GEO-TEMPORAL ANALYSIS OF THE EFFECTS OF URBANIZATION ON LYME DISEASE RATES IN THE UNITED STATES, 2008 - 2020

Daphne Fauber[1] & Hsin-Yi Weng[2]

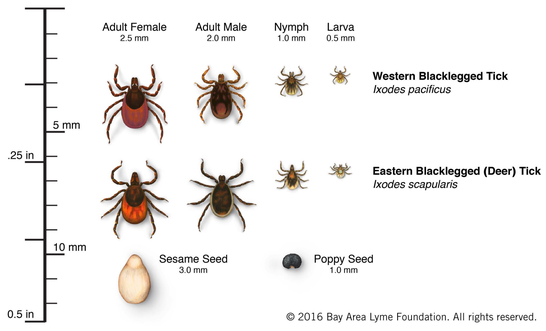
[1]Department of Agricultural and Biological Engineering, Purdue University; [2]Department of Comparative Pathobiology, Purdue University

PURDUE UNIVERSITY
College of Veterinary Medicine

ABSTRACT

- Lyme disease (LD) is an transmitted through the bite of infected ticks. In the US, an estimated 476,000 people are diagnosed each year[5].
- Urbanization has been posited as a contributor to LD risk and could be a factor in the geographic spread over time[3,4].
- The goal of this research is to identify trends in LD rates as compared to urbanization indicators between 2008 and 2020.
- Through a space-time Poisson analysis of LD rates, counties designated as 'large metro' comprised the largest percentage of significant clusters
- Through stratified analysis only 'non-metro' counties indicated an increasing trend

BACKGROUND



A diagram of tick life stages from the Bay area Lyme Foundation[2].

- LD is most commonly geographically associated with the Northeast, Northern Midwest, and Northwest areas of the US[1,4]
- Ticks spread the bacteria that causes the disease in humans, which manifests as rash, fever, arthritis, and body aches[1]
- The CDC cites LD as "the most common vector borne disease" and it is a top surveillance priority for US public health[1]

METHODS

- Publicly available data were collected from the following sources:

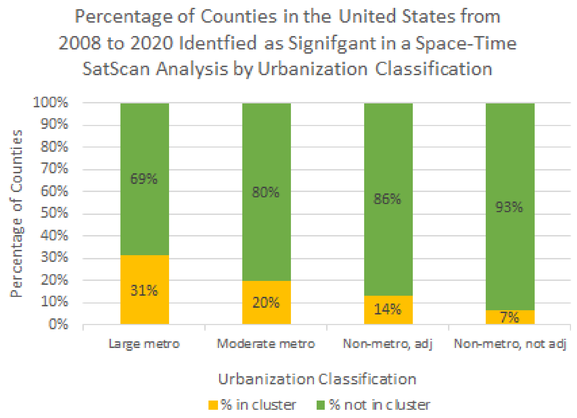
Name	Source	Description
Rural-Urban Continuum Codes	USDA ERS[7]	Definitions of nine codes that for each county indicates a county's population bracket as well as the metro classification of adjacent counties
Population Estimates	NCI SEER[8]	Intercensal population estimates for each county
Metro and Micro Statistical Areas	OMB[9]	Semi-regularly derived lists of statistical areas mapped to counties of places determined to be metropolitan
LD Case Numbers	CDC[1]	LD case numbers by county

- The data were aggregated by county for every year from 2008 to 2020 and merged in Excel and a SQLite database
- The Rural-Urban Continuum code definitions and Metropolitan and Micropolitan Statistical Areas were adapted and the codes re-distributed for every county in the US from 2008 to 2020
- SatScan™ was utilized to conduct a space-time Poisson analysis for LD case rates from 2008 to 2020, through which geographic clusters of high rates were identified[6]

The results of a SatScan™ Space-Time Poisson analysis for LD case rates from 2008 to 2020 with the highlighted regions representing statistically significant geographic clusters of high rates.

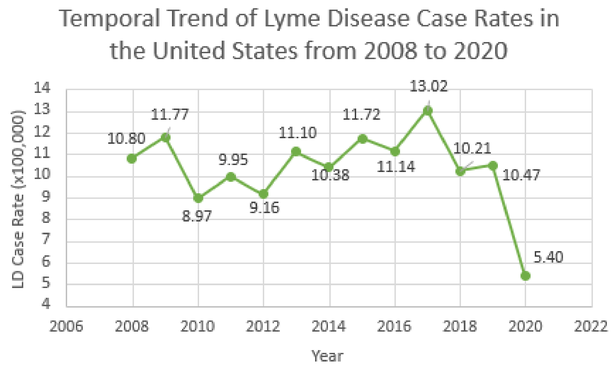
RESULTS

- 14% (n = 5850) of the counties were identified as being in a cluster
- Of the clustered counties, 'large metro' counties accounted for the largest proportion of counties represented, with 31% of them being in a cluster

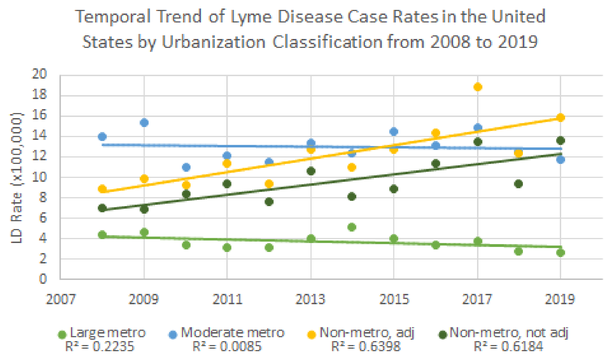


The percentage of counties by urbanization classification determined to be a part of a statistically significant cluster through a SatScan™ space-time analysis of LD case rates.

- The overall trend of national LD case rates showed a slight positive trend from 2008 to 2019 with a sharp dip in 2020, likely due to COVID-19 lockdowns and limited access to care



The change in national LD case rates from 2008 to 2020; where 2020 is indicated as an outlier year.



The change in county LD case rates from 2008 to 2019 as grouped by the counties' urbanization classification.

- Stratified analysis indicated an increasing trend in the 'non-metro' counties and a slightly decreasing trend in the 'metro' counties

CONCLUSION

- While this research is still in progress, there is so far mixed indications of urbanization effect on LD rate
- Clusters of high rates include the most 'large metro' counties, however only 'non-metro' counties showed an increasing trend
- Data may be limited by outliers, underreported cases, and changes in clinical understanding of LD over time
- Future work will utilize satellite imagery of land use change over time as an additional measure of urbanization

CITATIONS

1) CDC. Lyme disease home | CDC. In: Centers for Disease Control and Prevention. 2023.
2) Bay area Lyme Foundation. Blacklegged Tick. 2023.
3) Guo et al. Influence of urban expansion on Lyme disease risk: A case study in the U.S. I-95 Northeastern corridor. Cities. 2022.
4) Li, et al. Spatial and Temporal Emergence Pattern of Lyme Disease in Virginia. Am J Trop Med Hyg. 2014
5) Schwartz et al. Use of Commercial Claims Data for Evaluating Trends in Lyme Disease Diagnoses, United States, 2010–2018. Emerg Infect Dis. 2021
6) Kulldorf. SatScan. 2022.
7) USDA ERS. Rural-Urban Continuum Codes. 2020.
8) NCI SEER. US County Population Data 1969-2020. 2020.
9) OMB. Metropolitan and Micropolitan Statistical Areas. 2022.

Thank you to the United States Department of Agriculture Economic Research Services, National Cancer Institute Surveillance, Epidemiology, and End Results Program, Us Office of Management and Budget, and the Centers for Disease Control and Prevention for keeping data free and publicly available for research purposes. Thank you to Dr. Clase for granting me the time to work on this project.