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Measurements of Dermal Uptake of Nicotine Directly from Air and Clothing

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Recent studies suggest that dermal uptake of certain semivolatile organic compounds directly from air can be a significant exposure pathway. This has been experimentally confirmed for two phthalates. An experiment has been conducted to investigate if dermal uptake of nicotine directly from air or from clothing may be similarly important. Two subjects wearing only shorts and a third subject wearing clean cotton clothes were exposed to environmental tobacco smoke (ETS) for three hours in a 55m³ chamber while breathing clean air from hoods they wore. The ETS was generated by mechanically “smoking” cigarettes, with three lit at any given time. The resulting average nicotine concentration (475 µg/m³) is comparable to the highest levels reported for smoking sections of pubs. Urine samples were collected immediately before exposure. For the subjects wearing only shorts, all urine was collected for the 60 hours post-exposure. These samples were pooled for the first 12 h, 12-36 h and 36-60 h post-exposure. For the clothed subject, urine samples were collected until the next morning. After collecting a new pre-exposure urine sample, this subject entered the chamber for another three-hour exposure wearing a hood and clothes, including a shirt that has been exposed for 5 days to elevated nicotine levels (>200 µg/m³). The urine samples were analyzed for nicotine and two metabolites -- cotinine and 3OH-cotinine. Following exposure, the subjects who wore only shorts excreted a significant amount of nicotine and nicotine metabolites. Assuming that 90% of nicotine and its metabolites are excreted via urine and that nicotine, cotinine and 3OH-cotinine constitute 85% of what is excreted via urine, the back-calculated minimum amount of dermally absorbed nicotine was 570 µg for the bare-skinned subjects. For the subject wearing clean clothes, it was 20 µg, and while wearing a shirt previously exposed to nicotine, it was 80 µg. Peak cotinine and 3OH-cotinine concentrations in the urine of the bare-skinned subjects were an order of magnitude higher than for non-smokers who avoid ETS exposure and comparable to levels measured among non-smokers in hospitality environments before smoking bans. This study indicates that meaningful dermal uptake of nicotine can occur from exposure to environmental tobacco smoke. This is especially important for children in homes where smoking or vaping occurs. Fresh clothing can significantly limit dermal uptake, but clothing can also be a source if it was pre-exposed to cigarette smoke.