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Disinfection byproducts in drinking water and skin cancer? A hypothesis

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Recent evidence suggests possible carcinogenic effects of exposure to disinfection byproducts (DBPs) via non-ingestion routes (i.e., bathing, showering or swimming) [1]. In light of these findings and the accumulating data that dermal absorption represents an important human exposure pathway for trihalomethanes (a major component of DBPs) [2] we conducted an exploratory analysis of the hypothesis that exposure to DBPs may enhance risk of cancers of skin. Our hypothesis is supported by experimental evidence that some genes that metabolize DBPs into reactive intermediates (*CYP2E1* and *GSTT1*) are expressed in the skin [3] and are involved in the genetic susceptibility of skin cancer [4]. In a preliminary analysis, we used data accrued in a completed population-based case–control study of keratinocyte-derived malignancies (basal cell carcinomas (BCC) and squamous cell carcinomas (SCC)) from New Hampshire originally designed to examine the effects of drinking water arsenic [5]. Newly diagnosed cases of BCC and SCC were identified through a state-wide network of dermatologists, dermatopathologists and pathologists, and age- and sex-matched controls were selected from population lists. The study comprised 293 SCC cases, 603 BCC cases and 540 controls (response rates of 83% of cases and 69% of controls confirmed as eligible) [5]. Participants completed a self-administered work and residential history calendar and structured interview regarding water supply at lifetime residences along with other risk factors (e.g., sun exposure, smoking history etc.). Total trihalomethane (THM) levels, based on the four regulated THMs (chloroform, bromodichloromethane, dibromochloromethane, bromoform), were obtained from routine monitoring data of public water systems maintained by the New

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Hampshire Department of Environmental Services. Average THM levels were computed from samples taken from public water systems between 1984 and 1994 and assigned by subject's residence at their reference date (date of diagnosis of the cases and a comparable date for controls). Residents of towns or cities with multiple water systems were assigned the average THM value weighted by the proportion of the population served by these systems. Grouping according to maximum THM levels produced essentially the same categories. Among individuals who reported using public water systems, the odds ratio for those with levels above 40 mcg/L were 2.4 (95% CI = 0.9–6.7) for BCC and 2.1 (95% CI = 0.7–7.0) for SCC (Table 1). Users of public water systems with either trace or no THMs served as the reference group; estimates based on other reference groups (i.e., private wells) did not materially change the results. Presented odds ratios were adjusted for age, gender and skin sensitivity to the sun (i.e., tendency to sunburn) using unconditional logistic regression. Further adjustment for toenail arsenic concentrations did not affect the results. Based on this preliminary analysis, we think the hypothesis that DBP exposure might affect the pathogenesis of skin cancer warrants further exploration.

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Table 1

Odds ratios (OR) and 95% confidence intervals (CI) for total trichloromethanes (THM) in residential water and risk of basal cell carcinoma (BCC) and squamous cell carcinoma (SCC) skin cancer

Water source THM (mcg/L)	**Control *N* (%)**	**BCC *N* (%)**	**OR (95% CI)**	**SCC *N* (%)**	**OR (95% CI)**
Private	200 (41.4)	237 (43.5)	1.1 (0.7–1.8)	107 (40.2)	1.1 (0.6–1.9)
Public					
<1	51 (10.6)	51 (9.4)	1.0—Referent	25 (9.4)	1.0—Referent
≥1 to 20	104 (21.5)	102 (18.7)	0.9 (0.6–1.5)	47 (17.7)	0.9 (0.5–1.6)
>20 to 40	121 (25.1)	139 (25.5)	1.1 (0.7–1.8)	79 (29.7)	1.3 (0.7–2.3)
>40	7 (1.4)	16 (2.9)	2.4 (0.9–6.7)	8 (3.0)	2.1 (0.7–7.0)

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