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Assessing dermal exposure to nicotine - an interdisciplinary approach

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Abstract: In a pilot study it was shown that dermal uptake of nicotine directly from air can be a significant exposure pathway. On the basis of these preliminary results, scientists from the fields of building sciences, human-biomonitoring, gas-phase analytics, physical chemistry and modeling collaborated to design a more detailed research plan, and experiments were performed in October 2016 at the Technical University of Denmark. During all of the exposure experiments, the volunteers breathed clean air from hoods they wore. Nicotine (dissolved in water) was delivered to the 55 m^3 exposure chamber from a step-motor driven syringe. In all experiments the average nicotine concentration in air was between 236 µg/m^3 and 324 µg/m^3. In week 1, four volunteers wearing only shorts and two volunteers wearing clean cotton clothes were exposed in the chamber for five hours. In week 2, two of the bare-skin participants were again exposed in the chamber for five hours, and then showered immediately after exposure rather than waiting at least 24 h as they had done in week 1. The two participants who wore clean clothes in week 1 were now exposed wearing a shirt, socks and gloves that had been exposed to nicotine at > 250 µg/m^3 for almost a month. They wore clean full-length pants that had not been exposed. Urine samples were collected before, during and after exposure and analyzed for nicotine, cotinine and 3OH-cotinine. The major results of the study can be summarized as follows: a) dermal uptake, directly from air, is a meaningful exposure pathway for nicotine - comparable to inhalation; b) clean clothing acts as a barrier to dermal exposure from air; c) clothing that has absorbed nicotine can promote its dermal uptake; c) skin is a reservoir - delivery continues after leaving chamber. The outcome emphasizes the advantage of interdisciplinary research design, which is helpful to undrstand exposure scenarios to indoor pollutants.

Keywords: A-indoor environment, B-VOCs, C-air, A-biomonitoring, A-exposure models