



Susceptibility, likelihood to be diagnosed, worry and fear for contracting Lyme disease



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Summary Risk perception and psychological concerns are relevant for understanding how people view Lyme disease. This study investigates the four separate outcomes of susceptibility, likelihood to be diagnosed, worry, and fear for contracting Lyme disease. University students ($n = 713$) were surveyed about demographics, perceived health, Lyme disease knowledge, Lyme disease preventive behaviors, Lyme disease history, and Lyme disease miscellaneous variables. We found that women were associated with increased susceptibility and fear. Asian/Asian-American race/ethnicity was associated with increased worry and fear. Perceived good health was associated with increased likelihood to be diagnosed, worry, and fear. Correct knowledge was associated with increased susceptibility and likelihood to be diagnosed. Those who typically spend a lot of time outdoors were associated with increased susceptibility, likelihood to be diagnosed, worry, and fear. In conclusion, healthcare providers and public health campaigns should address susceptibility, likelihood to be diagnosed, worry, and fear about Lyme disease, and should particularly target women and Asians/Asian-Americans to address any possible misconceptions and/or offer effective coping strategies.

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Introduction

Lyme disease is transmitted by ticks and had 329,000 cases per year in the United States during 2005–2010 [1]. Symptoms of Lyme disease vary greatly in terms of severity, and include fever, headaches, fatigue, stiff neck, and muscle and joint

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aches [2]. In the United States, Lyme disease is most prevalent in the northeastern region and also in the additional states of Minnesota, Wisconsin and Virginia, with 96% of the confirmed cases occurring in these areas in 2014 [3].

Susceptibility to contracting Lyme disease is analyzed in a number of studies. In a community in which many individuals perceived that they were susceptible to Lyme disease, blood testing for Lyme disease was provided. As many of the blood tests did not confirm Lyme disease, the self-reported incidence of Lyme disease decreased in subsequent years [4]. Slightly more than 10% of participants from high-incidence Lyme disease states reported that their likelihood of ever contracting Lyme disease was 50% or more [5]. Additionally, individuals' perceived susceptibility to Lyme disease was not associated with checking their skin for the presence of ticks to prevent Lyme disease [6]. Susceptibility to Lyme disease was greater for women than men for ages 35–54 years [7]. Slightly more than half perceived themselves to be at risk for Lyme disease; this risk perception did not differ between indoor and outdoor workers [8].

To our knowledge, we are only aware of three studies about concern or worry for contracting Lyme disease. Those who were somewhat concerned to very concerned about being bitten by ticks were associated with engaging in behaviors to prevent tick bites [5]. Both Canadian and Swiss samples reported high levels of being worried about contracting Lyme disease. Women reported greater worry than men among those in the Swiss sample of those aged 55 and older [7]. Increased worry about Lyme disease was associated with engaging in Lyme disease preventive behaviors [6].

One research team combined susceptibility, worry, and a number of other factors together as an aggregate measure of risk perception for Lyme disease [7] [9]. Increased risk perception was associated with engaging in preventive behaviors for Lyme disease [9]. In the Canadian sample, women and increased knowledge of Lyme disease were associated with increased risk perception. Those in the 18–34 and 35–54 age groups were associated with decreased risk perception. Knowing someone with Lyme disease was not associated with risk perception overall. However, in the Swiss sample, knowing someone with Lyme disease was associated with increased risk perception. Knowledge, sex, and age were not associated with risk perception. In both samples, a personal history of Lyme disease, a relative having Lyme disease, and outdoor exposure were not associated with risk perception [7].

Most studies of susceptibility, likelihood, and worry about Lyme disease use susceptibility, likelihood and worry as predictors for understanding Lyme disease preventive behaviors [6,9,5]. The one multivariate study with an aggregate measure including susceptibility and worry as an outcome variable reported conflicting results depending on whether the sample was from Canada or Switzerland [7]. This study [7] did not include engaging in preventive behaviors as a predictor variable. While one study focused on the fear of contracting the mosquito-transmitted disease of malaria [10], we are not aware of any research about the fear of contracting Lyme disease. Although fear can be related to worry, they are different constructs [11]. We study with a United States sample four separate outcome variables of susceptibility, likelihood to be diagnosed, worry, and fear for contracting Lyme disease. We use a multivariate framework and include demographic variables, perceived health, Lyme disease knowledge, Lyme disease preventive behaviors, Lyme disease history and miscellaneous Lyme disease-related variables as predictor variables.

Methods

Participants

The sample was 713 undergraduate students who anonymously completed a survey at a public university located in New York City. A total of 757 students were approached; 21 refused to participate, 22 individuals who were older than 36 were excluded to maintain a more conventional college-aged group, and 1 person failed to answer the outcome variables. The response rate was 97.1% from the 735 completed surveys $[(735/757) * 100\%]$. The study was approved by the college Human Research Protection Program and was ethically conducted in accordance with the guidelines of the Declaration of Helsinki. All participants provided informed consent and were surveyed from September through October 2014.

Measures

Demographics

Demographics consisted of age (years), sex (man or woman), and race/ethnicity [white, African-American, Hispanic-American, Asian/Asian-American, South Asian (India, Pakistan, surrounding areas), and other].

Perceived health

The participants in the study self-reported their current health status with choices of excellent, very good, good, fair, or poor. Responses of fair and poor were combined due to the small number of responses.

Knowledge related to Lyme disease

Participants answered five true-or false knowledge questions: (1) people can get Lyme disease after a tick bite; (2) the chance for tick bites is higher during the summer than the winter; (3) ticks mostly fall out of trees; (4) using insect repellent on skin can protect against tick bites [6]; and (5) the insect that causes Lyme disease is typically as large as an adult common housefly [12]. All of the correct answers were true, except for "ticks mostly fall out of trees," which was false.

Preventive behaviors

The five preventive behavior items were: (1) perform tick checks after being outdoors; (2) use insect repellent on skin/and or clothing when outdoors; (3) wear long pants in wooded or brushy areas; (4) avoid wooded areas; and (5) tuck pant legs into socks [13]. The answer choices were never, sometimes, and always.

Lyme disease history and miscellaneous Lyme disease related variables

These were five yes-or-no questions: (1) I typically spend a lot of time outdoors; (2) before participating in this survey, have you ever heard of Lyme disease?; (3) have you ever been diagnosed with Lyme disease?; (4) do you know someone who was diagnosed with Lyme disease?; and (5) have you ever had a tick bite?

Outcome variables

The four outcomes variables: "If I do not take preventive measures, I am susceptible to getting Lyme disease," "I am likely to be diagnosed with Lyme disease in the next 12 months," and "I am worried about getting Lyme disease," were slightly modified from [6]. The fear item, "I am afraid about getting Lyme disease" is original. All items were measured with a Likert-style scale ranging from 1=strongly disagree to 7=strongly agree.

Statistical analysis

Means and standard deviations were calculated for the continuous variables while percentages and frequencies were calculated for the categorical variables. Multivariate linear regression

analyses were conducted to study the relationships between the predictors and the four separate outcome variables. Predictors included demographics, perceived health, Lyme disease knowledge, Lyme disease preventive behaviors, Lyme disease history, and miscellaneous variables. All p-values were two sided. Stata/SE Version 13 [14] was used to perform these analyses.

Results

Table 1 shows the descriptive statistics of the sample. The mean age was slightly older than 22 years, and women made up slightly more than half of the sample. Race/ethnicity included slightly more than one-quarter Asian/Asian American, more than one-tenth African American, and slightly less than one-tenth Hispanic American. More than half were born in the United States. Almost two-thirds reported either excellent or very good perceived health. For the knowledge questions, two were answered with more than three-quarters correct, two were answered with more than half correct, and one had less than half correct. Only two of five preventive behaviors were endorsed as always done by more than one-fifth of the participants. More than half typically spent a lot of time outdoors. More than half previously heard of Lyme disease before participating in this survey. Less than 2% were ever diagnosed with Lyme disease. Less than one-fifth knew someone who was diagnosed with Lyme disease. More than one-tenth ever had a tick bite. For the outcome variables, susceptibility to Lyme disease had a mean score above the midpoint in the direction of strongly agree. All the other outcome variables of likely to be diagnosed, worried, and afraid of getting Lyme disease each had mean scores below the midpoint in the direction of strongly disagree.

Table 2 shows the linear regression analyses for not taking preventive measures and being susceptible to getting Lyme disease. The following variables were each associated with increased susceptibility: women, correct knowledge answers to two knowledge items (tick bites higher during the summer than winter; the insect causing Lyme disease is typically as large as an adult common housefly) spend a lot of time outdoors and know someone diagnosed with Lyme disease. Hearing about Lyme disease before participating in the survey was statistically significantly associated with decreased susceptibility. None of the perceived health or preventive behavior variables were statistically significant.

Table 1 Sample characteristics of survey for vulnerability and fear for Lyme disease.

Variable	Mean (SD)	Percentage (frequency)
<i>Demographics</i>		
Age (years)	22.1 (3.52)	—
Sex (women)	—	50.1% (357)
Race/ethnicity		
White	—	35.6% (254)
African-American		14.2% (101)
Hispanic-American		9.3% (66)
Asian/Asian-American		25.9% (185)
South Asian (India, Pakistan, surrounding areas)		6.5% (46)
Other		8.4% (60)
Missing		0.1% (1)
Born in the United States		
Yes	—	60.7% (433)
Missing		0.1% (1)
<i>Perceived health</i>		
Overall, would you say your health is:		
Excellent	—	21.7% (155)
Very good		43.6% (311)
Good		30.3% (216)
Fair/poor		4.2% (30)
Missing		0.1% (1)
<i>Knowledge</i>		
People can get Lyme disease after a tick bite		
Correct	—	83.0% (592)
Missing		0.4% (3)
The chance for tick bites is higher during the summer than the winter		
Correct		80.6% (575)
Missing	—	0.3% (2)
Ticks mostly fall out of trees		
Correct	—	60.3% (430)
Missing		0.4% (3)
Using insect repellent on skin can protect against tick bites		
Correct	—	52.9% (377)
Missing		0.6% (4)
The insect that causes Lyme disease is typically as large as an adult common housefly		
Correct		41.4% (295)
Missing	—	0.7% (5)

Table 1 (Continued)

Variable	Mean (SD)	Percentage (frequency)
<i>Preventive behaviors</i>		
Perform tick checks after being outdoors		
Never	—	67.5% (481)
Sometimes		27.2% (194)
Always		3.9% (28)
Missing		1.4% (10)
Use insect repellent on skin and/or clothing when outdoors		
Never	—	40.7% (290)
Sometimes		45.3% (323)
Always		12.6% (90)
Missing		1.4% (10)
Wear long pants in wooded or brushy areas		
Never	—	14.7% (105)
Sometimes		49.6% (354)
Always		34.2% (244)
Missing		1.4% (10)
Avoid wooded areas		
Never	—	25.1% (179)
Sometimes		53.0% (378)
Always		20.5% (146)
Missing		1.4% (10)
Tuck pant legs into socks		
Never	—	61.9% (441)
Sometimes		29.3% (209)
Always		7.4% (53)
Missing		1.4% (10)
<i>Lyme disease history and miscellaneous</i>		
I typically spend a lot of time outdoors		
Yes	—	56.0% (399)
Missing		0.8% (6)
Before participating in this survey, have you ever heard of Lyme disease?		
Yes	—	62.8% (448)
Have you ever been diagnosed with Lyme disease?		
Yes	—	1.7% (12)
Missing		0.1% (1)
Do you know someone who was diagnosed with Lyme disease?		
Yes	—	14.6% (104)
Have you ever had a tick bite?		
Yes	—	12.3% (88)

Table 1 (Continued)

Variable	Mean (SD)	Percentage (frequency)
<i>Outcome variables</i>		
If I do not take preventive measures, I am susceptible to getting Lyme disease	4.4 (1.62)	—
I am likely to be diagnosed with Lyme disease in the next 12 months	2.5 (1.57)	—
I am worried about getting Lyme disease	3.4 (1.92)	—
I am afraid about getting Lyme disease	3.8 (2.01)	—

Note: *M* = mean, *SD* = standard deviation.

Table 3 shows the linear regression analyses for likely to be diagnosed with Lyme disease in the next 12 months. The following variables were each associated with this increased likelihood: perceived good health, a correct knowledge answer to using insect repellent to protect against tick bites, those who always tuck their pant legs into their socks, and those who typically spend a lot of time outdoors. The following variables were each associated with decreased likelihood: those who sometimes used insect repellent when outdoors and those who had heard about Lyme disease before participating in the survey. None of the demographic variables were statistically significant.

Table 4 shows the linear regression analyses for worried about getting Lyme disease. The following variables were each associated with increased worry: Asian/Asian-American race/ethnicity, perceived good health, a correct knowledge answer that the insect causing Lyme disease is typically as large as an adult common housefly, those who sometimes avoided wooded areas, and those who typically spend a lot of time outdoors. The following variables were each associated with decreased worry: increased age and a correct knowledge answer that ticks do not mostly fall out of trees.

Table 5 shows the linear regression analyses for afraid of getting Lyme disease. The following variables were each associated with increased fear: women, Asian/Asian-American race/ethnicity, perceived good health, both sometimes and always avoided wooded areas, and those who typically spend a lot of time outdoors. The following variables were each associated with decreased fear: increased age and a correct knowledge answer that ticks do not mostly fall out of trees.

Discussion

This study found several associative relationships with regard to Lyme disease. Increased age was associated with decreased worry and decreased fear. Women were associated with increased susceptibility and fear. Asian/Asian-American race/ethnicity was associated with increased worry and fear. Perceived good health was associated with increased likelihood to be diagnosed, increased worry, and increased fear. Correct knowledge that the chance for tick bites is higher during the summer than the winter was associated with increased susceptibility. Correct knowledge that ticks do not mostly fall out of trees was associated with decreased worry and decreased fear. Correct knowledge that using insect repellent on the skin can protect against tick bites was associated with increased likelihood to be diagnosed. The preventive behavior variable of sometimes using insect repellent on the skin and/or clothing when outdoors was associated with a decreased likelihood to be diagnosed. The preventive behavior variable of sometimes avoiding wooded areas was associated with increased worry, while both sometimes and always avoiding wooded areas were associated with increased fear. The preventive behavior variable of always tucking pant legs into socks was associated with an increased likelihood to be diagnosed. Those who typically spend a lot of time outdoors were associated with increased susceptibility, increased likelihood to be diagnosed, increased worry, and increased fear. Those who had heard about Lyme disease before the survey were associated with decreased susceptibility and decreased likelihood to be diagnosed. Those who knew someone diagnosed with Lyme disease were associated with increased susceptibility.

In our multivariate analyses we found that within the sample of those ages 18–35 years, that increased age was associated with decreased worry and decreased fear; while there was no association of age with susceptibility and likelihood to be diagnosed. To the best of our knowledge, ours is the first research study regarding age and its associations with separate particular attitudes about Lyme disease that used multivariate analyses adjusting for other potentially relevant variables. We found one multivariate analysis with an aggregate risk perception measure for Lyme disease that included attitudes of susceptibility and worry along with an additional topic of perceived severity for different age group comparisons. This study found in their Canadian sample that those aged 18–34 years had the lowest odds and those 35–54 years the next lowest odds compared to the age group of 55 years

Table 2 Linear regression analyses for being susceptible to getting Lyme disease.

Variable	Beta	SE	p-value
<i>Demographics</i>			
Age (years)	-0.02	0.02	0.23
Sex (women)	0.27	0.13	0.04
Race/ethnicity			
White	Reference		
African-American	-0.12	0.20	0.54
Hispanic-American	0.10	0.23	0.66
Asian/Asian-American	0.13	0.17	0.43
South Asian (India, Pakistan, surrounding areas)	0.21	0.27	0.43
Other	0.12	0.24	0.63
Were you born in the United States (yes)	-0.05	0.15	0.75
<i>Perceived health</i>			
Overall, would you say your health is:			
Excellent	Reference		
Very good	-0.04	0.16	0.83
Good	0.19	0.18	0.31
Fair/poor	0.03	0.33	0.93
<i>Knowledge</i>			
People can get Lyme disease after a tick bite	0.27	0.17	0.12
The chance for tick bites is higher during the summer than the winter	0.34	0.16	0.04
Ticks mostly fall out of trees (reverse)	-0.13	0.13	0.30
Using insect repellent on skin can protect against tick bites	-0.10	0.13	0.41
The insect that causes Lyme disease is typically as large as an adult common housefly	0.38	0.13	0.003
<i>Preventive behaviors</i>			
Perform tick checks after being outdoors			
Never	Reference		
Sometimes	-0.09	0.16	0.56
Always	-0.25	0.35	0.48
Use insect repellent on skin and/or clothing when outdoors			
Never	Reference		
Sometimes	0.24	0.15	0.11
Always	0.09	0.22	0.70
Wear long pants in wooded or bushy areas			
Never	Reference		
Sometimes	0.02	0.21	0.93
Always	-0.15	0.22	0.49
Avoid wooded areas			
Never	Reference		
Sometimes	-0.07	0.16	0.67
Always	-0.26	0.20	0.09
Tuck pant legs into socks			
Never	Reference		
Sometimes	-0.05	0.15	0.76
Always	0.21	0.27	0.42
<i>Lyme disease history and miscellaneous</i>			
I typically spend a lot of time outdoors (yes)	0.34	0.13	0.01
Before participating in this survey, have ever heard of Lyme disease? (yes)	-0.35	0.14	0.01
Have you ever been diagnosed with Lyme disease? (yes)	0.23	0.50	0.64
Do you know someone who was diagnosed with Lyme disease? (yes)	0.68	0.19	<0.001
Have you ever had a tick bite? (yes)	-0.23	0.20	0.25
Constant	4.14	0.53	<0.001

Note: SE = standard error.

Table 3 Linear regression analyses for likely to be diagnosed with Lyme disease in the next 12 months.

Variable	Beta	SE	p-value
<i>Demographics</i>			
Age (years)	-0.01	0.02	0.50
Sex (women)	-0.09	0.12	0.44
Race/ethnicity			
White	Reference		
African-American	0.10	0.19	0.59
Hispanic-American	0.02	0.21	0.91
Asian/Asian-American	0.11	0.16	0.50
South Asian (India, Pakistan, surrounding areas)	0.45	0.25	0.07
Other	0.37	0.23	0.10
Were you born in the United States (yes)	-0.07	0.14	0.62
<i>Perceived health</i>			
Overall, would you say your health is:			
Excellent	Reference		
Very good	-0.02	0.15	0.89
Good	0.49	0.17	0.004
Fair/poor	0.32	0.31	0.31
<i>Knowledge</i>			
People can get Lyme disease after a tick bite	-0.06	0.16	0.73
The chance for tick bites is higher during the summer than the winter	-0.21	0.15	0.18
Ticks mostly fall out of trees (reverse)	-0.14	0.12	0.23
Using insect repellent on skin can protect against tick bites	0.27	0.12	0.03
The insect that causes Lyme disease is typically as large as an adult common housefly	0.17	0.12	0.15
<i>Preventive behaviors</i>			
Perform tick checks after being outdoors			
Never	Reference		
Sometimes	0.01	0.15	0.97
Always	0.56	0.33	0.09
Use insect repellent on skin and/or clothing when outdoors			
Never	Reference		
Sometimes	-0.42	0.14	0.003
Always	-0.39	0.21	0.06
Wear long pants in wooded or bushy areas			
Never	Reference		
Sometimes	-0.05	0.20	0.80
Always	0.12	0.20	0.55
Avoid wooded areas			
Never	Reference		
Sometimes	0.19	0.15	0.22
Always	0.31	0.19	0.10
Tuck pant legs into socks			
Never	Reference		
Sometimes	0.17	0.14	0.23
Always	0.61	0.25	0.02
<i>Lyme disease history and miscellaneous</i>			
I typically spend a lot of time outdoors (yes)	0.43	0.12	<0.001
Before participating in this survey, have ever heard of Lyme disease? (yes)	-0.37	0.13	0.01
Have you ever been diagnosed with Lyme disease? (yes)	0.57	0.47	0.23
Do you know someone who was diagnosed with Lyme disease? (yes)	-0.11	0.18	0.52
Have you ever had a tick bite? (yes)	-0.10	0.19	0.60
Constant	2.65	0.50	<0.001

Note: SE = standard error.

Table 4 Linear regression analyses for worried about getting Lyme disease.

Variable	Beta	SE	p-value
<i>Demographics</i>			
Age (years)	-0.04	0.02	0.04
Sex (female)	0.24	0.15	0.11
Race/ethnicity			
White	Reference		
African-American	-0.04	0.23	0.87
Hispanic-American	0.10	0.26	0.71
Asian/Asian-American	0.46	0.19	0.02
South Asian (India, Pakistan, surrounding areas)	0.22	0.30	0.46
Other	0.13	0.27	0.63
Were you born in the United States (yes)	-0.31	0.17	0.07
<i>Perceived health</i>			
Overall, would you say your health is:			
Excellent	Reference		
Very good	0.07	0.19	0.71
Good	0.47	0.21	0.02
Fair/poor	0.09	0.38	0.82
<i>Knowledge</i>			
People can get Lyme disease after a tick bite	-0.18	0.20	0.36
The chance for tick bites is higher during the summer than the winter	0.11	0.18	0.56
Ticks mostly fall out of trees (reverse)	-0.70	0.15	<0.001
Using insect repellent on skin can protect against tick bites	0.02	0.14	0.91
The insect that causes Lyme disease is typically as large as an adult common housefly	0.34	0.14	0.02
<i>Preventive behaviors</i>			
Perform tick checks after being outdoors			
Never	Reference		
Sometimes	0.31	0.18	0.08
Always	0.42	0.40	0.29
Use insect repellent on skin and/or clothing when outdoors			
Never	Reference		
Sometimes	0.09	0.17	0.59
Always	-0.33	0.25	0.20
Wear long pants in wooded or bushy areas			
Never	Reference		
Sometimes	-0.11	0.24	0.66
Always	-0.04	0.25	0.88
Avoid wooded areas			
Never	Reference		
Sometimes	0.46	0.19	0.02
Always	0.42	0.23	0.07
Tuck pant legs into socks			
Never	Reference		
Sometimes	0.14	0.17	0.41
Always	0.47	0.30	0.12
<i>Lyme disease history and miscellaneous</i>			
I typically spend a lot of time outdoors (yes)	0.40	0.15	0.01
Before participating in this survey, have ever heard of Lyme disease? (yes)	-0.30	0.16	0.06
Have you ever been diagnosed with Lyme disease? (yes)	0.48	0.57	0.40
Do you know someone who was diagnosed with Lyme disease? (yes)	0.23	0.21	0.29
Have you ever had a tick bite? (yes)	-0.28	0.23	0.22
Constant	3.94	0.60	<0.001

Note: SE = standard error.

Table 5 Linear regression analyses for afraid of getting Lyme disease.

Variable	Beta	SE	p-value
<i>Demographics</i>			
Age (years)	-0.05	0.02	0.02
Sex (women)	0.35	0.15	0.02
Race/ethnicity			
White	Reference		
African-American	-0.01	0.23	0.98
Hispanic-American	-0.01	0.27	0.98
Asian/Asian-American	0.50	0.20	0.01
South Asian (India, Pakistan, surrounding areas)	0.34	0.31	0.27
Other	0.46	0.28	0.10
Were you born in the United States (yes)	-0.30	0.17	0.08
<i>Perceived health</i>			
Overall, would you say your health is:			
Excellent	Reference		
Very good	0.17	0.19	0.38
Good	0.76	0.21	<0.001
Fair/poor	-0.08	0.39	0.83
<i>Knowledge</i>			
People can get Lyme disease after a tick bite	-0.10	0.20	0.64
The chance for tick bites is higher during the summer than the winter	0.25	0.19	0.19
Ticks mostly fall out of trees (reverse)	-0.81	0.15	<0.001
Using insect repellent on skin can protect against tick bites	-0.05	0.15	0.76
The insect that causes Lyme disease is typically as large as an adult common housefly	0.21	0.15	0.16
<i>Preventive behaviors</i>			
Perform tick checks after being outdoors			
Never	Reference		
Sometimes	0.05	0.18	0.81
Always	0.26	0.41	0.53
Use insect repellent on skin and/or clothing when outdoors			
Never	Reference		
Sometimes	0.25	0.17	0.15
Always	-0.42	0.26	0.10
Wear long pants in wooded or bushy areas			
Never	Reference		
Sometimes	-0.02	0.24	0.93
Always	0.16	0.25	0.54
Avoid wooded areas			
Never	Reference		
Sometimes	0.53	0.19	0.01
Always	0.55	0.24	0.02
Tuck pant legs into socks			
Never	Reference		
Sometimes	0.26	0.18	0.14
Always	0.48	0.31	0.13
<i>Lyme disease history and miscellaneous</i>			
I typically spend a lot of time outdoors (yes)	0.49	0.15	0.001
Before participating in this survey, have ever heard of Lyme disease? (yes)	-0.26	0.16	0.11
Have you ever been diagnosed with Lyme disease? (yes)	0.27	0.59	0.65
Do you know someone who was diagnosed with Lyme disease? (yes)	0.38	0.22	0.09
Have you ever had a tick bite? (yes)	-0.36	0.24	0.14
Constant	3.97	0.62	<0.001

Note: SE = standard error.

and older in terms of risk perception for Lyme disease. However, in their Swiss sample, there were no age group differences for risk perception for Lyme disease for those aged 18–34 years, 35–54 years, and 55 years and older [7]. We are aware of one study with univariate analyses for separate particular attitudes about Lyme disease that reported that those aged 18–29 years had lower percentages for worry about contracting Lyme disease than those aged 30–49 years and older than 50 years. There were no age differences between those aged 18–29 years, 30–49 years, and older than 50 years with regard to either susceptibility or likelihood to be diagnosed with Lyme disease [6]. Another communicable infectious disease of influenza was studied and reported that age in a sample of those aged 18 to older than 65 years was not associated with worry or being scared about influenza [15]. Our study findings are similar to the report of no association of age with regard to likelihood to be diagnosed and also similar to the pattern of either no association of age and susceptibility or when susceptibility was combined in an aggregate measure. With regard to worry or fear, we are not able to directly compare our sample of those aged 18–35 years to these other studies, as our study only included one age group while the other studies either compared different age groups, with only the youngest age group being similar to our sample, or comprised many different ages including those much older than in our sample. We suggest that within the broadly defined young adult age range of 18 to 35 years that as age increases, people are more knowledgeable about medical illness in general and Lyme disease in particular and base their attitudes on facts rather than worry or fear and thus have less worry as age increases.

We found that women had attitudes for increased susceptibility and fear of contracting Lyme disease while there were no sex differences for attitudes regarding likelihood to be diagnosed or worry. Another study of participants from Canada and Switzerland did not find any association of sex with susceptibility or worry about Lyme disease in their subset of those aged 18–34 years [7]. Our findings are similar for worry but differ for susceptibility. It is possible that those from the United States have different susceptibility attitudes than those from Canada and Switzerland. It is also possible that that more research is necessary to clarify this topic. We are not aware of any existing research on sex and fear of contracting Lyme disease. Another study of communicable infectious disease focusing on influenza reported no sex differences for fear about influenza risk [20]. Our findings differ from the

pattern in influenza, suggesting that women have greater fear than men for contracting Lyme disease.

We found that Asian/Asian-American race/ethnicity was associated with increased worry and fear. We are not aware of any literature for Asian/Asian-American race/ethnicity and worry or fear about Lyme disease. Another communicable infectious disease study of influenza reported that three-quarters of their Chinese sample were not afraid of contracting H1N1 influenza [16]. Our study differs from the pattern seen by influenza, suggesting that there may be some cultural reasons why young adult Asian/Asian-Americans have worry and fear about Lyme disease. Future research should investigate these possible cultural reasons.

We found an association of good perceived health with increased likelihood to be diagnosed, worry and fear; no such associations were observed with very good perceived health or fair/poor perceived health. Perceived health has a typical consistent pattern such as by chronic diseases where those with more chronic diseases report lower levels in the direction of poorer perceived health [17]. It is surprising that our study differs from this pattern in that we only found associations for good perceived health. It is possible that this pattern for perceived health does not apply to attitudes for Lyme disease. Also, a possible speculative reason for this difference is that those with good health are those who previously had health concerns and worked hard to improve their health. These individuals might apply their experience toward being concerned and worried about the impact of other diseases such as Lyme disease.

With regard to the knowledge variables, depending upon the variable, we found that correct knowledge was associated with either increased susceptibility, increased likelihood to be diagnosed and/or increased worry. Previous research that included a number of our knowledge questions found an association of higher correct total knowledge scores with engaging in preventive behaviors for Lyme disease [6]. Our study findings are similar to this study, suggesting that knowledge is also associated with attitudes toward susceptibility, likelihood to be diagnosed and/or worry. However, correctly answering one of our knowledge items that ticks do not mostly fall out of trees was associated with decreased worry and fear. This differs from the pattern for the other knowledge variables. Future research should study why this pattern occurred.

We found that engaging in the Lyme disease preventive behavior of avoiding wooded areas was associated with increased worry and fear. This is

consistent with previous research that engaging in Lyme disease preventive behaviors of checking skin and wearing protective clothing were associated with increased worry [6]. Our results were mixed regarding likelihood to be diagnosed with Lyme disease; engaging in the preventive behavior of tucking pant legs into socks was associated with an increased likelihood while using insect repellent on the skin was associated with a decreased likelihood. This might be explained by the findings from another study in which the preventive behavior of checking the skin was associated with an increased likelihood in the univariate analysis while in the multivariate analysis this pattern no longer occurred [6]. Our study findings suggest that different preventive behaviors may be associated with different patterns regarding the likelihood to be diagnosed with Lyme disease.

We found that those who reported that they typically spend a lot of time outdoors showed a significant association with increased susceptibility, increased likelihood to be diagnosed, increased worry, and increased fear regarding Lyme disease. We are not aware of any similar research on Lyme disease. Previous research reports that those who are exposed to a disease often have greater psychological concerns such as worry and fear [18]. Our study is similar to this approach. It is also logical that those who typically spend a lot of time outdoors and have increased exposure to Lyme disease would be concerned with increased susceptibility, increased likelihood of diagnosis, increased worry, and increased fear of Lyme disease.

We found that those who had heard of Lyme disease before participating in the survey had decreased associations with susceptibility and likelihood to be diagnosed. We are not aware of any previous research on this topic focusing on Lyme disease. Previous research on the health topic of cardiovascular disease reports that those who had previously heard about cardiovascular disease had accurate knowledge about certain risk factors for cardiovascular disease [19]. We suggest that our study uses a similar framework and it is quite logical that those who heard about Lyme disease have accurate knowledge about risk factors for Lyme disease and therefore do not believe that they are susceptible or likely to be diagnosed for Lyme disease.

We did not find any association of ever diagnosed with Lyme disease with either susceptibility, likelihood to be diagnosed, worry, or fear. We are not aware of any previous research on this aspect of Lyme disease. We propose that our results can be explained by equally compelling reasons

directly competing with each other and resulting in non-significance. It is possible that those with a previous Lyme disease diagnosis may perceive themselves as having some type of immunity for future Lyme disease. It is also possible those who have had Lyme disease may be more concerned and thus more susceptible, likely to be diagnosed, worried, and afraid. A third possibility is that there were too few individuals with Lyme disease to allow us to observe any association. We also found that those who knew someone who had been diagnosed with Lyme disease had an increased association with susceptibility. We are not aware of any previous literature on this topic for Lyme disease. We suggest that it is possible that knowing someone diagnosed with the disease increases a person's perception of its relevance and results in feelings of increased susceptibility.

This study has several limitations. First, because the study only included a relatively young age group, its results may not be applicable to middle and older ages. Second, the state of New York has a high incidence of Lyme disease; therefore, the respondents may be more educated about Lyme disease as compared to those from low-incidence Lyme disease areas. Future research should study those from low-incidence states. Third, we did not study the possible associations of a weakened immune system due to the presence of an existing medical condition. Future research should study those with pre-existing medical conditions regarding their attitudes toward susceptibility, likelihood to be diagnosed, worry, and fear about Lyme disease.

Conclusions

We found that women were associated with increased susceptibility and fear. Asian/Asian-American race/ethnicity was associated with increased worry and fear. Those with perceived good health were associated with increased likelihood to be diagnosed, worry, and fear. Correct knowledge was associated with increased susceptibility and likelihood to be diagnosed. Those who typically spend a lot of time outdoors were associated with increased susceptibility, likelihood to be diagnosed, worry, and fear. Physicians, healthcare providers, and public health campaigns should address susceptibility, likelihood to be diagnosed, worry, and fear about Lyme disease, particularly targeting women and Asians/Asian-Americans, in an effort to address any possible misconceptions and/or offer effective coping strategies.

Author contributions

Joshua Fogel made substantial contributions to: (1) the conception and design of the study, acquisition of data, and analysis and interpretation of data; (2) revising the article for critically important intellectual content; and (3) final approval of the version to be submitted.

Gurasees Chawla made substantial contributions to: (1) analysis and interpretation of data; (2) drafting the article for important intellectual content; and (3) final approval of the version to be submitted.

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