (by the four 9-W and two 9-W lamps), which they reported to represent over 90% of lamps used in salons. To measure the carcinogenic-effective irradiance and wavelength produced by three commonly used UV Nail lamp devices, we used a Luzchem Spectroradiometer SPR-4001. The sensitivity of this device covers the spectral interval of 235–850 nm.

Three common UV Nail Lamp devices—Device A consisted of four 9-W UV fluorescent bulbs (36 W total); Device B consisted of one 9-W UV fluorescent bulb (9 W); and Device C consisted of six 1-W light-emitting diode UV lights (6 W)—were tested.

UV nail lamps primarily emitted UVA with no detectable UVB or UVC. The lower limit of detection for this device is 0.1–0.2 mW m$^{-2}$. There was a difference in the spectral emission between the units containing fluorescent lamps (A and B) and the light-emitting diode unit C. Devices A and B had peak emission at wavelengths at 368 and 370 nm, respectively (Figure 1), whereas Device C had a peak emission at a wavelength of 405 nm.

Spectral irradiance in the plane of the nails was measured from several locations within each device. Highest recorded spectral irradiance produced by devices A and B was 15,253 and 15,202 mW m$^{-2}$, respectively, whereas Device C produced 2845 mW m$^{-2}$. Devices emitted varying spectral irradiance by probe location.

We used the SCUP-h action spectrum to determine a UV nail lamp session's carcinogenic-effective irradiance in terms of NBUVB phototherapy courses (de Gruijl and Van der Leun, 1994). SCUP-h allows the conversion of different UV doses to the same scale of carcinogenic effectiveness (Figure 1).

To determine each device's carcinogenic-effective irradiance, we calculated the sum of the product of SCUP-h and spectral irradiance over all wavelengths emitted by the lamp at the probe location with highest integral spectral irradiance.

We then converted each UV nail lamp's carcinogenic-effective irradiance to a nail lamp session's UV dose. To calculate the nail lamp's UV dose (J cm$^{-2}$) per nail light session, we assumed 10 minutes per UV nail lamp session for each device's carcinogenic-effective irradiance.

We compared the device's UV dose with that of a single course of NBUVB, by assuming a cumulative UV dose of 25 J cm$^{-2}$ received by a patient per NBUVB course. A single course corresponds to 15–30 treatments over a period of 5–10 weeks (Diffey and Farr, 2007).

We then calculated the carcinogenic equivalence in terms of NBUVB courses (Table 1). Over 13,000 Device A or B and more than 40,000 Device C sessions lasting for 10 minutes would be required to be received at the nail plane to equal the UV dose received during one NBUVB course. Given the

*Abbreviations: KC, keratinocyte carcinoma; NBUVB, narrowband UVB; SCUP-h, Skin Cancer Utrecht–Philadelphia human; UVR, UV radiation*

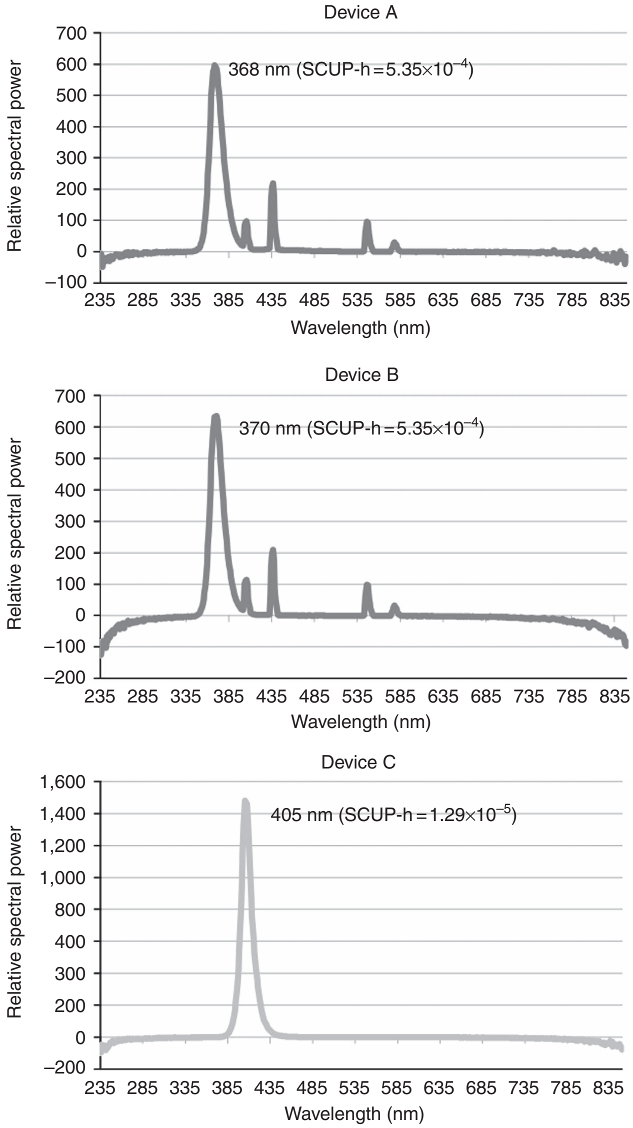


**Figure 1. UV nail lamp spectral power distribution by device.** Note: According to the manufacturer, the negative spectral irradiance values are due to fluctuations in electronic noise, where noise in the dark may be slightly higher than the noise acquired during the sample measurement at a given wavelength. In that case, if there is no signal in the given region, that value appears negative.

**Table 1. NBUVB equivalents emitted by UV nail lamp device per session**

| UV device | NBUVB | A | B | C |
|---|---|---|---|---|
| Carcinogenic-effective irradiance (mW m$^{-2}$) | — | 4.7 | 4.9 | 1.6 |
| UV dose (J cm$^{-2}$) = (carcinogenic-effective irradiance) × (duration) | 20 | $3 \times 10^{-4}$ | $3 \times 10^{-4}$ | $9.6 \times 10^{-5}$ |
| Number of UV nail lamp sessions to equal one NBUVB course | 1 | 14,200 | 13,700 | 42,400 |

Abbreviation: NBUVB, narrowband UVB.

low theoretical risk increase from even a course of NBUVB treatments (Diffey and Farr, 2007), one would need over 250 years of weekly UV Nail sessions to experience the same risk exposure.

Our study of three UV nail lamps reveals that such exposure is a tiny fraction of a single NBUVB course, and hence does not produce a clinically significant increased risk of developing skin cancer. The potential associated skin cancer risk from UV nail lamp use has only been discussed once in a scientific literature case series (MacFarlane and Alonso, 2009) and evaluated one other time by the nail industry (Schoon *et al.*, 2010). The case review of two women with a history of UV nail light exposure, who developed squamous cell carcinomas on their dorsal hands, concluded that exposure to UV nail lights is a risk factor for the development of skin cancer (MacFarlane and Alonso, 2009). On the basis of historical information and comparisons between UV nail and tanning bed lamp wattages, the authors suggested that UV light emitted from these nail lamps is the cause of those lesions. However, this case review is anecdotal and the spectral irradiance cannot be calculated by using bulb wattage (bulb's power requirements) and exposed to body surface area, but must be measured spectroradiometrically, as performed in our study.

A laboratory, hired by the nail industry, used an inappropriate study design to test many UV nail lamps and concluded that UV nail lamps emit low and safe levels of UV light (Schoon *et al.*, 2010). Broadband meters were used to measure UVA and UVB and then estimate the corresponding exposure times in sunlight in order to calculate the UV dose received by nail lamp users. This was incorrect, as the spectral emission of sunlight and the nail lamp is different, the spectral response of the meters was not specified, and an appropriate biological end point (e.g., erythema, burn, or skin cancer) had not been determined (Schoon *et al.*, 2010).

Although some sources of UVA and UVB contribute to the development of KCs, UV nail lamps do not appear to significantly increase the lifetime risk of KC. Dermatologists and primary-care physicians may reassure patients regarding the safety of these devices.

## CONFLICT OF INTEREST

The authors state no conflict of interest.

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