## Background

- Birth defects are the leading cause of infant mortality in USA, causing one in every five infant deaths and placing a financial burden on families and society.
- One in every 33 infants in the United States is born with a birth defect. In Nebraska, two of every 33 infants born has a birth defect. Water plays a major role in human health.
- The BOW study examines maternal exposure to drinking water contaminants and health of offspring.

## Methods

### **Study population**

Nebraska women with at least one birth recorded in Nebraska state databases(figure 1).

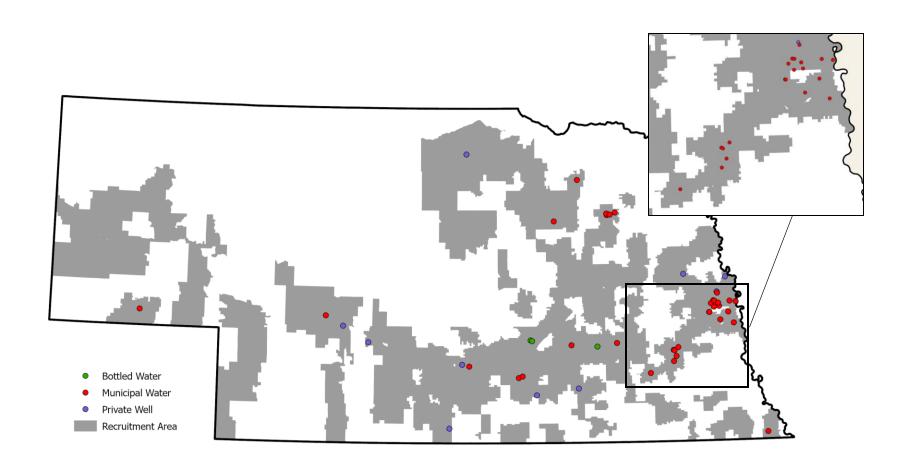
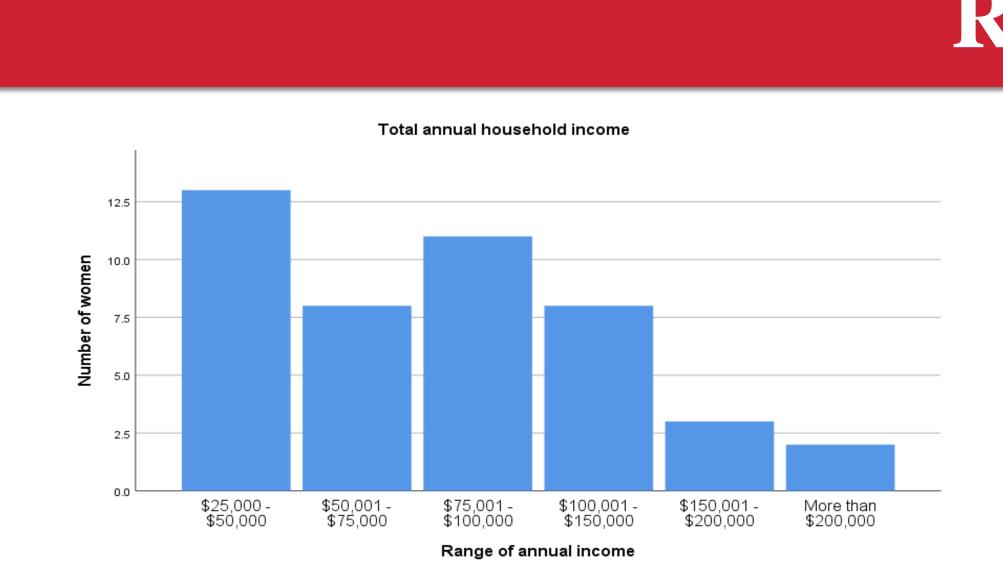


Figure 1. Fetal death or live birth in 2014,2015,2018,2019. Water samples and survey on demographics, health, diet and residence of participants. Recruitment focused on zip codes with at least one BD and one well positive for NO3-N + nitrosatable agrichemical.

### **Statistical Analysis**

- We estimated maternal agrichemical exposure (> 0.001 mg/L for atrazine and > 0.001 mg/L for nitrate) from source of drinking water.
- 2 x 2 contingency tables were constructed to calculate odds ratio for exposure vs. non-exposure to agrichemicals between cases and controls.
- Chi-square tests were used to examine  $\bullet$ associations between birth defects and agrichemical exposure, age, lifestyle factors.
- We estimated a binary logistic model with Age, Atrazine, Nitrate, Nitrite, Acetochlor OA and Acetochlor ESA. All analysis were conducted using SPSS V 29.



Agrichemi Compound Contami Atraz No Yes Metolac No Yes Metolachle No Yes Metolachl No Yes Acetoc No Yes Acetochlo No Yes Acetachlo No Yes Alachl No Yes Alachlor No Yes Alachlor No Yes DEA No Yes DIA No Yes Dimethen No Yes Propazi No Yes

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

# **Exploring the Multifactorial Nature of Birth Defects in the Birth Outcomes and Water Pilot Study:** The Impacts of Agrichemical Exposure, Maternal Age and Lifestyle

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## Results

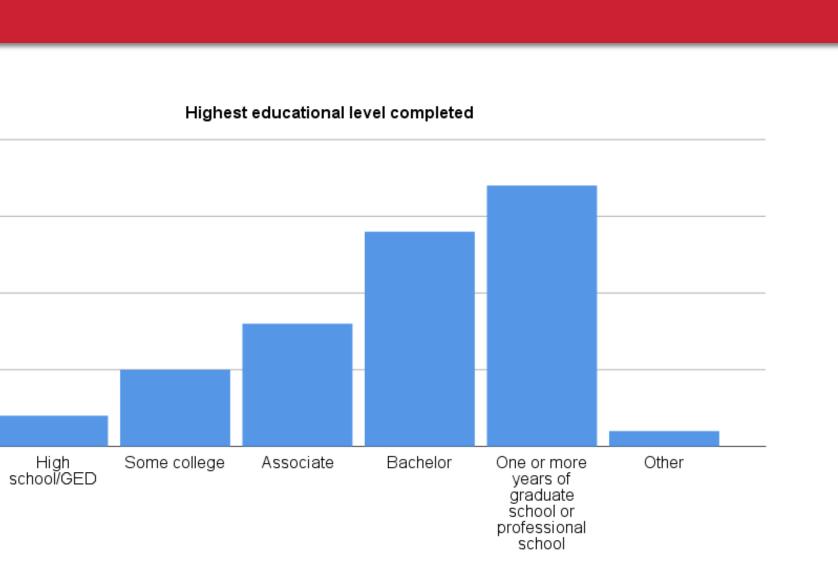
	20	
men	15	
Number of women	10	
Num	5	
	0	

nds	Controls (n=26) *	Cases (n=21) **	OR (95% CI)	<b>P-value</b>	Agrichemical Compounds	Controls (n=26) *	Cases (n=21) **	OR (95% CI)	)	<b>P-value</b>
ninants					2,4-D			1.8(0.4-	7.8)	0.6
zine			4.2 (0.7-26.1)	0.1	No	7	6	, , , , , , , , , , , , , , , , , , ,	/	
0	5	2			Yes	6	9			
es	10	17			Butylate	0		1.1(0.9-	1 2)	0.4
achlor			3.4 (0.8-14.2)	0.08	No	15	18	1.1(0.)	1.2)	0.7
0	10	7			Yes	0	10			
es	5	12				0				0.3
lor ESA		1	4.2 (0.4-46.5)	0.2	Nitrate***	0				0.5
0	3				No No	0				
	10	14		0.2	Yes	13	19			
hlor OA		1	4.2 (0.4-46.5)	0.2	<sup>"</sup> Nitrite			4.6(0.9-2	22.2)	0.05
0	3					10	3			
2S	10	14			Yes	8	11			
chlor	15	10	1.1 (0.9-1.2)	0.3						
0	15	18			Table 2. Agrichemie					
es lor ESA	0	1		0.01	** All the women v	vere expos	ed to nitrate s	since nitrate wa	is detec	ted in thei
$\begin{array}{c} 101 \mathbf{ESA} \\ 0 \end{array}$	6	1	12 (1.2-120)	0.01	drinking water.					
	67	14								
es Ilor OA		14	7.5 (1.2-48)	0.02						
0	7	2	7.3 (1.2-40)	0.02						
0										
20	n n	'∡								
es hlor	6	13	28(02-333)	0.4						<b>.</b>
hlor			2.8 (0.2-33.3)	0.4	Agrichemicals		Slope	S.E	P-va	alue
hlor o	13	13 18 1	2.8 (0.2-33.3)	0.4			<b>Slope</b> -0.1	<b>S.E</b> 0.1	P-va	<b>alue</b> 0.2
hlor o es					Agrichemicals         Age		▲		P-va	
hlor o es or OA	13	18 1	2.8 (0.2-33.3) 2.5(0.5-13.5)	0.4	Age		-0.1	0.1	P-va	0.2
hlor o es or OA o	13 2 5	18 1 3					▲		P-va	
hlor o es or OA o es	13	18 1	2.5(0.5-13.5)	0.2	Age		-0.1	0.1	P-va	0.2
hlor o es or OA o es or ESA	13 2 5 8	18 1 3 12			Age		-0.1	0.1		0.2
hlor o	13 2 5 8 5	18 1 3 12 2	2.5(0.5-13.5)	0.2	Age Atrazine		-0.1 -2.1	0.1 5.4		0.2 0.7
hlor o es or OA o es or ESA o	13 2 5 8	18 1 3 12	2.5(0.5-13.5) 4.1 (0.6-26)	0.2 0.1	Age Atrazine Metolachlo	or	-0.1 -2.1 89.5	0.1 5.4 47.4		0.2 0.7 0.04
hlor o es or OA o es or ESA o es	13 2 5 8 5 8	18 1 3 12 2 13	2.5(0.5-13.5)	0.2	Age Atrazine	or	-0.1 -2.1	0.1 5.4		0.2 0.7
hlor o es or OA o es or ESA o es	13 2 5 8 5 8 3	18 1 3 12 2 13 2	2.5(0.5-13.5) 4.1 (0.6-26)	0.2	Age Atrazine Metolachlo	or	-0.1 -2.1 89.5	0.1 5.4 47.4		0.2 0.7 0.04
hlor o es or OA o es or ESA o es	13 2 5 8 5 8	18 1 3 12 2 13	2.5(0.5-13.5) 4.1 (0.6-26) 2.1 (0.3-14.7)	0.2 0.1 0.4	Age         Atrazine         Metolachlo         Acetochlor F	or ESA	-0.1 -2.1 89.5 -58.4	0.1 5.4 47.4 27.5		0.2 0.7 0.04 0.03
hlor o es or OA o es or ESA o es	13 2 5 8 5 8 3 12	18     1     3     12     2     13     2     17     17     1	2.5(0.5-13.5) 4.1 (0.6-26)	0.2	Age Atrazine Metolachlo	or ESA	-0.1 -2.1 89.5	0.1 5.4 47.4		0.2 0.7 0.04
hlor o es or OA o es or ESA o es o	13 2 5 8 5 8 3	18 1 3 12 2 13 2	2.5(0.5-13.5) 4.1 (0.6-26) 2.1 (0.3-14.7)	0.2 0.1 0.4	Age Atrazine Metolachle Acetochlor H Acetochlor	or ESA	-0.1 -2.1 89.5 -58.4 29.8	0.1 5.4 47.4 27.5 19.7		0.2 0.7 0.04 0.03 0.1
hlor o es or OA o es or ESA o es o	13 2 5 8 5 8 3 12 13	18     1     3     12     2     13     2     17     16     1	2.5(0.5-13.5) 4.1 (0.6-26) 2.1 (0.3-14.7)	0.2 0.1 0.4	Age         Atrazine         Metolachlo         Acetochlor F	or ESA	-0.1 -2.1 89.5 -58.4	0.1 5.4 47.4 27.5		0.2 0.7 0.04 0.03
hlor o es or OA o es or ESA o es o es o	13 2 5 8 5 8 3 12 13	18     1     3     12     2     13     2     17     16     1	2.5(0.5-13.5) 4.1 (0.6-26) 2.1 (0.3-14.7) 1.2 (0.2-8.4)	0.2 0.1 0.4 0.8	Age Atrazine Metolachle Acetochlor H Acetochlor	or ESA	-0.1 -2.1 89.5 -58.4 29.8	0.1 5.4 47.4 27.5 19.7		0.2 0.7 0.04 0.03 0.1
hlor o es or OA o es or ESA o	$   \begin{array}{c}     13\\     2\\     5\\     8\\     5\\     8\\     3\\     12\\     13\\     2   \end{array} $	$     18 \\     1 \\     3 \\     12 \\     2 \\     13 \\     2 \\     17 \\     16 \\     3     3   $	2.5(0.5-13.5) 4.1 (0.6-26) 2.1 (0.3-14.7) 1.2 (0.2-8.4)	0.2 0.1 0.4 0.8	Age Atrazine Metolachlo Acetochlor H Acetochlor Mitrite	or ESA	-0.1 -2.1 89.5 -58.4 29.8 -49.7	0.1 5.4 47.4 27.5 19.7 30.9		0.2 0.7 0.04 0.03 0.1 0.1
hlor o es or OA o es or ESA o es o es o es enamid o	$   \begin{array}{c}     13 \\     2 \\     5 \\     8 \\     5 \\     8 \\     3 \\     12 \\     13 \\     2 \\     10 \\   \end{array} $	18     1     3     12     2     13     2     17     16     3     12     12	2.5(0.5-13.5) 4.1 (0.6-26) 2.1 (0.3-14.7) 1.2 (0.2-8.4)	0.2 0.1 0.4 0.8	Age Atrazine Metolachle Acetochlor H Acetochlor	or ESA	-0.1 -2.1 89.5 -58.4 29.8	0.1 5.4 47.4 27.5 19.7		0.2 0.7 0.04 0.03 0.1
hlor o es or OA o es or ESA o es o es o es enamid o es	$   \begin{array}{c}     13 \\     2 \\     5 \\     8 \\     5 \\     8 \\     3 \\     12 \\     13 \\     2 \\     10 \\   \end{array} $	18     1     3     12     2     13     2     17     16     3     12     12	2.5(0.5-13.5) 4.1 (0.6-26) 2.1 (0.3-14.7) 1.2 (0.2-8.4) 2.5 (0.4-15.2)	0.2 0.1 0.4 0.8 0.3	Age Atrazine Metolachlo Acetochlor H Acetochlor Mitrite	or ESA OA	-0.1 -2.1 89.5 -58.4 29.8 -49.7	0.1 5.4 47.4 27.5 19.7 30.9		0.2 0.7 0.04 0.03 0.1 0.1

Table 3. A binary logistic regression model with birth defect as response variable and agrichemicals as explanatory variable including the interaction between atrazine and nitrate.

Table 1. Agrichemical exposure vrs case control birth defect

University of Nebraska-Lincoln



- Majority (17) of the women had graduate or professional school.
- Birth defect was associated with Acetochlor ESA, Acetochlor OA and Nitrite.
- This suggests that there is a high risk of birth defect when exposed to Acetochlor ESA, Acetochlor OA and Nitrite.
- The association between birth defect and Metolachlor was marginally significant.
- The basis for the negative relationship between nitrate and birth defect and atrazine and birth defect is less apparent
- The results also suggest that atrazine and nitrate interaction is not significant.
- Even though the results suggest that atrazine and nitrate are not significant, Metolachlor and Acetochlor ESA are significant.

## **Conclusions and Limitations**

- The study suggest that there is an association between birth defect and agrichemicals.
- This pilot study did not control for other factors like genetics, blood and saliva data.
- Residential history and mobility impacted racial description. As a result, all the participants were white.
- A larger study is needed to ascertain the association between birth defect and agrichemicals.



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## Discussion

## Acknowledgments









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