Interaction between Disinfection By-Products (DBPs) and Birth Defects: A Systematic Review

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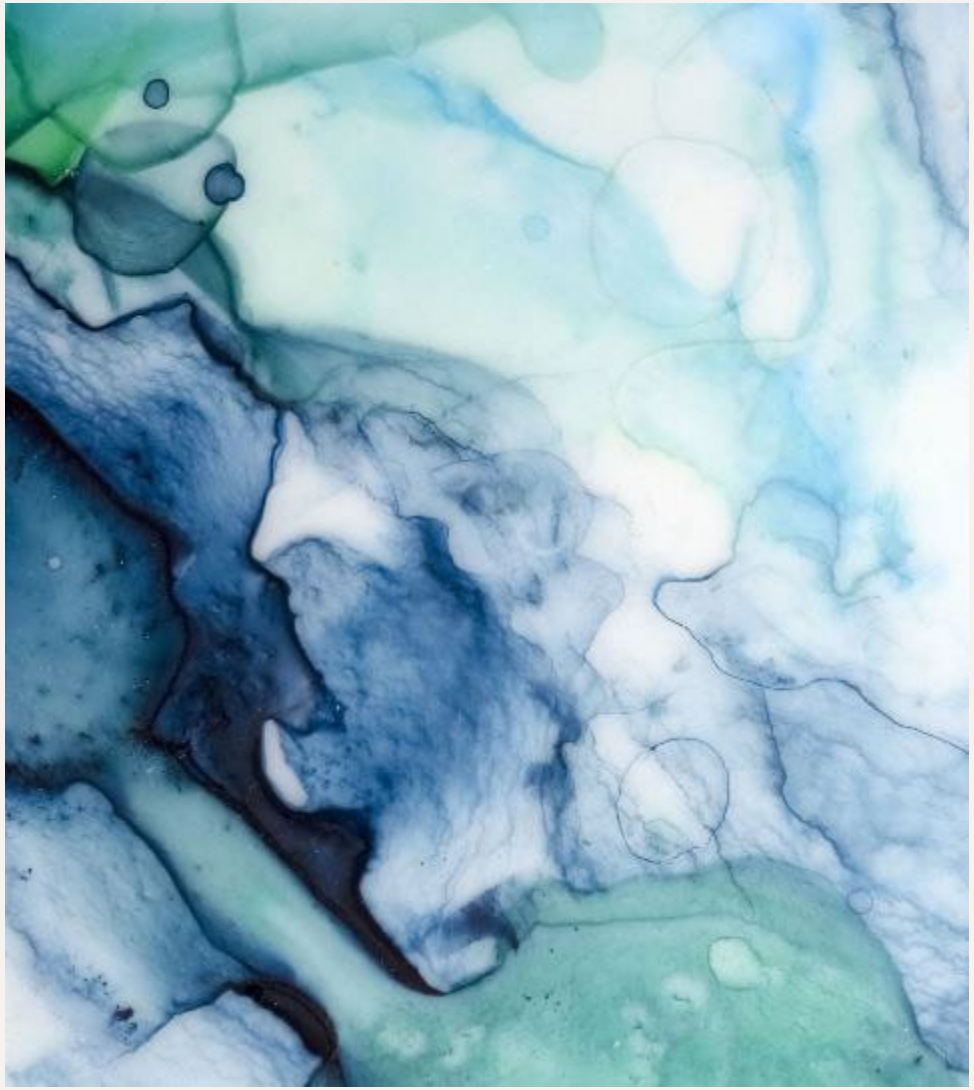


Background

DBPs are formed upon the reaction of chemical disinfectants with DBP precursors.

DBP formation is influenced by water quality, treatment conditions, type, dose, and residue of the disinfectant used, and concentration and properties of the organic matter present in the water.

Table 3. Disinfectant by-products present in disinfected waters

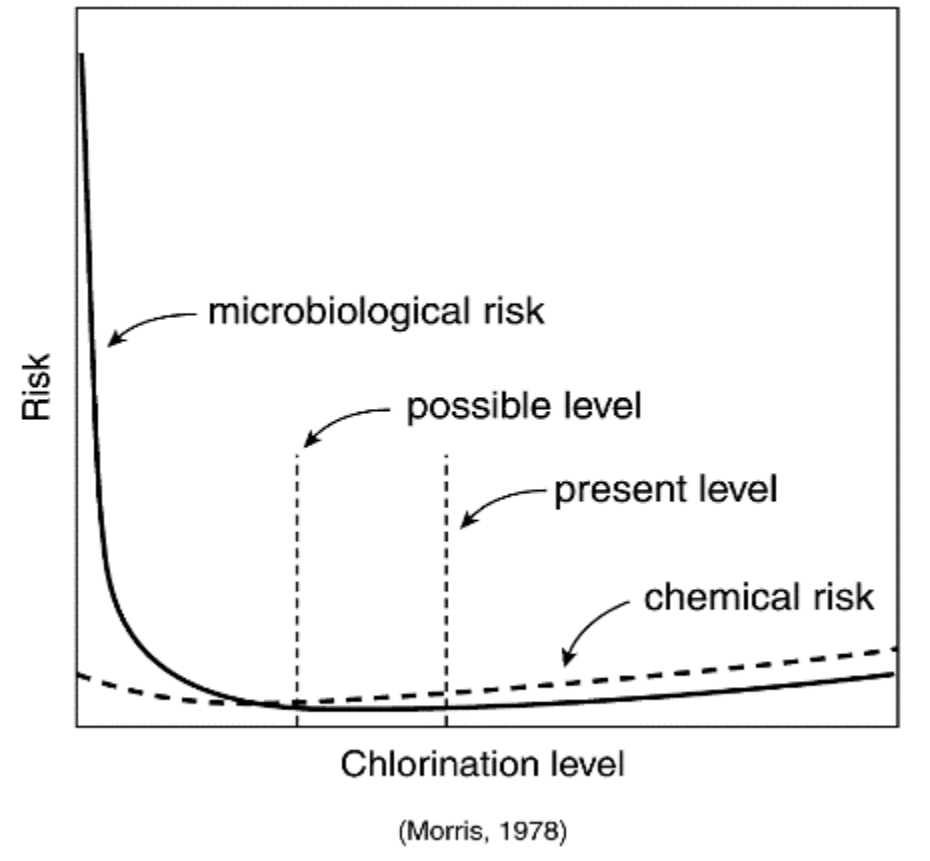
Disinfectant	Significant organo-halogen products	Significant inorganic products	Significant non-halogenated products
Chlorine/ hypochlorous acid	THMs, HAAs, HANs, chloral hydrate, chloropicrin, chlorophenols, *N*-chloramines, halofuranones, bromohydrins	Chlorate (mostly from hypo-chlorite use)	Aldehydes, cyanoalkanoic acids, alkanoic acids, benzene, carboxylic acids
Chlorine dioxide		chlorite, chlorate	unknown
Chloramine	HANs, cyanogen chloride, organic chloramines, chloramino acids, chloral hydrate, haloketones	nitrate, nitrite, chlorate, hydrazine	aldehydes, ketones
Ozone	bromoform, MBA, DBA, DBAC, cyanogen bromide	chlorate, iodate, bromate, hydrogen peroxide, hypobromous acid, epoxides, ozonates	aldehydes, ketoacids, ketones, carboxylic acids

Background

Numerous DBPs can be hazardous to health but these risks are still lower than the microbiological ones.

Therefore, in most cases, abandoning the disinfection process is impossible.

However, the health risks caused by DBPs, even if low, given the large number of people exposed, result in a high number of cases, therefore, cannot be ignored.



(Morris, 1978)

Health effects

Possible carcinogenicity and mutagenicity

14 to 16% of all bladder cancer cases can be attributed to exposure to DBPs (King, 1996)

9% of all bladder cancer cases and 15% of bowel cancer cases are attributed to chlorinated by-products in drinking water (Morris, 1992)


ELSEVIER

Water Research 38 (2004) 3809–3819

WATER RESEARCH

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A new approach to evaluating the toxicity and genotoxicity of disinfected drinking water

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Review

Water disinfection by-products and bladder cancer: is there a European specificity? A pooled and meta-analysis of European case–control studies

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Published by Oxford University Press on behalf of the International Epidemiological Association
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International Journal of Epidemiology 2010;39:733–745
doi:10.1093/ije/dyp371

Disinfection by-products in drinking water and colorectal cancer: a meta-analysis

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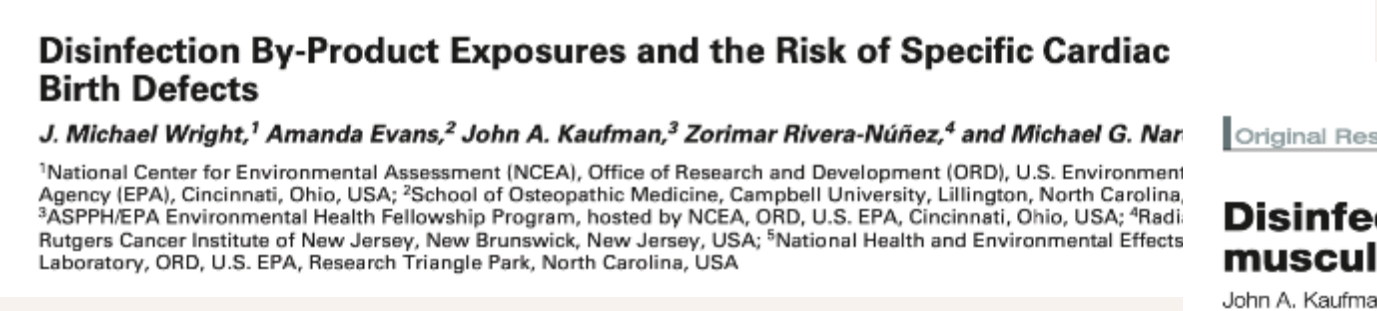
Health effects

Prenatal exposure to DBPs in drinking water has been associated with various adverse effects on the reproductive sphere such as stillbirth, abortion, uterine growth retardation, low birth weight, prematurity and malformations.

Epidemiological evidence is still weak due to the difficulties in assessing individual exposure to DBPs, in identifying personal habits that can influence the extent of exposure and in controlling the action exerted by numerous confounding factors.



Disinfection By-Product Exposures and the Risk of Specific Cardiac Birth Defects

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Original Research

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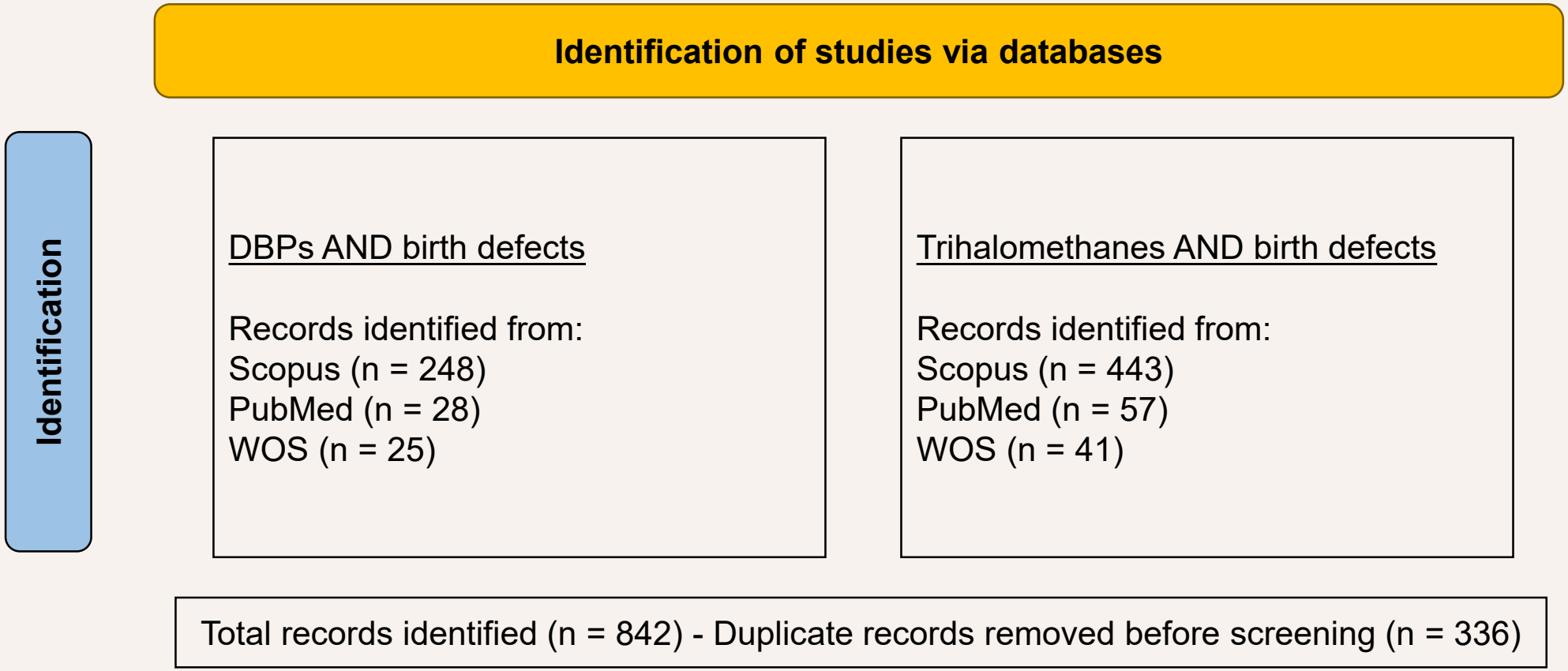
Disinfection by-product exposures and the risk of musculoskeletal birth defects

John A. Kaufman[a,*], J. Michael Wright[b], Amanda Evans[c], Zorimar Rivera-Núñez[d], Amy Meyer[e], Michael G. Narotsky[f]

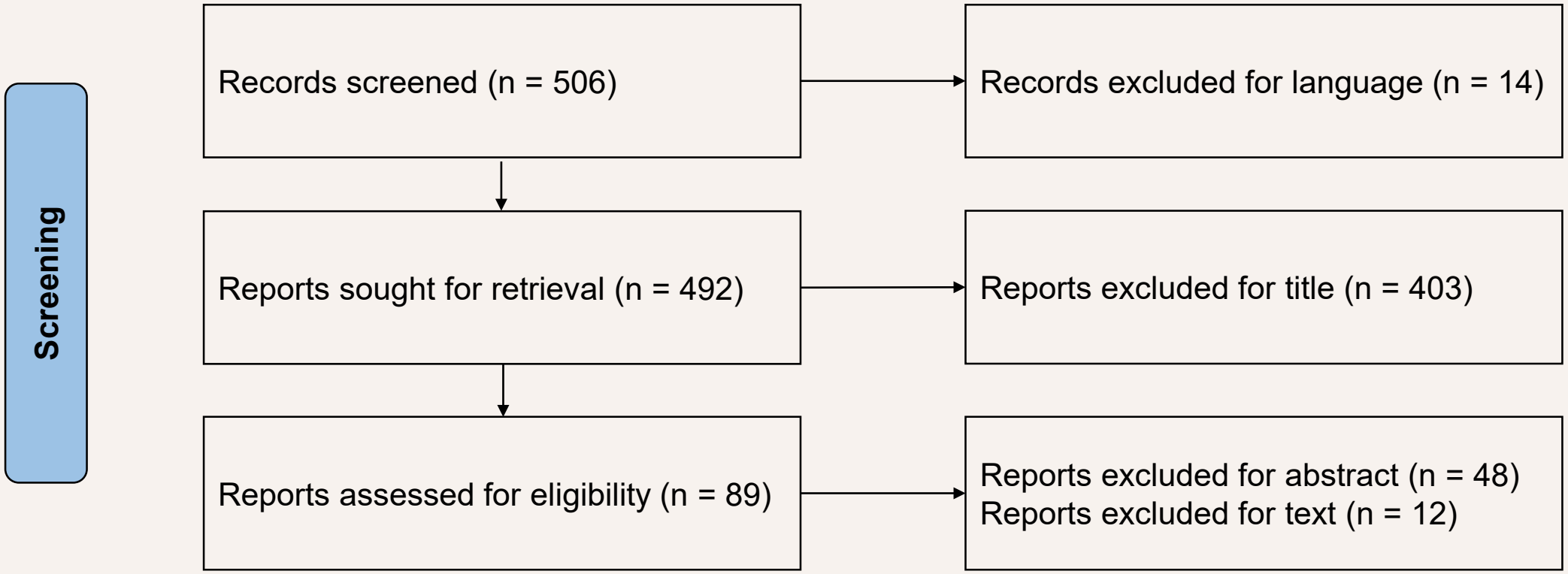
Objective

This study was aimed at systematically assessing the association between exposure to different DBPs and the occurrence of birth defects, using a dose-response approach

Literature search and selection



Literature search and selection



Literature search and selection

Included

Studies included in review (n = 29)
Reports of included studies (n = 30)

id
app
reference
year
region
country
design
cohort
window
period
sex

outcome1
outcome
exposure
d_stringa
dose
cases
n
rr
lrr
urr
adj_model
type

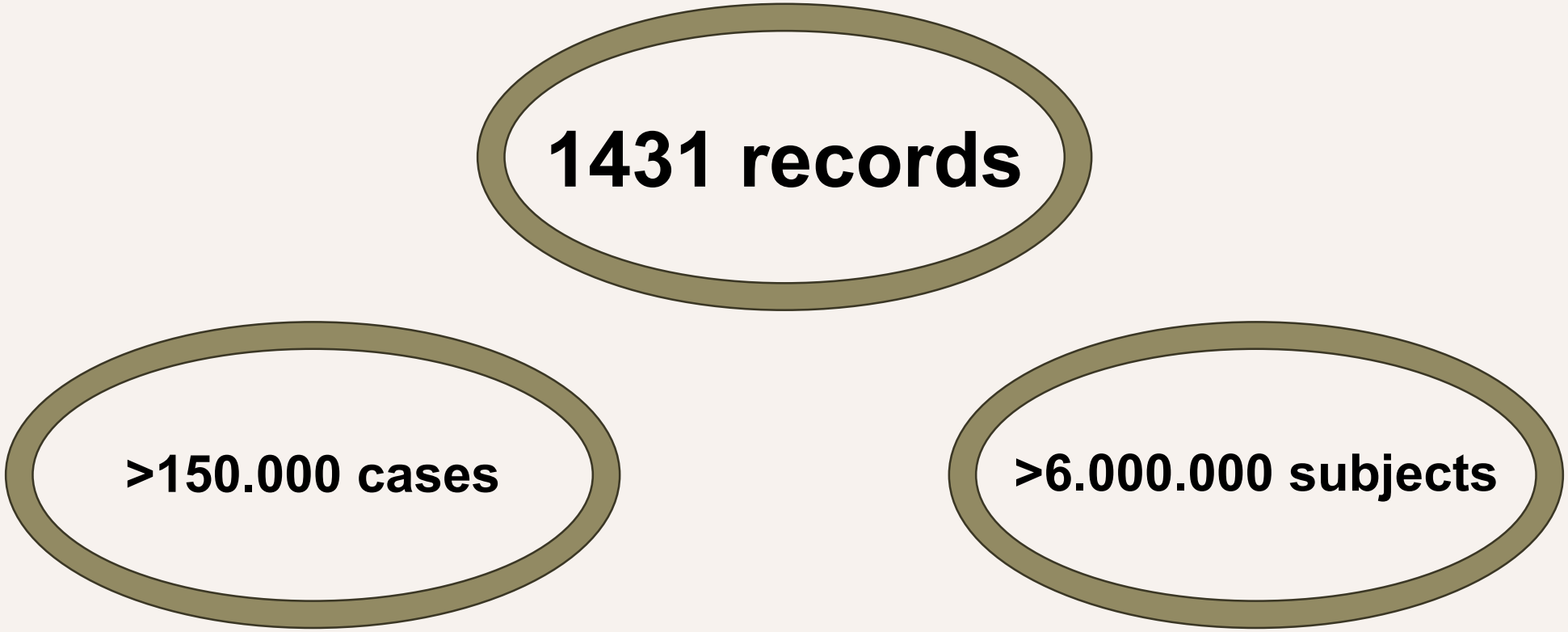
Results

Case-control (n = 13)

Cohort (n = 11)

Cross-sectional (n = 5)

Results



Results

THMs = chloroform, bromoform, dibromochloromethane, bromodichloromethane

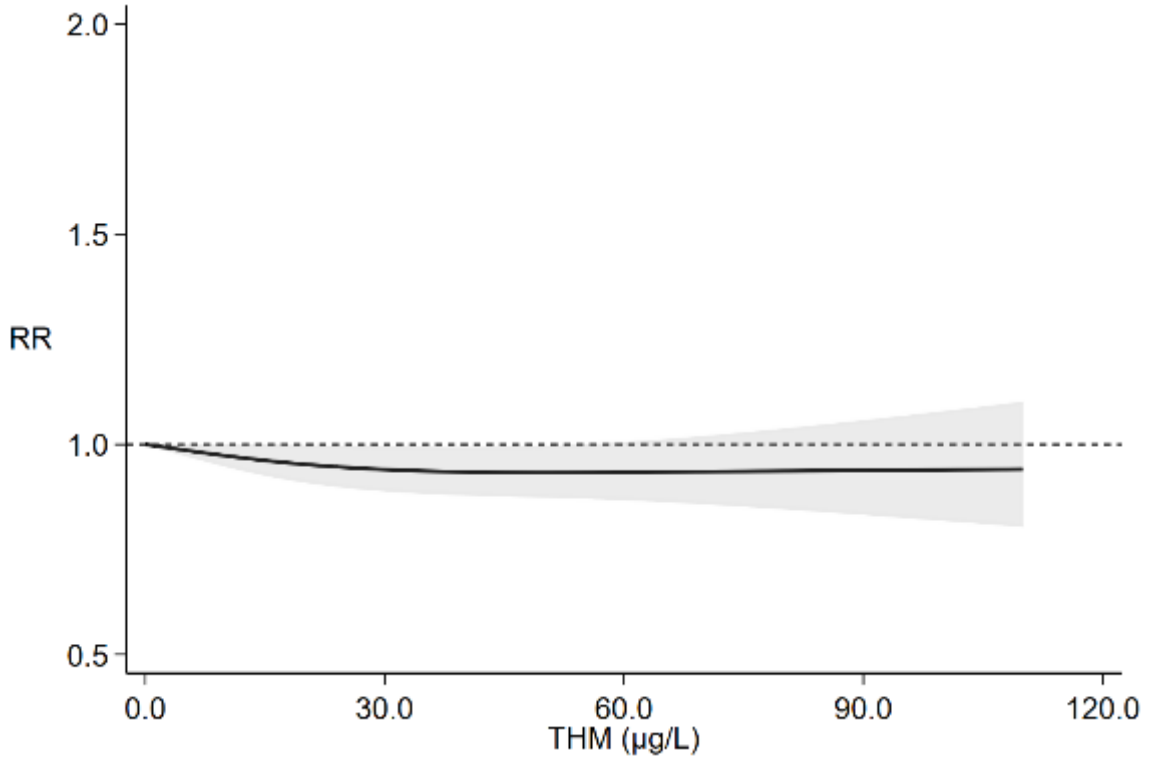
HAAs = trichloroacetic acid, dichloroacetic acid, monochloroacetic acid, dibromoacetic acid, monobromoacetic acid, bromochloroacetic acid

Others DBPs = chlorite, chlorate, nitrate

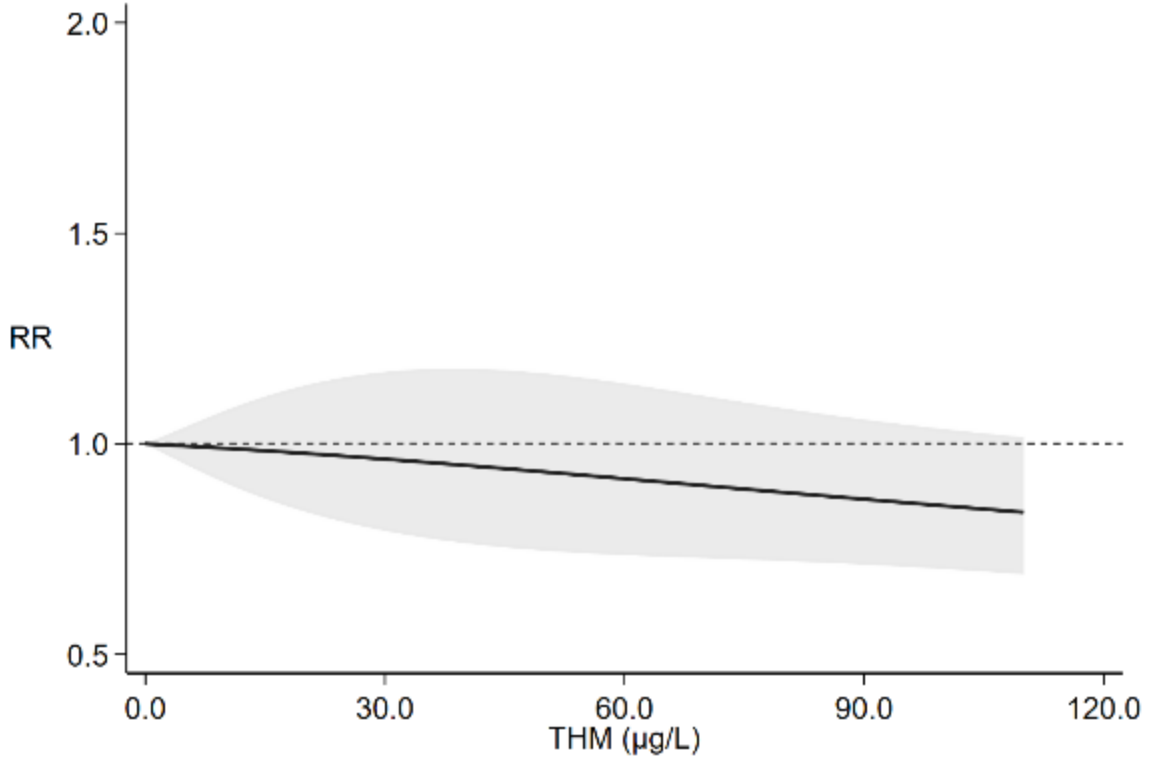
Results

outcome3	Freq.	Percent	Cum.
abdominal wall defects	96	7.28	7.28
cardiovascular defects	395	29.95	37.23
chromosomal defects	40	3.03	40.26
digestive system defects	15	1.14	41.39
growth defects	129	9.78	51.18
integument congenital defects	3	0.23	51.4
musculoskeletal defects	122	9.25	60.65
nervous system defects	12	0.91	61.56
neural tube defects	82	6.22	67.78
orofacial defects	357	27.07	94.84
respiratory system defects	20	1.52	96.36
urogenital defects	48	3.64	100
Total	1,319	100	
.			

Results

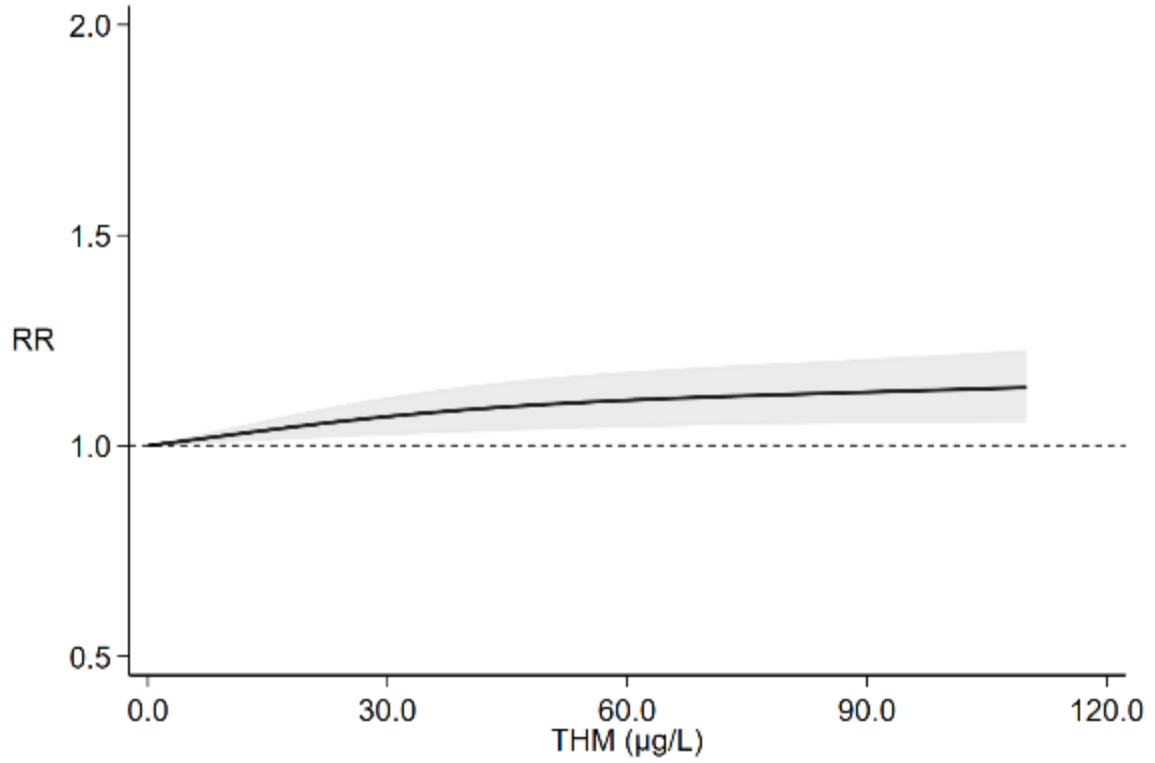


THMs and oro-facial defects

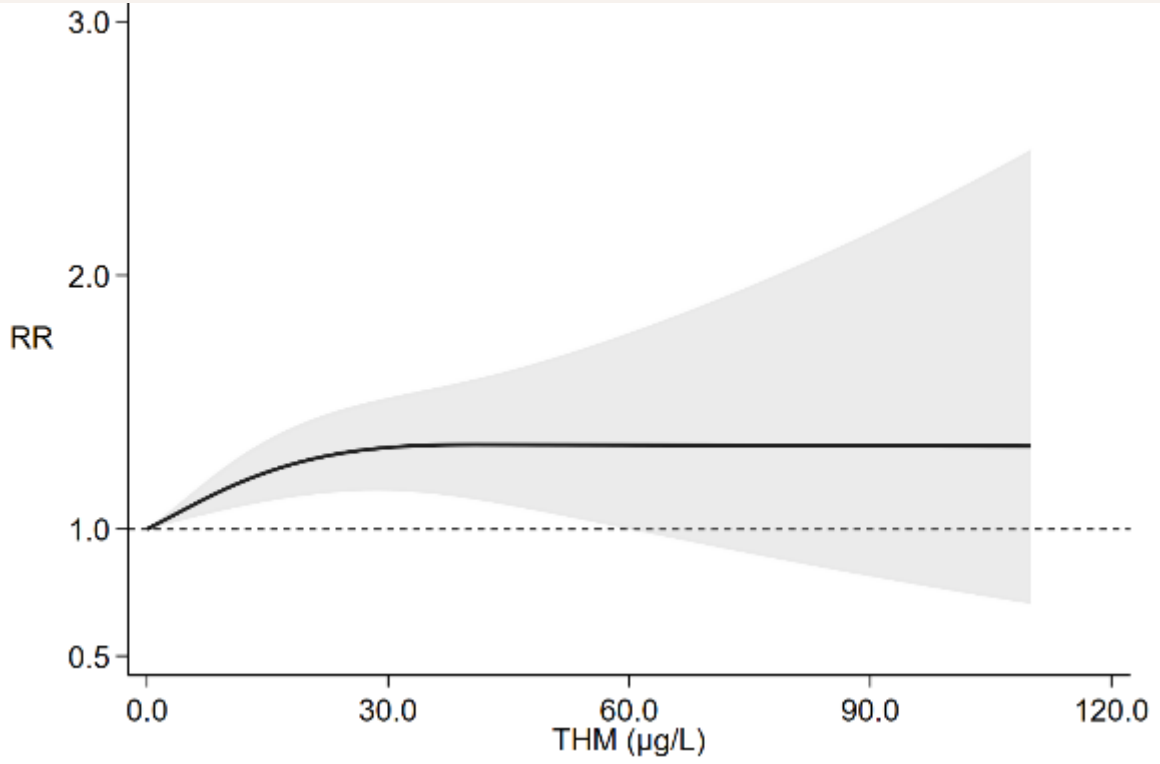


THMs and cardiovascular defects

Results



THMs and growth defects



THMs and urogenital defects

Conclusions

Understanding the potential interaction between DBPs exposure and birth defects is crucial to develop effective prevention and intervention strategies and to establish more accurate exposure assessment methods. Therefore, study findings may have significant implications for water treatment procedures, public health policies, and prenatal care recommendations.

The new national legislation on the quality of drinking water imposes a parametric value for THMs of 30 µg/l, more restrictive than the 100 µg/l provided for by EU Directive 2020/2184 and, in accordance with the same directive, adds a parameter value for HAAs with 60 µg/l.

TO BE CONTINUED...