CLIMATE CHANGE AND INCREASED PRECIPITATIONS: THE IMPACT OF HEAVY RAINFALLS ON SURFACE WATER TOTAL ORGANIC CARBON (TOC) AND RESULTING HUMAN EXPOSURE TO TRIHALOMETHANES

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Background and aims: Several studies suggest that climate change will be accompanied with increased precipitations. Heavy rainfalls can impact surface water total organic carbon (TOC) and, upon treatment, lead to higher trihalomethane levels in drinking water. These meteorological events could therefore exacerbate human exposure to these toxic disinfection by-products. This study aimed at i) assessing the impact of heavy rainfalls on surface water TOC and ii) evaluating subsequent exposure to chloroform and its internal dose metrics in humans.
Methods: Surface water TOC was measured in samples taken from an established sampling point used for drinking water production in a small river in Brittany (France) during dry days and following high precipitations (> 10 mm). Trihalomethane production during water treatment was estimated based on TOC levels, temperature and chlorine dose using an established multivariate model. Finally, drinking water chloroform levels were used to construct different scenarios of exposure (i.e., water consumption, shower/bath and inhalation) in newborns, children, adults and pregnant women using a published physiologically based pharmacokinetic (PBPK) model.
Results: Following high precipitations, surface water TOC increased from a median of 6.2 to 8.9 mg/L. Consequently, median total trihalomethane levels in drinking water were estimated to increase from 29.7 to 33.1 µg/L. Human exposures to chloroform after > 10 mm rainfalls increased hepatic metabolite levels by 11 % when compared to levels reached during dry days. This increase did not vary substantially between exposure routes or physiologic condition.
Conclusions: This study suggests that the occurrence of heavy rainfalls can increase surface water TOC levels. The higher levels of trihalomethanes in drinking water following these precipitations may lead to increased tissue levels in humans. In the context of climate change, risk assessors may need to consider higher exposure to drinking water contaminants.