



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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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).

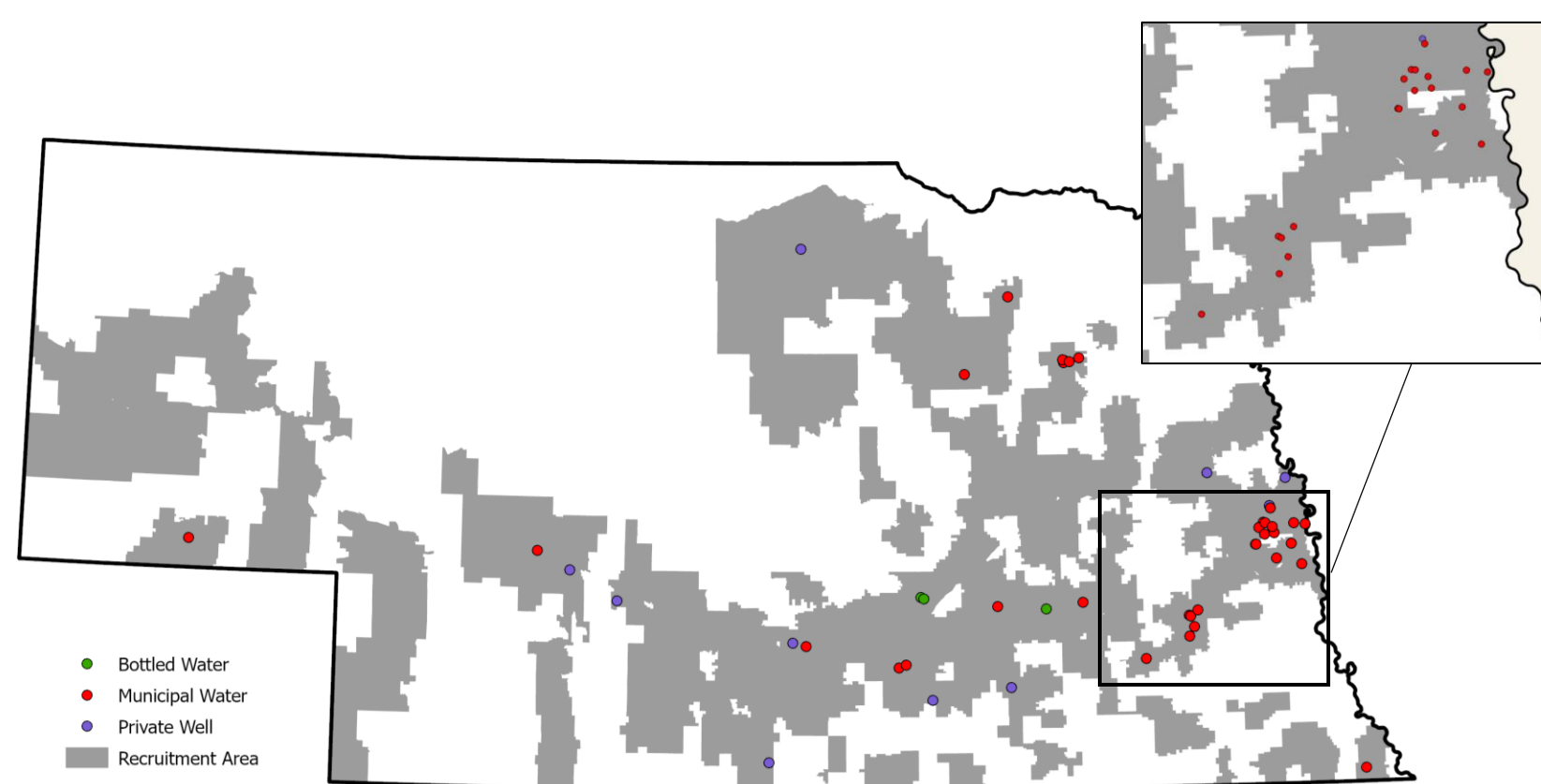
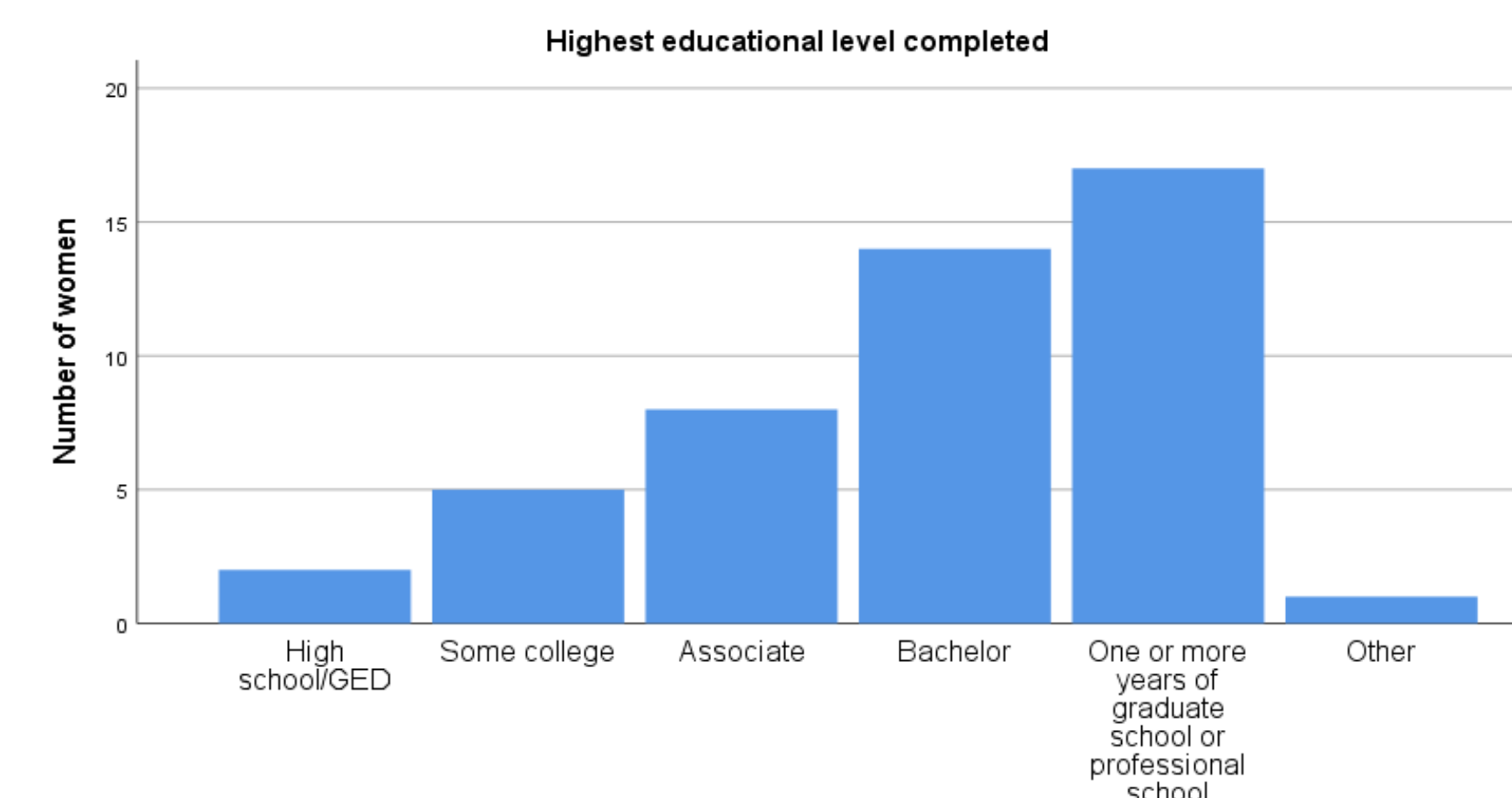
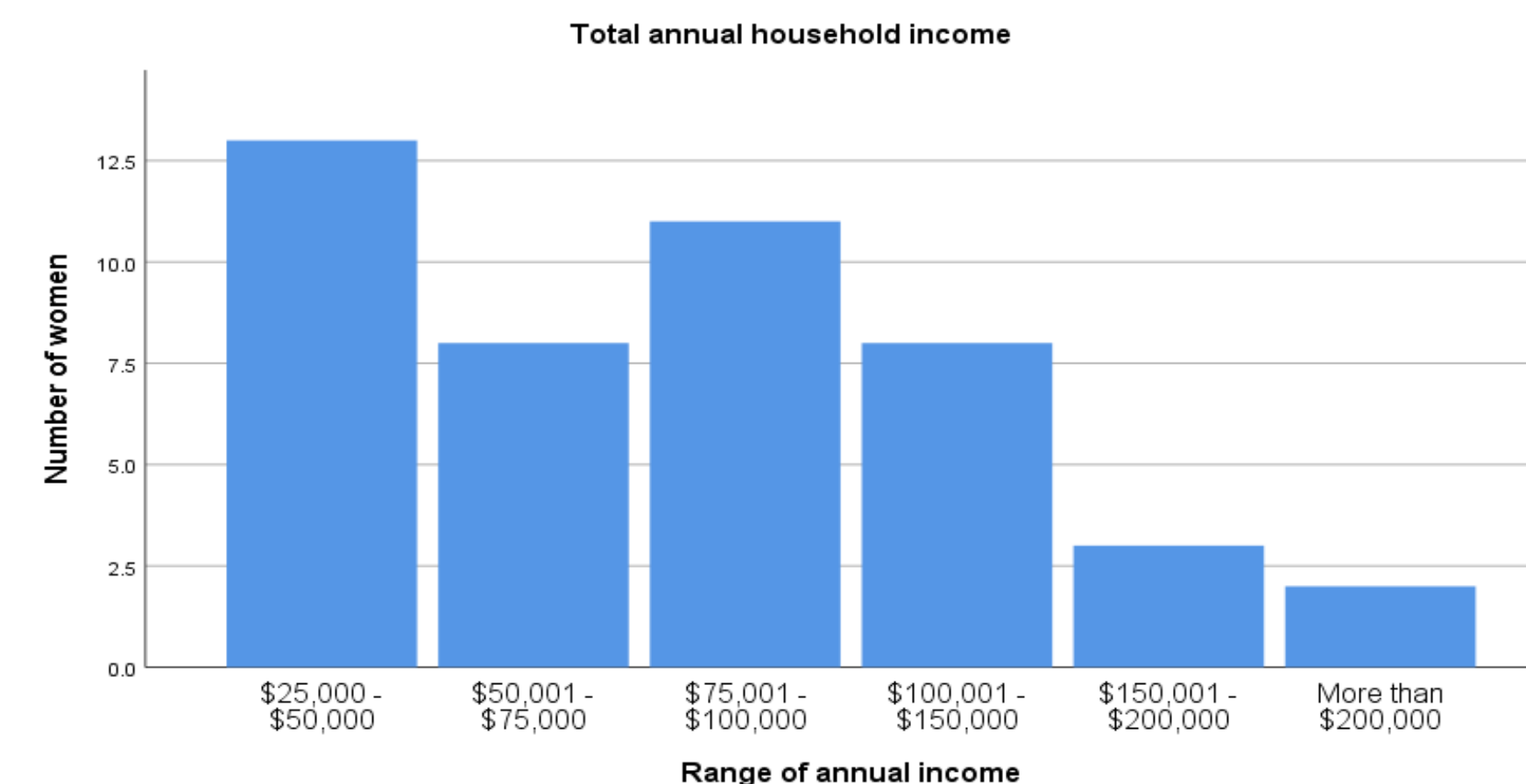


Figure 1. Fetal death or live birth in 2014, 2015, 2018, 2019. Water samples and survey on demographics, health, diet and residence of participants. Recruitment focused on zip codes with at least one BD and one well positive for NO3-N + nitrosatable agrichemical.

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 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.

Results



Agrichemical Compounds	Controls (n=26) *	Cases (n=21) **	OR (95% CI)	P-value
Contaminants				
Atrazine			4.2 (0.7-26.1)	0.1
No	5	2		
Yes	10	17		
Metolachlor			3.4 (0.8-14.2)	0.08
No	10	7		
Yes	5	12		
Metolachlor ESA			4.2 (0.4-46.5)	0.2
No	3	1		
Yes	10	14		
Metolachlor OA			4.2 (0.4-46.5)	0.2
No	3	1		
Yes	10	14		
Acetochlor			1.1 (0.9-1.2)	0.3
No	15	18		
Yes	0	1		
Acetochlor ESA			12 (1.2-120)	0.01
No	6	1		
Yes	7	14		
Acetochlor OA			7.5 (1.2-48)	0.02
No	7	2		
Yes	6	13		
Alachlor			2.8 (0.2-33.3)	0.4
No	13	18		
Yes	2	1		
Alachlor OA			2.5 (0.5-13.5)	0.2
No	5	3		
Yes	8	12		
Alachlor ESA			4.1 (0.6-26)	0.1
No	5	2		
Yes	8	13		
DEA			2.1 (0.3-14.7)	0.4
No	3	2		
Yes	12	17		
DIA			1.2 (0.2-8.4)	0.8
No	13	16		
Yes	2	3		
Dimethenamid			2.5 (0.4-15.2)	0.3
No	10	12		
Yes	2	6		
Propazine			1.5 (0.4-7.8)	0.6
No	10	11		
Yes	5	8		

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

Table 1. Agrichemical exposure vrs case control birth defect

Agrichemical Compounds	Controls (n=26) *	Cases (n=21) **	OR (95% CI)	P-value
2,4-D			1.8(0.4-7.8)	0.6
No	7	6		
Yes	6	9		
Butylate			1.1(0.9-1.2)	0.4
No	15	18		
Yes	0	1		
Nitrate***				0.3
No	0	0		
Yes	13	19		
Nitrite			4.6(0.9-22.2)	0.05
No	10	3		
Yes	8	11		

Table 2. Agrichemical exposure vrs case control birth defect

*** All the women were exposed to nitrate since nitrate was detected in their drinking water.

Agrichemicals	Slope	S.E	P-value
Age	-0.1	0.1	0.2
Atrazine	-2.1	5.4	0.7
Metolachlor	89.5	47.4	0.04
Acetochlor ESA	-58.4	27.5	0.03
Acetochlor OA	29.8	19.7	0.1
Nitrite	-49.7	30.9	0.1
Nitrate	-0.2	0.3	0.4
Atrazine *Nitrate	-2.2	4.9	0.6

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.

Discussion

- 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.

Acknowledgments

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