Chlorination disinfection byproducts in water and their association with adverse reproductive outcomes: a review

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1. Mark J Nieuwenhuijsena,b, Mireille B Toledanoc, Naomi E Eatonb, John Fawellc, Paul Elliotta

+ Author Affiliations

1. aSmall Area Health Statistics Unit, Department of Epidemiology and Public Health, Imperial College School of Medicine at St Mary's, London W2 1PG, UK, bTH Huxley School of Environmental, Earth Sciences and Engineering, Imperial College School of Science, Technology and Medicine, Prince Consort Road, London SW7 2BP, UK, cNational Centre for Environmental Toxicology, The Water Research Centre, Marlow, Bucks SL7 2HD, UK

1. Professor Paul Elliott, Department of Epidemiology and Public Health, Imperial College School of Medicine at St Mary's, London W2 1PG, UK

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Abstract

OBJECTIVES AND METHODS Chlorination has been the major disinfectant process for domestic drinking water for many years. Concern about the potential health effects of the byproducts of chlorination has prompted the investigation of the possible association between exposure to these byproducts and incidence of human cancer, and more recently, with adverse reproductive outcomes. This paper evaluates both the toxicological and epidemiological data involving chlorination disinfection byproducts (DBPs) and adverse reproductive outcomes, and makes recommendations for future research.

RESULTS AND CONCLUSIONS Relatively few toxicological and epidemiological studies have been carried out examining the effects of DBPs on reproductive health outcomes. The main outcomes of interest so far have been low birth weight, preterm delivery, spontaneous abortions, stillbirth, and birth defects— in particular central nervous system, major cardiac defects, oral cleft, and respiratory, and neural tube defects. Various toxicological and epidemiological studies point towards an association between trihalomethanes (THMs), one of the main DBPs and marker for total DBP load, and (low) birth weight, although the evidence is not conclusive. Administered doses in toxicological studies have been high and even though epidemiological studies have mostly shown excess risks, these were often not significant and the assessment of exposure was often limited. Some studies have shown associations for DBPs and other outcomes such as spontaneous abortions, stillbirth and birth defects, and although the evidence for these associations is weaker it is gaining weight. There is no evidence for an association between THMs and preterm delivery. The main limitation of most studies so far has been the relatively crude methodology, in particular for assessment of exposure.

RECOMMENDATIONS Large, well designed epidemiological studies focusing on well defined end points taking into account relevant confounders and with particular emphasis on exposure characterisation are ideally needed to confirm or refute these preliminary findings. In practice, these studies may be impracticable, partly due
to the cost involved, but this is an issue that can be put right—for example, by use of subsets of the population in the design of exposure models. The studies should also reflect differences of culture and water treatment in different parts of the world. To identify the specific components that may be of aetiological concern and hence to fit the most appropriate exposure model with which to investigate human exposure to chlorinated DBPs, further detailed toxicological assessments of the mixture of byproducts commonly found in drinking water are also needed.