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# Ticks and Tick-borne Diseases

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Original article

## Knowledge and preventive behaviors towards tick-borne diseases in Delaware

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### ABSTRACT

Delaware is among the top 10 states in the United States with the highest incidence for Lyme disease. The Delaware Division of Public Health (DPH) therefore has been working diligently to prevent and control tick-borne diseases through a variety of interventions including awareness campaigns and educational programs. To assess if tick-borne disease related information is reaching Delawareans through these programs, DPH in collaboration with Delaware State University administered an anonymous survey to 1755 participants in all three of Delaware counties during May 2017. The questionnaire assessed individuals' general knowledge about tick-borne diseases and performance of selected tick-borne disease prevention methods. Overall, participants' knowledge of tick-borne diseases was poor; only 38.4% of respondents stated that ticks were problematic in Delaware and only 12.7% of respondents "strongly agreed" that Lyme disease is a problem in Delaware. A little over half of the respondents (51.6%) indicated having seen advertisements/infomercials/flyers for protection from ticks or the disease agents spread by ticks; the most common places for viewing these advertisements were doctor's offices and through social media. The reported frequency of performing preventive behaviors was variable and disparities were observed by age, race, gender and county of residence. Existing public health communication efforts on tick-borne diseases in Delaware do not appear to be having the desired effect. This study provides important baseline information to rethink communication channels for education and more effectively guide future tick-borne disease awareness campaigns.

### 1. Introduction

The majority of tick-borne diseases (TBDs) in the eastern United States result from the bite of an infected blacklegged tick (deer tick), *Ixodes scapularis*. Pathogens spread by this tick include the causative agents of Lyme disease (LD), babesiosis, anaplasmosis, *Borrelia miyamotoi* disease (relapsing fever-like illness) and Powassan virus disease (Eisen et al., 2017). Most humans are infected through the bites of small and easily overlooked immature blacklegged ticks, particularly the nymphal life stage, during the spring and summer months, but adult ticks also contribute to infection during their active periods in the spring and fall (Eisen et al., 2017). TBDs are increasingly becoming a cause for concern in the United States as residential areas are being developed in formerly uninhabited forested areas where ticks live along with their animal hosts (Sathiamoorthi and Smith, 2016; Eickhoff and Blaylock, 2017).

Personal protective practices are considered important to prevent

TBDs (Herrington et al., 1997; Hayes and Piesman, 2003; Herrington, 2004; Piesman and Eisen, 2008). The United States Centers for Disease Control and Prevention (CDC) support the use of a set of commonly recommended personal protective measures, including to bathe or shower as soon as possible after coming indoors (preferably within two hours), perform frequent tick checks, apply tick repellents to skin or clothing, and examining pets for the presence of ticks (CDC, 2017). In addition, tucking pants into socks and wearing long sleeves as protective clothing have also been recommended as preventive behaviors (Hayes and Piesman, 2003). These practices are believed to reduce the probability of getting tick bites and the risk of acquiring TBDs (Vazquez et al., 2008; Miller et al., 2011). The Delaware Division of Public Health (DPH) recommends all these prevention practices through advertisement, infomercials and flyers. Common information venues used by DPH include billboards, brochure distribution through doctor's offices and state parks, movie theater and newspaper advertisements, the DPH website and social media (Twitter, Facebook).

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In the United States, LD caused by *Borrelia burgdorferi* is the most common vector-borne disease (Eisen et al., 2017). Delaware is among the 10 states with the highest incidence rates for LD (Schwartz et al., 2017). According to DPH, in 2016 there were 506 LD cases in Delaware with an incidence rate (IR) of 53.2 cases per 100,000 population. Delaware has three counties: New Castle, Kent and Sussex. New Castle County in the north is most populous (population 556,987 in 2016) and economically developed but is the smallest of the counties 1279sq. km. The central Kent County has a mid-range area of 2067 sq. km and is least populous (174,827 population in 2016). Sussex County in the south is the largest county by area, 3098 sq. km; with a population of 220,251 in 2016. The eastern portion of this county is home to beaches/seaside resorts with the western portion being the center of Delaware's agricultural region. In 2016, New Castle reported 295 LD cases with an IR of 53.0 cases per 100,000 population; Kent County reported 92 LD cases with an IR of 52.6 cases per 100,000 and Sussex County reported 119 LD cases with an IR of 54.1 cases per 100,000 (DPH, 2017).

Since human incidence of LD in Delaware is high, DPH has been working to prevent and control TBDs through a variety of interventions including awareness campaigns and educational programs that encourage modification of personal behavior to prevent tick exposure. To assess if TBD related information is reaching Delawareans through these programs, DPH in collaboration with Delaware State University (DSU) conducted a survey of individuals in all three of Delaware counties during May 2017. The purpose of this study was to investigate knowledge about TBDs as well as beliefs and practices related to a variety of personal prevention methods among individuals in Delaware and report on the outreach/impact of DPH's prevention campaign.

## 2. Materials and methods

### 2.1. Study design

This study was cross-sectional and used data collected through a survey. DPH developed the "Delaware Tick Awareness" survey and contracted with DSU to review and administer the survey to at least 1000 Delaware residents from all three counties. The self-administered survey consisted of 32 questions covered the following topics: 1) general awareness about TBDs; 2) personal protective measures against ticks during peak incidence months; 3) awareness of existing tick prevention campaigns; 4) time spent outdoors 5) personal LD status; 6) respondent sociodemographic (age, gender, county of residence, race/ethnicity) and 7) tick prevention practices for children. The survey instrument used for this study is presented in Appendix A in Supplementary material.

The project was submitted to the DSU Institutional Review Board (IRB) for review and was given IRB exemption in April 2017 as it met the category of Exempt Research specified in 45 CFR 46.101(b).

### 2.2. Sampling and participant recruitment

Participants were recruited by convenience sampling in all three counties of Delaware. Efforts were made to recruit at least half the respondents from New Castle County and the other half distributed between Kent and Sussex counties to reflect the population distribution in Delaware. Measures were taken to minimize the likelihood of participant duplication. These included: 1) written instruction on the cover page requesting the respondent to take the survey only once, 2) prior to handing out the survey to the respondent, the student researcher verbally confirmed that the participant had not taken this survey before and 3) the student research team was given instructions to hand out surveys in different community settings to further minimize duplication. Six Wal-Mart gift cards (\$100) were distributed to randomly chosen participants via a lottery process at the completion of data collection. Participants were asked to provide their phone number or email address if they wanted to participate in the lottery. Participation

in the survey and in the gift card lottery was voluntary.

Only English speaking, non-institutionalized, Delaware residents, 18 years of age and older, were surveyed. Potential participants were approached at malls, doctor's offices, church gatherings, and other community settings in all three counties over the month of May by the student research team. Over a period of 30 d the student research team collected surveys from- 3 major shopping malls (one in each of the three counties), 2 doctor's offices, 6–8 church gatherings, one work place (restaurant), and other neighborhood community meetings and settings. To maintain independence between observations, participants in groups were asked to complete the survey independently. The completed surveys were sealed in envelopes. The survey took approximately 5–10 min to conduct. No identifying information was collected.

### 2.3. Statistical analysis

SAS version 9.3 (SAS Institute Inc., Cary, N.C., USA) was used for all analyses. Descriptive statistics in the form of frequencies and percentages were calculated for the statewide sample and by selected demographic variables. Frequencies and percentages were also calculated for demographic characteristics, awareness and risk perceptions regarding TBDs, prevention behaviors and child tick-prevention practices. Chi-square statistics were calculated to assess significant differences between selected groups and considered statistically significant at a  $p$ -value  $< .05$ . Selected demographic variables, age and race, were collapsed in order to eliminate cell frequencies of less than 5 and generate stable chi-square statistics. Age group was dichotomized into two groups ( $< 45$  years; 45 years and older). Race was grouped into three categories (White; Black and other).

## 3. Results

### 3.1. Demographics and general information

A total of 1755 surveys were collected from Delaware residents. Nearly half of the participants were from New Castle County (47.7%) followed by Sussex County (30.9%) and Kent County (21.4%). The proportion from each county roughly reflected the population distribution of Delaware by county. The sample of respondents comprised a larger proportion of females (57.6%) and were primarily white (52.6%). More than 70% of the respondents were less than 45 years of age. By ethnicity, non-Hispanics were predominant (82.1%). Similar patterns were recorded across all three counties for these variables (Table 1).

A little over half of the respondents (51.6%) indicated having seen any advertisements/informercials/flyers for protection from ticks or diseases caused by ticks-borne pathogens. However, only 13.2% indicated they had made any behavior changes to protect themselves from ticks after seeing or hearing this information. Additionally, around 12% of those who had made any behavior changes chose to describe these changes. The places where respondents saw advertisements/informercials/flyers varied. The majority (47.6%) indicated doctor's office and social media. Billboard advertisements (7.4%) and movie theatres (7%) were the least likely places for viewing information on TBDs (Table 2)

### 3.2. Knowledge and perceived susceptibility to ticks and tick-borne diseases

38.4% of respondents claimed ticks were problematic in Delaware. Significant differences were observed by age ( $p = .003$ ), gender ( $p = .0004$ ) and county ( $p < .0001$ ) for awareness regarding ticks being a problem in Delaware. In Kent County nearly 64% of respondents recognized ticks were problematic, followed by 40.6% in Sussex County and 25.6% in New Castle County. More females (41.9%) considered ticks to be problematic as compared to males (33.6%). 45 years and older age group reporting more awareness. While most

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