



Prevalence and Spatial Distribution of Gastroschisis in an Industrial Watershed

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Introduction

- Gastroschisis is a congenital malformation in which fetal viscera is herniated through the abdominal wall without an overlying membrane. Gastroschisis prevalence worldwide increased 10-20 fold from 1964 to 2004 with current US rates ranging from 3 to 4 per 10,000 live-births.
- Etiology of gastroschisis is not fully elucidated, with several proposed risk factors, including fetal environmental factors. Increased risk of gastroschisis tends to vary geographically and accumulate spatially, supporting environmental or infectious etiology.
- Kanawha River Valley contains several Environmental Protection Agency Facility Registry System (FRS) sites. FRS site is defined as an area in which a chemical known to harm humans is either stored or has been produced.
- Previous studies examining congenital diseases in this location have demonstrated spatial clustering in areas exposed to hazardous waste.



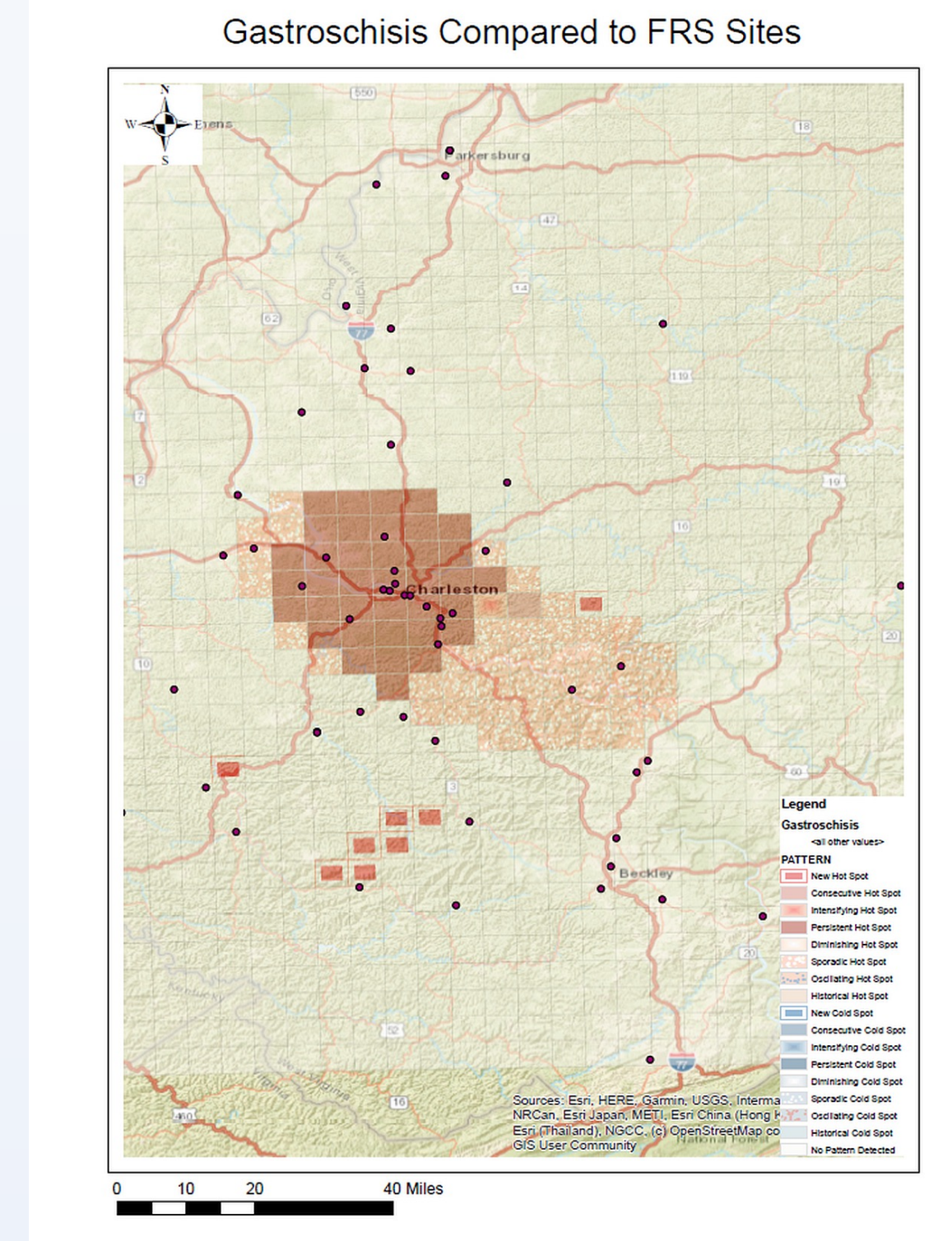
Methods

- This observational study was conducted at Charleston Area Medical Center Women's and Children's Hospital in Charleston, WV.
- Retrospective review was performed for all documented gastroschisis cases between January 1, 2006 and December 31, 2020. Fetal cases were identified via the hospital's ultrasound database. Neonatal cases were identified by discharge coding.
- We included a comparison group consisting of healthy neonates in a 3:1 ratio matched to gastroschisis cases.
- IBM-SPSS was used to analyze demographic data and risk factors. Spatial analysis and geo coding was performed using ArcGIS 10.8 to determine if clustering occurred around FRS sites.
- Emerging hot spot analysis was used to assess gastroschisis cases relative to FRS sites, with hot spots defined as higher than expected gastroschisis incidence. Unweighted Ripley's K function was conducted to explore the presence of a spatial relationship between gastroschisis cases and FRS sites.

Maternal and neonatal characteristics for gastroschisis	Neonates with gastroschisis	Healthy neonates	P value
	n = 58	n = 173	
Age at delivery	22.0 ± 4.6	26.2 ± 6.1	<0.001
Pre-pregnancy BMI	26.4 ± 5.2	33.3 ± 7.3	<0.001
Race-White	55 (95%)	155 (89%)	0.37
Primiparity	39 (67%)	59 (34%)	< 0.001
Tobacco use during pregnancy	24 (41%)	41 (24%)	<0.001
Positive prenatal alcohol screen	1 (2%)	1 (1%)	0.43
Positive prenatal screen for drug use	8 (14%)	18 (10%)	0.49
Gestational diabetes	1 (2%)	8 (5%)	0.32
Estimated gestational age at birth (weeks)	35.8 ± 2.4	38.4 ± 1.3	< 0.001
Birthweight (grams)	2390 ± 529	3334 ± 492	< 0.001

Results

- During the 15-year study period there was a total of 63 gastroschisis cases, 58 neonatal, providing an overall prevalence rate of 14.6 per 10000 live births.
- In comparison to healthy controls, maternal age was younger, pre-pregnancy BMI was lower, and rates of tobacco use was higher in the gastroschisis cohort.
- Relative to the FRS sites, there appeared to be several areas of concern and case clustering with varying levels of "hot spots," defined as being statistically significant. The observed K was significantly above the expected K across all distance bands, suggesting that the distribution of gastroschisis cases is being influenced by spatial location to FRS sites.



Conclusion

- Our results suggest a potential relationship between gastroschisis cases and hazardous waste locations in our institution's service area during the 15-year study period.
- Younger maternal age, tobacco use, and low BMI associated with gastroschisis in our cohort with these risk factors generally agreeing with previous published literature¹.
- Gastroschisis risk may be especially elevated in southern West Virginia due to the high prevalence of maternal risk factors in conjunction with the presence of environmental toxins with our prevalence rate substantially higher than national rates².
- Geographic spatial analysis of prevalence and increased risk could potentially lead to better understanding of gastroschisis' etiology and to future interventions aiding in prevention and management.

References

- Frolov P, Alali J, Klein MD. Clinical risk factors for gastroschisis and omphalocele in humans: a review of the literature. *Pediatr Surg Int.* 2010;26(12):1135-1148.
- Friedman AM, Ananth CV, Siddiq Z, D'Alton ME, Wright JD. Gastroschisis: epidemiology and mode of delivery, 2005-2013. *Am J Obstet Gynecol.* 2016; 215(3):348.e1-9.

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