

# The relationship between adverse health outcomes and nitrate in drinking water may be affected by co-occurring pesticides and their transformation products.

## Agrichemical Mixtures in Drinking Water Samples Collected for the Birth Outcomes and Water (BOW) Study

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BIRTH OUTCOMES AND WATER

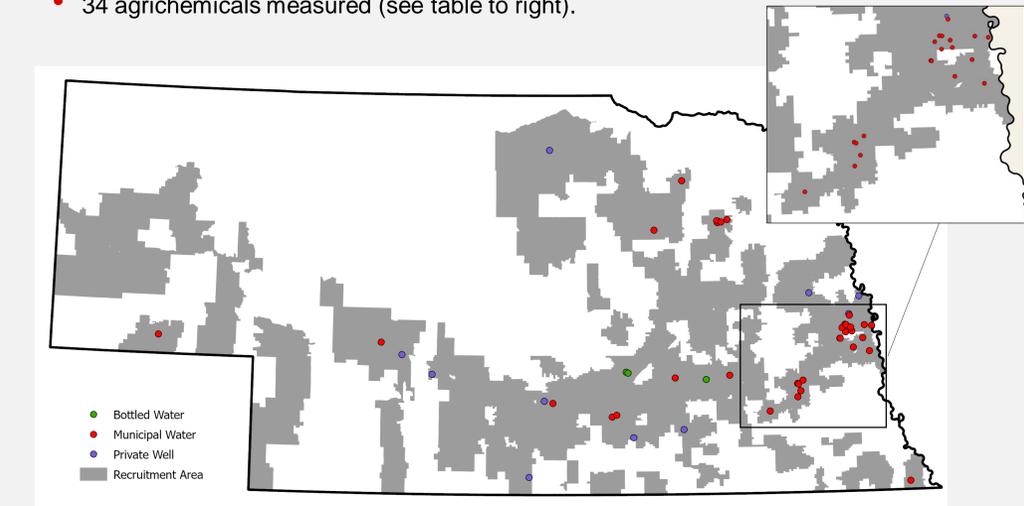
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### INTRODUCTION

- Exposure to agrichemical mixtures through drinking water is an emerging issue in Nebraska.
  - Nitrate in drinking water and nitrosatable compounds are associated with poor birth outcomes.
    - Many agrichemical compounds are nitrosatable.
- Birth Outcomes and Water objective: Evaluate feasibility of a study to see whether a woman's exposure to agricultural chemicals in drinking water can affect the outcome of her pregnancies.
  - Develop survey instrument.
  - Conduct a pilot study of 40 subjects.
    - Questionnaire
    - Blood sample
    - Saliva sample
    - Water Sample**
    - Participant perception interview
  - Design stronger large-scale study.

### METHODS

- Nitrate and agrichemical compounds classified as nitrosatable were of specific interest.
- Water samples collected from residence of BOW participants (see map). Recruitment area: Zip codes with  $\geq 1$  birth defect case and 1 well with nitrate-N + nitrosatable agrichemical detected<sup>1</sup>.
  - 34 agrichemicals measured (see table to right).



Analytes (MCL)*
2,4-D (70 µg/L)
4-Hydroxychlorothalonil
Acetochlor
Acetochlor ESA
Acetochlor OA
Alachlor (2 µg/L)
Alachlor ESA
Alachlor OA
Atrazine (3 µg/L)
Butylate
Chlorothalonil
Cyanazine
DEA
DIA
Dicamba
Dimethenamid
EPTC
Metolachlor
Metolachlor ESA
Metolachlor OA
Metribuzin
Nitrate-N (10 mg/L)
Nitrite-N (1 mg/L)
Norflurazon
Nitrosodimethylamine
Pendamehalin
Permethrin
Prometon
Propachlor
Propachlor ESA
Propazine
Simazine (4 µg/L)
Tefluthrin
Trifluralin

### RESULTS

- Nitrate-N detected in all water samples (see large table to left).
- One water sample contained nitrate-N above the MCL (12.2 mg/L).
- Up to 12 agrichemicals (excluding nitrate-N) detected in some water samples.
- Concentrations of pesticides/transformation products (monitored under the Safe Drinking Water Act) are below MCL.
- Most common mixture contains nitrate-N, atrazine, DEA, acetochlor ESA, acetochlor OA, alachlor ESA, alachlor OA, metolachlor ESA and metolachlor OA (13 water samples).
- Ten parent pesticides and 8 transformation products detected.
- Pesticide transformation products were detected more frequently than parent pesticides.

Water Source	# of Participants
<b>Bottled Water</b>	2
<b>Private Well</b>	6
And Bottled Water	1
With RO System	1
<b>Public Water Supply</b>	23
And Bottled Water	6
<b>Rural Water District</b>	1
<b>Total</b>	40

\*As of 11/16/22

### DISCUSSION

- Agrichemical mixtures should be considered when evaluating linkages between exposure to nitrate in drinking water and poor health outcomes. Chronic, low-dose exposure to multiple compounds may have separate health impacts when compared to single compounds.
- Study findings can help prioritize agrichemical mixtures for establishing human-health benchmarks.
- Increased monitoring to establish the magnitude of agrichemical contamination of Nebraska drinking water supplies is warranted.

### ACKNOWLEDGMENTS

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1. Quality-Assessed Agrichemical Contaminant Database for Nebraska Groundwater (queried Fall 2015)

Pesticides and Degradation Products (µg/L) *	Detections (N/X samples)	Range of concentrations	Average concentration	Maximum Contaminant Level (MCL)
	<b>N/24</b>			<b>µg/L</b>
DEA	20	0.001-0.185	0.052	
Atrazine	19	0.005-0.560	0.165	3
Metolachlor	14	0.002-0.074	0.032	
Propazine	10	0.001-0.018	0.003	
Simazine	10	0.001-0.006	0.003	4
Dimethenamid	6	0.003-0.015	0.011	
DIA	5	0.010-0.086	0.028	
Acetochlor	1	0.010		
Butylate	1	0.001		
Permethrin	1	0.470		
	<b>N/27 samples</b>			
Metolachlor ESA	23	0.006-0.475	0.158	
Metolachlor OA	23	0.001-0.273	0.076	
Acetochlor ESA	20	0.002-0.084	0.045	
Alachlor ESA	20	0.011-0.352	0.055	
Alachlor OA	19	0.001-0.265	0.026	
Acetochlor OA	18	0.001-0.270	0.100	
2-4-D	14	0.001-0.039	0.009	70
Dicamba	2	0.073-0.367	0.220	
	<b>N/32 samples</b>			<b>mg/L</b>
Nitrate-N	32	0.010-12.20	2.226	10
Nitrite-N	14	0.001-0.124	0.018	1

Pesticides and their degradation products, nitrate and nitrite detections in Nebraska drinking water samples collected from homes of Birth Outcomes and Water study participants. Sources include public and private water supplies. Compounds missing MCLs are not monitored under the Safe Drinking Water Act. Total samples  $\neq$  40 due to pending analyses.

\*DEA=deethylatrazine, DIA=deisopropylatrazine, 2,4-D=2,4-dichlorophenoxyacetic acid, ESA=ethane sulfonic acid, OA=oxanilic acid