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BEHAVIORAL AND ENVIRONMENTAL RISK FACTORS FOR LYME DISEASE IN THE SOUTHERN TIER OF NEW YORK

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Introduction

- Following its characterization in the early 1980s (Burgdorfer et al., 1982), Lyme disease has become the most prominent vector-borne disease in the United States, with the majority of cases occurring in the Northeast (CDC, 2019).
- The deer tick (*Ixodes scapularis*) is the primary vector responsible for transmission of Lyme-causing bacteria (*Borrelia burgdorferi*) bacteria to humans.
- Ticks consume the blood of vertebrates, such as mice and deer. If a tick consumes *B. burgdorferi*-infected blood during one blood meal, it can pass that bacteria to other hosts (including humans) at later blood meals.
- Human behavior and environmental characteristics have been shown to influence risk of tick bite (Mead, 2011).
- The Southern Tier of New York state has a relatively high risk of Lyme disease, making it an ideal location to study risk factors for contracting Lyme.
- Behavioral and ecological risk factors for Lyme at the household level are understudied. This pilot project identifies behaviors and environmental risks related to tick bite and Lyme infection at the household level.

Methods

- Surveys and yard dragging were performed at 129 households across **Broome and Chenango counties** during 2018-2019 in order to identify behaviors and ecological risks for Lyme exposure at the household level.
 - Surveyed topics: lifestyle choices and environmental factors related to risk of tick bite and Lyme diagnosis, such as pet ownership, wild animals seen in yards, the use of personal protection against ticks, yard activities, and time spent in yard.
 - Measured outcomes: tick bites and diagnosis of Lyme in any household members, Lyme in pets, and presence of ticks in yard
- Tick dragging was performed in backyards. A 1m² corduroy cloth was dragged systematically through the yard. Recovered ticks were stored for later testing. Details about the yard dimensions and characteristics including proximity to woodlands were recorded.
- Chi square analysis and relative risk ratios were used to find and describe associations between variables of interest.

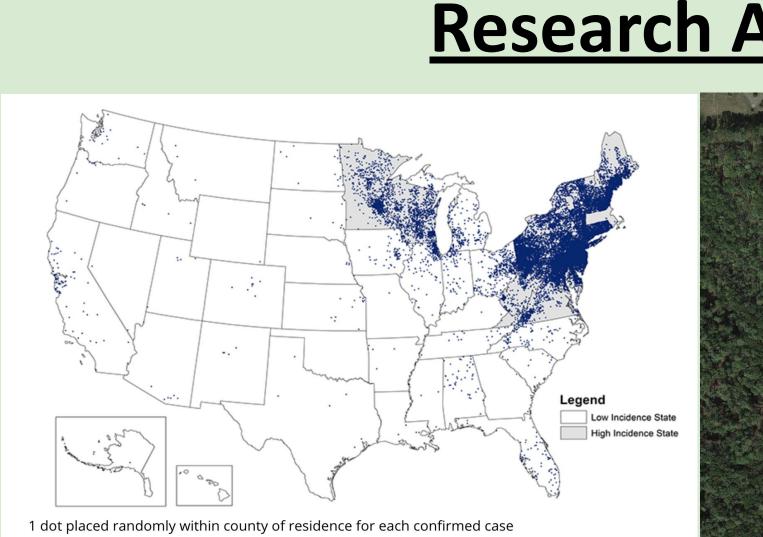


Figure 3. Incidence of Lyme Disease in the US in 2019. (Source: CDC)

Research Area

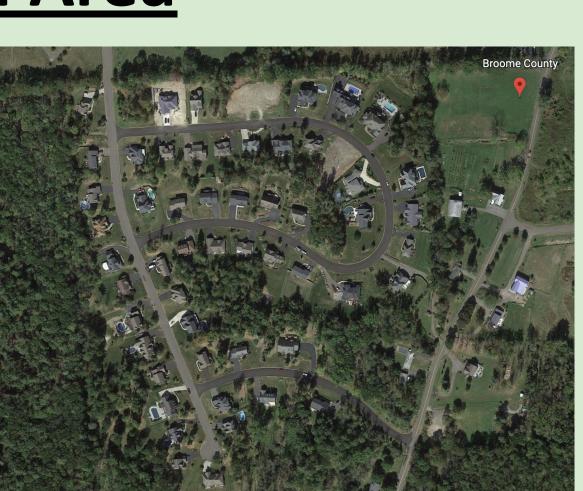


Figure 4. Typical type of Broome County neighborhood used in study. (Source: Google Earth)



9

3

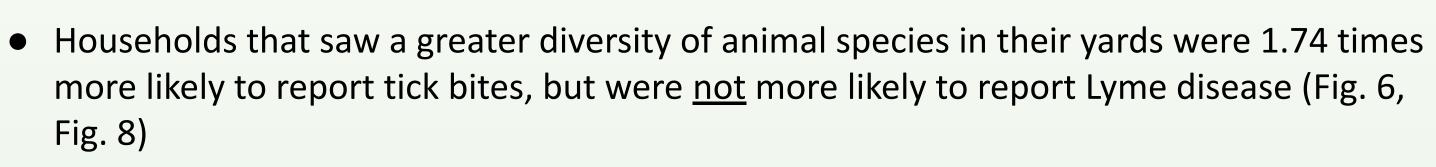
top): egg. nymph. larva. adult





Figure 2. Student researcher checks for ticks on 1m² corduroy cloth. *Photo: M.L.*

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Results

- People with Lyme were more 1.69 times more likely to report using tick mitigation measures in their yards (Fig. 9).
- Those who reported tick bites were more likely to perform tick checks and use any form of personal tick protection (Fig. 5).
- People whose families played sports and games in their yards were 1.6 times more likely to report a tick bite (Fig. 8).
- People who had reported tick bites were less likely to have pets diagnosed with Lyme disease (Fig. 8).
- People who regularly spend over 7 hours per week outdoors yard per week were less likely to have been bitten by a tick (Fig. 8).
- Yards with direct proximity to wooded areas were significantly more likely to contain ticks. Proximity to wooded areas was also positively associated with tick bites, ticks being seen in yards, and >4 categories of wildlife present (Fig. 7).
- An average of 0.870 ticks per 1,000 m² was found, based on 25,283 m² of residential yards dragged.

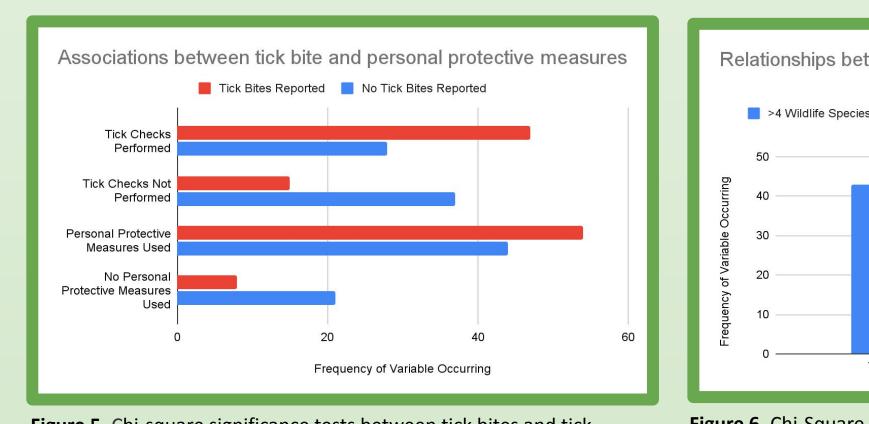


Figure 5. Chi-square significance tests between tick bites and tick checks, and between tick bites and use of personal tick protection

> Associations between adjacent woodlands and ticks in yard, tick bites in household, and wildlife species sighted in yard Yard Doesn't Border Woods 🗧 Yard Borders Woods



tick mitigation

deer seen in yard

sports game i

yards by homeowners, diversity of wildlife sighted in yard, tick bites

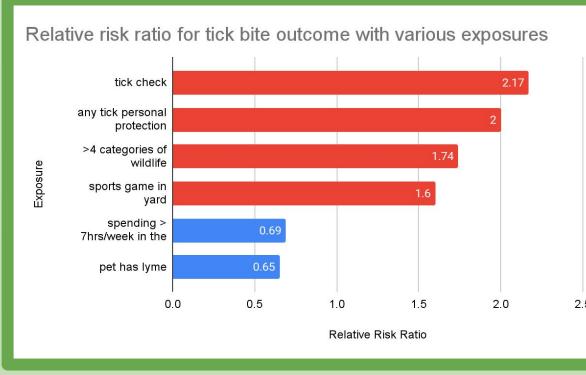


Figure 8. Relative risk ratios indicating how much more likely the outcome of tick bite is for each exposure variable. Red bars indicate a risk factor, while blue bars represent a protective factor.

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Google Earth Pro (2021). Broome County, US 42°10'39"N 75°51'16"W MmSVLA

Price, B. Ixodes scapularis on finger. Left to right: Adult female, adult male, nymph, larva. Indiana State Dept. of Health. [Online] https://www.in.gov/health/erc/zoonotic-and-vectorborne-epidemiology-entomology/pests/ixodes-scapul

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Figure 6. Chi-Square significance relationships between tick bites individual deer wildlife present, and various wildlife species observed

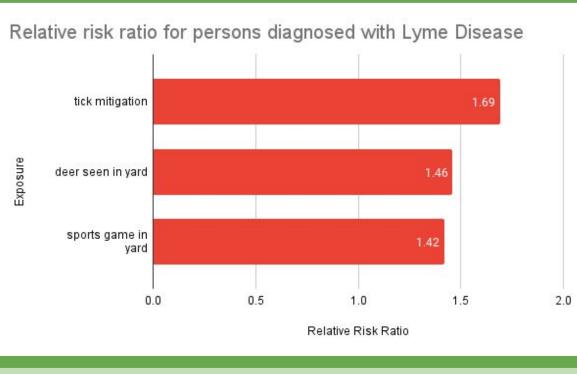


Figure 9. Relative risk ratios indicating how much more likely the outcome of Lyme disease is for each exposure variable. All variables included are risk factors.

[Online] https://www.cdc.gov/lyme/datasurveillance/maps-recent.htm

[Online].https://earth.google.com/web/search/broome+county/@42.17767269,-75.85467221,357.16104 228a,1878.86372272d,35y,0h,0t,0r/data=CigiJgokCYZVCpW-hDRAEYNVCpW-hDTAGW7Ft3M3CT1AIVwcdf

Biodiversity and Environment

- mammals. (Levi et al., 2012, Roome et al., 2016)

Prevention/Protection:

and Lyme diagnosis.

Behavior

- vigilant in using protective measures against ticks.

<u>Pets</u>

- studies have shown that pets carry ticks into homes.

Tick Presence

- significant.
- compared with yards that are not close to woods (Millins et. al. 2017).

<u>Limitations</u>

- density.
- incidence.
- Sample size was small (n=129).



- Further research is needed to investigate these results.
- campaigns for homeowners within the study area.

Discussion

• The association between more animal sightings and more tick bites (Fig. 8) is not surprising, because more animals traveling through a yard means more chances ticks will drop into a yard...

• With greater biodiversity, ticks feed on animals that aren't common reservoirs for *B. burgdorferi*, and are therefore less likely to transfer the bacteria to humans. This may account for the lack of association between more animal sightings and Lyme diagnoses in a household.

• A significant positive association was found between **deer sightings** and **reported tick bites**. A positive (but non-significant) association between deer sightings and Lyme was noted. Deer are an important reproductive host for adult ticks, but are not as significant in spreading Lyme as small

• The positive association between adjacent woodland areas and ticks being found in yards is likely due to the increased presence of animal hosts for ticks in nearby wooded areas (Fig. 7).

• People who had been previously bitten by ticks were twice as likely to use personal tick protection (long pants, rubber boots, insect repellent) (Fig. 5, Fig. 8). This is likely a reactive behavior following past tick bites. No association was found between the use of tick protection

• People who regularly spent **7+ hours in the yard** were <u>less</u> likely to report being **bitten by a tick** (Fig. 8). This is an unexpected result. Perhaps people who spend long hours outdoors are more

• There was a significant positive association between tick bites and playing yard sports and games (Fig. 8), but not a significant association between these activities and Lyme diagnosis.

• People who had reported tick bites were less likely to have pets diagnosed with Lyme (Fig. 8). Perhaps those who had been bitten by ticks were more likely to use tick prevention on their pets. • There were no associations between pet ownership and Lyme disease, which is unexpected; past

• The dragging of 104 yards yielded an **average of 0.87 ticks per 1000m²**. With a tick infectivity rate of **30-54.7%** in the Southern Tier of NYS (Roome, et. al 2018), the threat to public health is

• Ticks were more likely to be found in yards that were directly adjacent to wooded areas. This is likely because the woodland habitat brings a greater number tick-carrying animals to the yard

• Tick dragging was performed once per yard, due to personnel constraints. Ideally, all yards would be dragged multiple times per year to obtain a more accurate and specific understanding of tick

• Surveys didn't account for behavioral changes following a tick bite or Lyme diagnosis. A longitudinal study would clarify cause-and-effect relationships for behavioral risk factors in Lyme

Conclusion

• The most significant contribution to tick bite risk was living next to a wooded area. Unexpectedly, most activities and factors that increased tick bite risk did not increase Lyme risk. This is likely due to ecological factors that affect whether or not a tick carries Lyme.

• Future research could include in-depth interviews and geographic expansion.

• The results can be used to inform public health recommendations and tick awareness