



Cancer risk associated with household exposure to chloroform.

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Source

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Abstract

Chloroform (CHCl₃) the trihalomethane most prevalent in drinking water, is a proven animal carcinogen and a suspected human carcinogen. Consequently, standards have been issued by health authorities to limit its concentration in drinking water. These limits are based solely on ingestion, without taking into account inhalation and skin contact. Exposure to CHCl₃ was assessed for 18 men (age: mean 38 years; range 23-51) following a 10-min shower in their respective residences located in the Quebec City region (Canada). CHCl₃ concentration was measured in alveolar air samples collected before, immediately after, and 15 min and 30 min following the shower. Indoor air and water concentrations were determined concomitantly. Mean CHCl₃ concentrations in the air of the shower stall and in water were respectively 147 microg/m³ (SD = 56.2 microg/m³) and 20.1 microg/L (SD = 9.0 microg/L). Water concentrations were comparable to those documented in a large proportion of distribution networks in Canada. The mean increase in alveolar air CHCl₃ concentration (Δ CHCl₃ALV) at the end of the shower was 33 microg/m³ (SD = 14.7 microg/m³). A multiple-regression analysis revealed that Δ CHCl₃ALV values were only associated with chloroform concentration in air of the shower stall. Δ CHCl₃ALV were described using a physiologically based pharmacokinetic (PBPK) model. This model was then used to estimate concentrations of CHCl₃ metabolites bound to liver and kidney macromolecules following a shower, and also according to exposure scenarios that integrate drinking-water ingestion and air inhalation. The concentration predicted in the liver following a worst-case exposure scenario was 0.41 microg CHCl₃ equivalents/kg of tissue, some 6,000 times lower than the lowest concentration that did not increase the incidence of hepatic tumors in laboratory animals. Data indicate that for this range of exposure the safety margin appears therefore considerable with respect to the potential carcinogenic effect of household exposure to CHCl₃.