

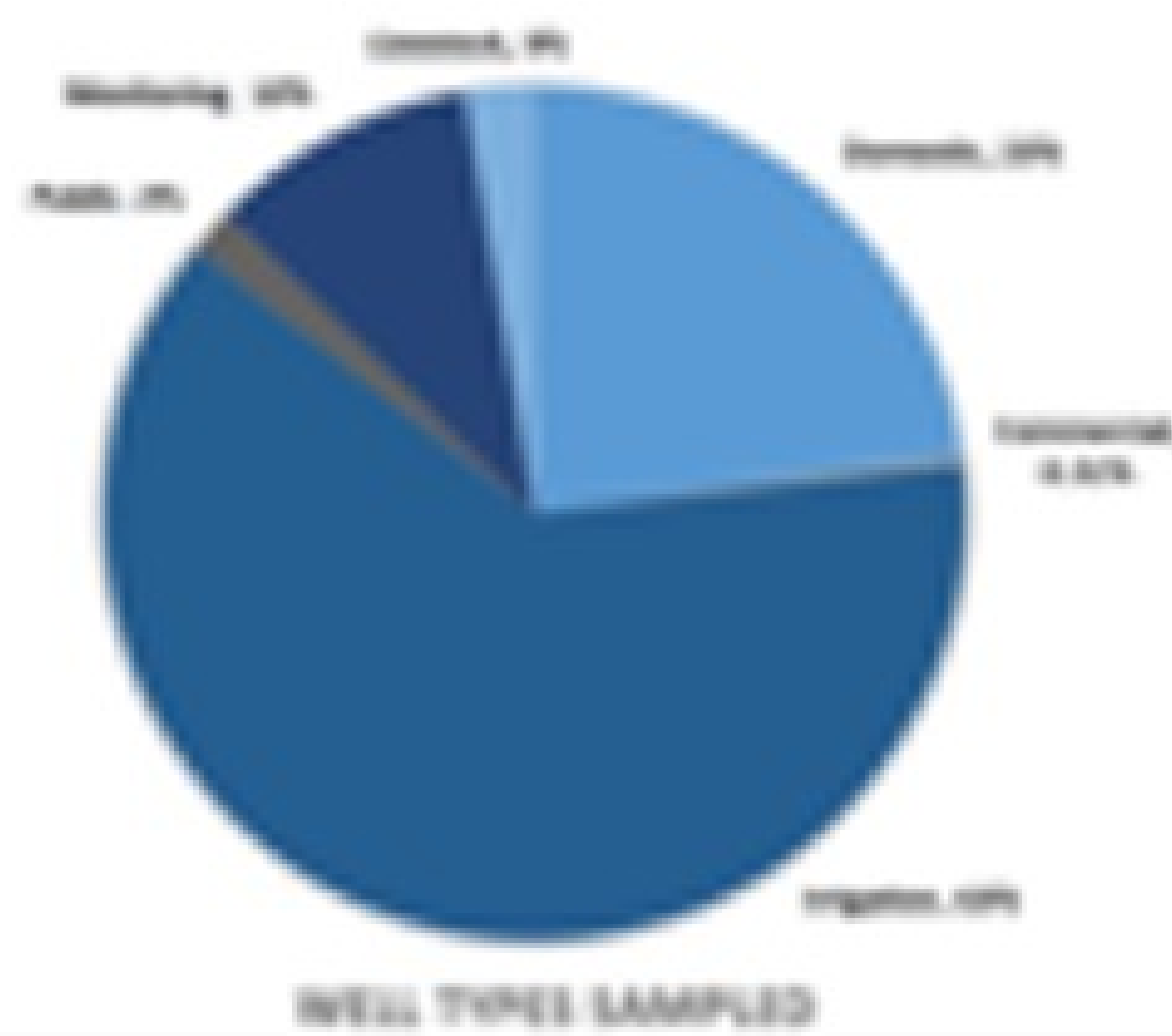


Correlation between Nitrate and Nitrosatable Agrichemicals in Nebraska Groundwater and the Risk of Adverse Birth Outcomes

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INTRODUCTION

- Nebraska's rate of birth defects (6%) is notably higher than the national rate (3%).¹
- Agricultural practices use atrazine and nitrogen-based fertilizers.
 - Atrazine and nitrate have been detected in groundwater and can be present in drinking water
 - Combine to form a nitrosamine called N-nitrosoatrazine (NNAT)
 - Exposure to nitrosamines may be correlated with neural-tube defects, cleft palate, neonatal death, and stillbirth in rodents.²
- Exploratory research showed a positive correlation between birth defect rates and the percent of wells containing nitrate and at least one nitrosatable compound.
- **Purpose:** Identify the relationship between exposure of nitrate and nitrosatable agrichemicals in drinking water, birth defect rates, and fetal death rates, utilizing new data gathered about the fetal death rates in each county.
 - To better understand associations between exposure to nitrate and nitrosatable agrichemicals and the risk of adverse birth outcomes.



Source: Quality-Assessed Agrichemical Contaminant Database for Nebraska Groundwater (queried Fall 2015)

METHODS

- Added to an existing dataset that contained agrichemical information.
 - Included information on number of positive wells for each of Nebraska's 93 counties, total wells tested for each agrichemical and the percent of wells positive for the agrichemical.
- Created 15 new variables
 - Combined nitrate concentrations greater than 0, nitrate concentrations greater than 2, atrazine, DEA and DIA to see if any agrichemicals were present in the same water samples multiple times.
 - Ran correlations of all variables against the following variables
 - 2010-2014 Birth weight <1500g
 - 2010-2014 Birth weight <2500g
 - 2010-2014 fetal death rate
 - 2010-2014 infant death rate
 - 2010-2014 neonatal death rate
 - 2010-2014 perinatal death rate
 - 2005-2014 All birth defects
 - 2005-2014 National Birth Defects Prevention Study (NBDPS) birth defects
 - Well data was restructured so each well was represented in the data analysis once.
 - Used Clearinghouse numbers
- The birth defect and fetal death rate for each county were obtained from the Nebraska Department of Health and Human Services.
- Calculated significant correlations using Kendall-Tau Correlation Coefficient Test.
 - Not all variables normally distributed so cannot use Pearson Correlation

	Nitrate	Atrazine	DEA	DIA	ATZgt0	ATZgt2	DEA	DEA	NC	ATZ	NC	ATZ	DEA+DEA	DEA	DIA	EPIC	Inf	Inf	ATZgt0	NO2gt0	NO2gt1			
2010-2014 Birth weight <1500g			0.173	0.173	0.173	0.173																		
2010-2014 Birth weight <2500g	0.157		0.168						0.168	0.191	0.16	0.175		0.169										
2010-2014 fetal death rate									0.173	0.147				0.175										
2010-2014 infant death rate																			0.2					
2010-2014 neonatal death rate																			0.2				0.199	
2005-2014 All birth defects	0.184	0.252	0.218	0.223	0.183	0.145	0.18	0.226	0.203	0.203	0.186	0.182	0.213	0.222	0.186							0.199	0.199	0.199
2005-2014 NBDPS birth defects	0.185								0.23	0.17														

RESULTS

- 3 Agrichemicals have significant correlations with <1500g/1000 live births
- 7 Agrichemicals have significant correlations with <2500g/ 1000 live births
- 3 Agrichemical has significant correlations with fetal death/1000 live births
- 1 Agrichemical has significant correlations with infant death/1000 live births
- 2 Agrichemicals have significant correlations with neonatal death/1000 live births
- 17 Agrichemicals have significant correlations with all birth defects
- 3 Agrichemical has significant correlations with NBDPS birth defects.
- 97 pairs of significantly correlated agrichemicals

REFERENCES

1. Williams, Thomas L., et al. *Nebraska 2016 Vital Statistics Report*. s.l. : Nebraska Department of Health and Human Services, 2016. pp. 1, 11, 48-53.
2. *The Analysis of N-Nitrosoatrazine and N-Nitrosocarbaryl in Whole Mice*. Krull, I. S., et al. 5, September/October 1980, Journal of Analytical Toxicology, Vol. 4, pp. 260-262.
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CONCLUSION

We can look at the correlations to understand the impacts of drinking water containing nitrate and nitrosatable agrichemicals and adverse fetal outcomes, such as fetal death, perinatal death, infant death, neonatal death, and the birth defect rate. Most agrichemicals had positive significant correlations with these adverse fetal outcomes. While we cannot infer causation because of correlation, we can use these results and the knowledge that the agrichemicals have significant correlations to generate future hypotheses.

This study project allows us to better understand associations between exposure to nitrate and nitrosatable agrichemicals and the risk of adverse birth outcomes. Previous literature and research mostly looked at single compounds. This study looks at mixtures of compounds.

One limitation of the study is that contaminants could be surrogates for another. Another limitation is that we do not know for sure if the agrichemicals are confounders.

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