

Acknowledgments

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Predisposing Factors for Individuals' Lyme Disease Prevention Practices: Connecticut, Maine, and Montana

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Introduction

Lyme disease is caused by infection with the spirochete *Borrelia burgdorferi*, acquired from the bite of an infective *Ixodes scapularis* tick in the northeastern and upper midwestern United States or *Ixodes pacificus* in the West.¹ First described in 1977 as a chronic arthritis among children living in Connecticut,² Lyme disease has become an important emerging infectious disease over the past decade, accounting for more than 90% of all reported cases of vector-borne illness in the United States.³ In 1996, 16 461 cases of Lyme disease were reported to the Centers for Disease Control and Prevention (CDC) by 45 state health departments.⁴ The overall trend has been an average 15% annual increase in reported cases since 1991, when all 50 states adopted the national Lyme disease case surveillance definition. Although considerable knowledge of the biology and ecology of Lyme disease has been accumulated,⁵⁻¹¹ the prevalence of behavioral risk factors for Lyme disease has not been well defined. No studies have systematically investigated the factors that motivate indi-

viduals to take health-directed personal protective measures against Lyme disease. Recommended personal protective measures against tick bites include wearing light-colored clothing, long-sleeve shirts, and long pants; tucking pant legs into socks; using a tick repellent on clothing and exposed skin; or practicing a combination of these.¹²⁻¹⁴

The purpose of this study was to characterize Lyme disease-related knowledge, attitudes, and behavioral risk factors of per-

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ABSTRACT

Objectives. This study examined factors that predispose individuals to protect against Lyme disease.

Methods. Knowledge, attitude, and practice questions concerning Lyme disease prevention were included in the Behavioral Risk Factor Surveillance surveys in Connecticut, Maine, and Montana. A total of 4246 persons were interviewed.

Results. Perceived risk of acquiring Lyme disease, knowing anyone with Lyme disease, knowledge about Lyme disease, and believing Lyme disease to be a common problem were significantly associated with prevention practices.

Conclusions. Predisposing factors differ substantially between states and appear related to disease incidence. Personal risk, knowing someone with Lyme disease, and cognizance about Lyme disease and acting on this information are consistent with social learning theories. (*Am J Public Health.* 1997;87: 2035-2038)

sons residing in states with high or marginal incidence of Lyme disease, as compared with persons residing in a state where the etiologic agent is not known to occur. In 1992, Connecticut led the nation with the highest reported incidence of Lyme disease (54 cases per 100 000 population). Maine reported 1.3 cases per 100 000 population in 1992.¹⁵ Montana has never reported a confirmed case of Lyme disease. Our hypothesis was that in answers to a set of knowledge, attitude, and practice questions, persons residing in areas of high incidence would exhibit greater knowledge about Lyme disease as well as attitudes and behaviors that favor personal protection against *B burgdorferi* infection.

Methods

To pilot test a method for characterizing risk factors for Lyme disease in areas of high, low, or zero incidence, the state health departments of Connecticut, Maine, and Montana added 10 Lyme disease questions to their 1992 Behavioral Risk Factor Surveillance System (BRFSS) survey. The BRFSS is a state-based survey of health-related practices and behaviors of adults. The methodology of the BRFSS has been described elsewhere.¹⁶⁻²¹ Estimates of behavioral risk factors obtained through telephone surveys are similar to estimates from national door-to-door surveys.²²⁻²⁵

Questionnaire

The 1992 Lyme disease add-on questions to the Behavioral Risk Factor Surveillance Survey consisted of nine questions that addressed knowledge, attitudes, and beliefs about Lyme disease, and one question that addressed behavior to prevent tick bites (Table 1). Seven sociodemographic and economic variables were also considered. From January through December 1992, investigators in Connecticut, Maine, and Montana selected for telephone interviews an independent probability-based sample of adults aged 18 years or older living in private residences. A computer-assisted telephone interviewing system was used in Montana (with respondents' answers entered directly into a computer program during the interview); Connecticut and Maine used a manual telephone interviewing system (with answers recorded on paper during the interview and later entered into a computer program). The BRFSS survey instrument took 12 to 15 minutes to administer, with the Lyme disease questions asked last.

TABLE 1—Lyme Disease Questions Added to the Behavioral Risk Factor Surveillance Surveys of Connecticut, Maine, and Montana, 1992

- | | | | | |
|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------|----------|------------|
| 1. How much would you say you know about Lyme disease? | A lot | Some | A little | Nothing |
| 2. Do you believe that Lyme disease is common in [state]? | Extremely | Fairly | Rarely | Not at all |
| 3. How would you rate your own chances of getting Lyme disease in the coming year? | High | Medium | Low | None |
| 4. Have you personally known anyone who has ever had Lyme disease? | Yes | No | | |
| 5. Many methods have been suggested to protect oneself from getting Lyme disease. Please tell me if you think that you can protect yourself by: | | | | |
| a. Wearing long pants when in the woods or grassy areas? | Yes | No | | |
| b. Looking for ticks on yourself and removing them after walking in the woods or grassy areas? | Yes | No | | |
| c. Using an insect repellent on your skin or clothes? | Yes | No | | |
| d. Avoiding wooded areas? | Yes | No | | |
| e. Avoiding people who have Lyme disease? ^a | Yes | No | | |
| 6. In the past year, have you taken any specific steps to prevent yourself from getting Lyme disease? | Yes | No | | |

^aQuestion asked only in Connecticut and Maine.

Statistical Analysis

Statistical Analysis System (SAS) version 6.04²⁶ was used to perform univariate and logistic regression analyses. Self-reported behavior to prevent Lyme disease within the past 12 months was the outcome variable of interest, and several predisposing factors that could influence behavioral action,²⁷ for example, knowledge, attitudes, beliefs, values, perceived risk, and sociodemographic characteristics, were considered as predictor variables. The chi-squared statistic, with Yates correction,²⁸ was used to compare proportions in two × two pairwise (Connecticut vs Maine, Connecticut vs Montana, and Maine vs Montana) and two × three tables. Statistical significance was considered to be $P \leq .05$. Odds ratios and 95% confidence intervals were calculated. All variables were dichotomized and entered into a logistic model that considered comparisons among the three states. Basic demographic variables such as age, marital status, race, sex, education attained, annual household income, and health insurance status were retained in the logistic model.

Results

Response Rate

Interviewers made 5037 random telephone contacts and successfully inter-

viewed 4246 eligible persons aged 18 years or older living in private residences; this yielded an overall 84% interview response rate. The 4246 persons successfully interviewed were included in the univariate analysis. Data from 47% (2016) of interviewees, for whom there were no missing values, were included in the multivariate logistic regression analysis.

Description of Sample Population

The sample of 4246 persons consisted of 1798 from Connecticut (42%), 1260 from Maine (30%), and 1188 from Montana (28%). The overall sample included a majority of women, married persons, and persons aged 45 years and older. The sample was predominately White. Fewer than half the respondents had attained a college-level education or higher. The majority of respondents reported a total annual household income greater than \$25 000. Nine of 10 respondents indicated that they had health insurance coverage. Sixty-one percent of respondents were currently employed. According to Bureau of the Census data for 1990, demographic characteristics of the three sample populations were similar to those of the general populations of the respective states sampled (data not shown).²⁹ Socioeconomic and demographic characteristics of the three populations surveyed were proportionally heterogeneous for race, marital status, education-

TABLE 2—Percentage of Responses to Behavioral Risk Factor Surveillance System Knowledge, Attitude, and Practice Questions about Lyme Disease, by State^a

	%		
	Connecticut (maximum n = 1798)	Maine (maximum n = 1260)	Montana (maximum n = 1188)
Looks for and removes ticks	93 ^{***}	96	97
Wears long pants	92 ^{**}	92 ^{**}	77
Avoids wooded areas	88 ^{**}	. . . ^b	80
Believes Lyme disease is fairly/ extremely common	83 ^{***}	51 ^{**}	29
Uses repellent	79 ^{**}	79 ^{**}	72
Has known anyone with Lyme disease	55 ^{***}	19	19
Has moderate/high knowledge of Lyme disease	50 ^{***}	38 [*]	35
Has taken preventive measures	46 ^{***}	32 ^{**}	25
Believes is at moderate/high risk for Lyme disease	44 ^{***}	22 ^{**}	17

^a2 × 2 pairwise comparisons (Connecticut vs Maine, Maine vs Montana, Montana vs Connecticut), χ^2 with Yates correction; cases with missing values included.

^bMaine did not ask question.

^{*}P < .01 vs Montana; ^{**}P < .001 vs Montana; ^{***}P < .001 vs Maine.

al attainment, annual household income, and health insurance coverage but were homogeneous on age and sex. Thirty-seven percent of the respondents from the three states surveyed answered affirmatively to the question, "In the past year, have you taken any specific steps to prevent yourself from getting Lyme disease?" The difference between states in the proportion of respondents who took preventive measures was statistically significant (Table 2).

Univariate Analyses

Univariate analyses revealed that Connecticut respondents were significantly more likely than Maine or Montana respondents to know something or a lot about Lyme disease, to say that Lyme disease was fairly or extremely common in their state, to state that their risk for Lyme disease was medium or high, to have personally known someone with Lyme disease, and to have taken specific steps in the past year to prevent themselves from getting Lyme disease. Connecticut respondents were significantly less likely than Maine or Montana respondents to believe that looking for and removing ticks was protective (Table 2). To validate a respondent's answers to these survey questions, Connecticut and Montana also asked the ringer question, "Can you protect yourself by avoiding people with Lyme disease?" As expected, nearly all respondents said that this was not an effective prevention method.

Multivariate Analyses

Results from the multivariate analysis of data from all three states combined showed significant associations between the outcome variable of interest, self-reported behavior of having taken specific steps in the past year to avoid getting Lyme disease, and the following predictor variables: a perceived risk of Lyme disease, having known

anyone with Lyme disease, moderate to high knowledge levels about Lyme disease, using a repellent, and perceptions that Lyme disease is fairly to extremely common in the respondent's state. Other demographic, attitudinal, and behavioral variables were not significantly associated with the outcome variable of interest (Table 3).

When the outcome variable of interest (having taken specific steps in the past year to prevent oneself from getting Lyme disease) was considered between states, significant associations with the following variables were observed: perceived risk of getting Lyme disease (Connecticut odds ratio [OR] = 1.9, Maine OR = 2.6, Montana OR = 2.0), moderate to high knowledge levels about Lyme disease (Connecticut OR = 1.6, Maine OR = 1.7), knowing anyone with Lyme disease (Connecticut OR = 2.1), age from 18 through 44 years (Montana OR = 2.0), being married (Connecticut OR = 1.7), and use of a repellent (Maine OR = 1.7). Other demographic, attitudinal, and behavioral variables were not significantly associated with the outcome variable of interest (Table 3).

Discussion

Results of the current pilot survey suggest that certain predisposing factors—including knowledge, attitudes, and perceptions concerning Lyme disease prevention practices—differ substantially among the

TABLE 3—Results of Multivariate Analysis (Logistic Regression) of Individual Correlates of Lyme Disease (LD) Prevention: Connecticut, Maine, and Montana

	Odds Ratio (95% Confidence Interval)			
	Combined (n = 2016)	Connecticut (n = 947)	Maine (n = 542)	Montana (n = 527)
Demographic variables				
Age 18–44 vs age ≥45 years	1.3 (1.0, 1.6)	1.1 (0.9, 1.5)	1.1 (0.7, 1.6)	2.0 (1.3, 3.1)
Not married vs married	1.3 (1.0, 1.6)	1.7 (1.2, 2.3)	1.0 (0.7, 1.5)	1.1 (0.7, 1.7)
Attitudinal variables				
Perceives risk for getting LD as high/medium vs little/none	2.1 (1.7, 2.6)	1.9 (1.4, 2.5)	2.6 (1.7, 4.1)	2.0 (1.2, 3.4)
Has personally known someone with LD vs not	1.8 (1.5, 2.2)	2.1 (1.6, 2.8)	1.2 (0.7, 1.8)	1.2 (0.7, 2.0)
Knows some/a lot vs little/ nothing about LD	1.5 (1.2, 1.9)	1.6 (1.2, 2.2)	1.7 (1.2, 2.5)	1.2 (0.8, 1.8)
Believes LD is fairly/ extremely common vs rarely/not at all common in home state	1.4 (1.1, 1.7)	1.4 (0.9, 2.1)	1.3 (0.8, 1.9)	1.1 (0.7, 1.7)
Knowledge/behavioral variables				
Believes can vs cannot protect self with repellent use	1.4 (1.1, 1.8)	1.3 (0.9, 1.9)	1.7 (1.1, 2.8)	1.2 (0.8, 1.9)

states surveyed. These differences appear to be related to the incidence of Lyme disease in each state.

Knowledge, attitudes, beliefs, values, and perceived needs and abilities are predisposing factors that motivate an individual to act in a health-directed manner. Believing that one is at personal risk, knowing an infected individual, and having more than moderate knowledge about Lyme disease and acting on this information are factors consistent with the health belief model,^{30,31} social learning theory,³² and the theory of reasoned action.^{33,34}

Lyme disease was first characterized in Connecticut, and for a decade, public service announcements and health education efforts there have been directed at prevention of the infection. As expected, the apparent frequencies of knowledge, attitude, and behavioral risk factors related to Lyme disease prevention are higher in Connecticut than in Maine or Montana. Although residents of Connecticut demonstrated a greater awareness of knowledge about Lyme disease, only 50% of Connecticut respondents as a group stated that they knew something or a lot about Lyme disease, and only 44% believed that their risk for Lyme disease was moderate or high in this endemic state. Further study is needed to identify and survey at-risk Connecticut residents, such as those living or working in situations where they are placed in frequent contact with tick-infested areas, as compared with individuals who are at low risk, such as those living or working in urban settings or other areas with little or no tick infestation and minimal risk of contact with infected vectors.

This study was limited in several ways. The perception of a moderate to high risk of acquiring Lyme disease by 17% of Montanans surveyed should be validated to determine whether this is an accurate indication of Montanans' knowledge about Lyme disease or an artifact reflecting respondents' concern about tick-borne diseases in general, for example, Rocky Mountain spotted fever, ehrlichiosis, babesiosis, tick paralysis, and Colorado tick fever, as well as Lyme disease. The self-reporting nature of telephone interviewing techniques does not allow for independent validation of the respondents' answers. Thus, other methods for obtaining this information should be explored. Further, telephone interviewing methods exclude potential respondents who do not have telephones, particularly economically dis-

advantaged and minority populations, thereby introducing potential selection bias. Finally, this pilot survey reflects responses from residents of three states and may not be generalizable to or representative of residents of other states. □

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