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Tick-borne disease preventive practices and perceptions in an endemic area

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ABSTRACT

Lyme disease is the most commonly reported vector-borne illness in the United States. Since the institution of Nationally Notifiable surveillance efforts for Lyme disease in the United States in 1991, there has been a consistent increase in the number of reported cases. Thus, the need for targeted prevention strategies is underscored. The purpose of this study was to investigate knowledge about tick-borne diseases as well as beliefs and practices related to a variety of personal tick-borne disease prevention methods among individuals in southwestern Connecticut, a Lyme disease-endemic area. Between June and September 2014, an anonymous questionnaire was administered to 275 participants through a point-of-contact convenience sample obtained at community events in southwestern Connecticut. The questionnaire assessed individuals' general knowledge about tick-borne diseases, performance of four selected tick-borne disease prevention methods, and perceived effectiveness and burdensomeness of those four behaviors. Some 80% of participants were female; median age was 55 years (IQR 45–64 years); 30% reported having been treated for a tick-borne illness and 50% reported a family member having been treated for a tick-borne illness. Overall, participants' knowledge of tick-borne diseases was poor; the average knowledge score was only 57% (SD 22.6%). The reported frequency of performing preventive behaviors was variable. The most commonly reported behavior was performing a tick check (68%); use of tick repellent was the least commonly reported behavior (38%). Those who were more knowledgeable about Lyme disease were more likely to perform tick checks but knowledge score was not significantly associated with any of the other three behaviors studied. Respondents largely believed preventive behaviors to be effective at reducing the risk of tick-borne diseases. Belief that a prevention behavior is effective was highly correlated with performing that behavior but perceived burdensomeness does not appear to influence behavior performance. The reasons for differential uptake of preventive behaviors remains unknown; further study of barriers to performance of personal preventive behaviors is needed to better target public health interventions.

Introduction

Ixodes scapularis, commonly referred to as blacklegged or deer ticks, are widely distributed in the northeastern and upper Midwestern United States (Centers for Disease Control and Prevention, 2014). These ticks can transmit the pathogens responsible for multiple diseases, including anaplasmosis, babesiosis, and Lyme disease. Lyme disease is the most commonly reported vector-borne illness in the United States and in 2014 it was the fifth most common Nationally Notifiable disease (Centers for Disease Control and Prevention, 2015b). In that same year there were over 25,000 confirmed cases and 8,000 probable cases reported to the Centers for Disease Control and Prevention (CDC) (Centers for Disease Control and Prevention, 2015d), although recent data suggest an estimated 300,000 people in the United States are diagnosed with Lyme disease annually (Centers for Disease Control and Prevention, 2013b; Hinckley et al., 2014; Nelson et al., 2015). Of reported cases, 96% are from just 14 states, including Connecticut (Centers for Disease Control and Prevention, 2015b). Since Nationally Notifiable surveillance efforts were instituted in the United States in 1991, there has been a consistent increase in the number of reported cases (Centers for Disease Control and Prevention, 2008). Notably, surveillance

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data have a number of limitations, including fluctuations in the number of captured cases based on modifications to the national surveillance case definition and year-to-year changes in each state's abilities to capture and classify data. Furthermore, the requirement to report cases of Lyme disease may contribute to an increased annual number of recognized cases (Connecticut Department of Public Health, 2009). However, multiple other measures support the overall increasing incidence of Lyme disease, including a substantial geographic expansion of counties at high risk for Lyme disease (Centers for Disease Control and Prevention, 2015a) and evidence of a paralleled increase in the population density of blacklegged ticks (Khatchikian et al., 2012). Thus, the need for awareness of targeted prevention strategies, as well as early disease recognition and treatment and a sustainable surveillance system, is underscored.

Given the current lack of commercially available vaccine against any tick-borne diseases, risk management primarily focuses on reducing the likelihood of tick bites through personal, peridomestic, and community measures. Personal tick bite prevention recommendations include wearing long sleeves and pants (Stafford, 2007), application of tick repellents such as DEET (Cisak et al., 2012; Lupi et al., 2013; Stafford, 2007) and permethrin (Centers for Disease Control and Prevention, 2015c; Roma et al., 2009), performing tick checks (Centers for Disease Control and Prevention, 2015c; Connally et al., 2009), bathing within two hours of possible tick exposure (Centers for Disease Control and Prevention, 2015c; Connally et al., 2009), and removal of ticks in the case of bites (Centers for Disease Control and Prevention, 2015c). Of note, there have been only limited studies of the efficacy of personal protective measures. Furthermore, the few studies conducted to date have yielded varying results for some measures, such as wearing protective clothing (Connally et al., 2009; Smith et al., 2001; Vazquez et al., 2008). Likely because of a lack of better alternatives, ease of implementation, and free or low cost, however, these methods are still suggested by respected bodies (Macauda, 2007).

Although an intuitive intervention, education about preventive behaviors has not been proven entirely efficacious (Centers for Disease Control and Prevention, 2013b; Daltroy et al., 2007; Hayes and Piesman, 2003). Studies previously have assessed the frequency of engaging in preventive behaviors against Lyme disease (Phillips et al., 2001) as well as the association between knowledge and behaviors (Herrington, 2004; Herrington et al., 1997; Malouin et al., 2003; Shadick et al., 1997; Valente et al., 2014). A recent study of Martha's Vineyard, Massachusetts residents and visitors supported the general findings of previous studies: participants had a limited understanding of Lyme disease risk and reported infrequent use of preventive behaviors (Valente et al., 2014).

Another study conducted among health fair participants in Fairfield County, Connecticut assessed awareness of and beliefs about chemical tick-borne disease prevention measures, including the use of repellents containing DEET, permethrin, pesticides on property, bait boxes, and "natural" products (Reid et al., 2013). Survey respondents reported highly variable use and awareness of efficacy and safety of these measures.

The purpose of this study was to investigate knowledge about tick-borne diseases as well as beliefs and practices related to a variety of personal tick-borne disease prevention methods among individuals in southwestern Connecticut, a Lyme disease-endemic area. This study further sought to better understand how demographics and knowledge correlate with tick-borne disease prevention practices, as well as how these measures compare to results of studies previously conducted in another Lyme disease endemic area, Martha's Vineyard. Understanding these issues will help in formulating strategic efforts for future public health initiatives designed to reduce the incidence of tick-borne diseases.

Material and methods

Between June and September 2014, a questionnaire modeled after the surveys used by Shadick et al. (1997) and Valente et al. (2014) was administered through a point-of-contact convenience sample obtained at community events in southwestern Connecticut. The vast majority of participants were recruited from three events across the region, including two town-wide festivals and one hospital-sponsored health and wellness fair. All participants were at least 18 years of age.

Survey design

The questionnaire collected demographic data, education level, employment status, and Connecticut residency status. It also included questions regarding known personal and familial treatment for tick-borne diseases. In addition, the survey asked questions related to tick-borne disease knowledge, tick-borne disease prevention practices, and perceptions about tick-borne disease prevention practice efficacy and burden.

The survey asked nine multiple-choice questions concerning overall knowledge of Lyme disease, including tick habitat and feeding practices, times of year when infection is most common, signs and symptoms of Lyme disease, and treatment regimens. The instrument asked about four preventive practices: wearing protective clothing, applying repellent, examining skin for ticks after returning indoors (performing a "tick check"), and bathing or showering within two hours of being outdoors.

Data analysis

An overall tick-borne disease knowledge score was calculated by summing the number of correct responses and dividing by 23, the number of correct answer options; therefore, 100% was a perfect score. Note that this scoring system was modeled after that which was used by Valente et al. (2014) and did not deduct for incorrect answers to questions with multiple options. Respondents selected whether they performed each of the four preventive behaviors "none of the time," "a little of the time," "some of the time," "most of the time," or "all of the time" when engaging in activities in a potential tick habitat. The respondents who selected "most of the time" or "all of the time" were considered to perform that behavior consistently. Respondents were also asked to rate the effectiveness of each behavior on a five-point Likert scale, where one was "not at all effective" and five was "very effective." The respondents who rated a behavior's effectiveness as four or five were considered to believe the behavior was effective. An analogous scale was used for perceived burdensomeness, where respondents who rated a behavior's burdensomeness as four or five were considered to believe the behavior was burdensome.

Simple frequency distributions were used to describe the respondent population and to report on the level of tick-borne illness knowledge as well as the frequency of practicing the four preventive behaviors. When creating frequency distributions for the sub-questions on the four preventive behaviors, the sample was limited to only those who selected that they practiced the behavior at least "a little of the time" and who responded to the specific questions.

Pearson's correlation coefficient was calculated to assess the strength and direction of the linear relationship between the perceived effectiveness and consistency of practicing protective behaviors, and between the consistency of practicing protective behaviors and general knowledge score. The general Linear Model (GLM) procedure was used to compare mean general knowledge scores between employment types, between education levels, and between those with and without reported prior treatment for a

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