

Tick bite frequency, prevention practices and Lyme disease diagnoses among U.S. Hispanic survey respondents

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Funding information

Project support was provided in part by an appointment to the CDC Fellowship Program, administered by the Oak Ridge Institute for Science and Education through an interagency agreement between the US Department of Energy and CDC. No financial disclosures were reported by the authors of this paper.

Abstract

Tick bite prevention practices, knowledge of Lyme disease (LD) symptoms and transmission, and patterns of LD diagnoses among Hispanic persons have been reported but not comprehensively evaluated. In 2014, CDC examined questions from a prospective nationwide survey of U.S. Hispanic adults conducted via the Offerwise QueOpinas panel regarding ticks and LD. From October to November, a total of 2,649 surveys were released and 1,006 completed surveys returned. Overall, 44% of respondents reported routinely practising at least one form of personal protection against tick bites, and wearing repellent was the most commonly reported method (29%). Approximately 6% of respondents reported a tick bite for either themselves or someone in their household during the previous 12 months. An individual or household diagnosis of LD in the previous year was reported by 2% of respondents, with the highest proportion of diagnoses reported by respondents from high LD incidence states. The annual incidence of healthcare provider-diagnosed LD in the survey population was higher than national surveillance estimates for reported LD among U.S. Hispanic persons during 2000–2013. As annual incidence of LD continues to increase, it is important to ensure equitable access to information about LD, including disease transmission, manifestations, and prevention recommendations. Results from this survey can help inform public health outreach focused on effective tick bite prevention methods and early recognition of LD.

KEYWORDS

Hispanic Americans, Lyme disease, surveys and questionnaires, tick bites, tick-borne diseases

1 | INTRODUCTION

Lyme disease (LD) is a common zoonotic infection in the United States caused by certain *Borrelia* species transmitted by infected *Ixodes scapularis* and *I. pacificus* ticks (Stanek et al., 2012). LD is geographically focal to the Northeast, mid-Atlantic and Upper Midwest, as well as areas on the Pacific Coast (Schwartz et al., 2017). Early, localized infection is characterized by fever, fatigue and in most cases, a characteristic skin lesion called erythema migrans; if left untreated, infection can progress to disseminated disease including various musculoskeletal, cardiac or neurologic

manifestations (Wormser et al., 2006). Disseminated disease can be potentially fatal, and Lyme carditis has caused sudden death in young, otherwise healthy teens and adults (Costello et al., 2009; Muehlenbachs et al., 2016; Yoon et al., 2015). To prevent exposure to LD, the Centers for Disease Control and Prevention (CDC) recommends avoiding tick bites via use of EPA-registered insect repellents, permethrin-treated clothing or gear, daily tick checks, showering soon after coming indoors, and avoidance of tick habitat, among other methods (CDC, 2019).

The U.S. Census Bureau estimates that 18% of the U.S. population (nearly 1 in 5 persons) is Hispanic or Latino (United States Census Bureau,

2020). However, few studies have evaluated experiences with ticks or incidence of LD in U.S. Hispanic populations. Limited existing data suggest differences in tick bite prevention practices, familiarity with LD symptoms and transmission, and timeliness of LD diagnosis between Hispanic and non-Hispanic persons. In a 2015 survey of knowledge, attitudes and behaviours of Hispanic and non-Hispanic residents of Maryland and Virginia, Hispanic respondents were significantly less likely to recognize LD symptoms and correctly identify ticks as the vector for LD compared to non-Hispanic respondents. Hispanic respondents were also less likely to report daily tick checks but were more likely to report showering soon after coming indoors to prevent tick bites. Adjusting for ethnicity and demographic variables, survey participants who primarily spoke Spanish were less likely to correctly identify the route of LD transmission, recognize LD symptoms and perform daily tick checks compared to those who primarily spoke English (Hu et al., 2019).

Analyses of national surveillance data from 2000 to 2013 found that Hispanic persons were more likely to have disseminated manifestations of LD such as arthritis and facial palsy than non-Hispanic persons. Additionally, Hispanic persons were more likely to experience disease onset during the fall versus summer months, suggesting differences in timing of exposure or diagnosis (Nelson et al., 2016). The underlying causes for these disparities reported by previous studies are likely complex and due to structural inequities and policies that disproportionately affect Hispanic populations in the United States, including economic and language barriers to accessing health services (Velasco-Mondragon et al., 2016).

Many gaps remain in our understanding of tick bite prevention practices, tick exposures and LD diagnoses among U.S. Hispanic populations. Information regarding these topics could be used to inform appropriate and effective public health educational efforts to recognize and prevent LD. To support this objective, CDC included questions on a prospective nationwide survey of U.S. Hispanic persons to assess experiences with tick bites and LD.

2 | MATERIALS AND METHODS

Estilos is an annual web-based survey of U.S. Hispanic adults conducted by Porter Novelli. The survey is designed to assess knowledge and attitudes related to a wealth of topics including technology, sustainability, purchase decisions and health. The survey was administered from October to November 2014 via the Offerwise QueOpinas panel. Further information about this voluntary panel can be found at (QueOpinas, 2021). CDC licenced the results of the Estilos survey post-collection from Porter Novelli. Analysis of these data was exempt from institutional review board assessment because personal identifiers were not included in the purchased data file. Although Porter Novelli Public Services and ENGINE Insights are not subject to institutional review board review, they adhere to professional standards and codes of conduct set forth by ESOMAR (the European Society for Opinion and Marketing Research) and the Insights Association. Respondents are informed that their answers are being used for market research and can refuse to answer any question at any time.

Impacts

- As annual incidence of Lyme disease continues to increase, it is important to ensure equitable access to information about Lyme disease, including disease transmission, manifestations and prevention recommendations.
- Many gaps remain in our understanding of tick bite prevention practices, tick exposures and LD diagnoses among U.S. Hispanic adults.
- Results from this survey can help inform public health outreach focused on effective tick bite prevention methods and early recognition of LD.

The survey was sent to a random sample of 2,649 panelists aged 18 years and older. Quotas were used for age, language, acculturation level, region, gender and heritage (PNStyles, 2019). Participants could choose to take the survey in either English or Spanish. Resulting data were weighted according to the U.S. Census American Community Survey for gender, age, household income, household size, education, census region, country of origin and acculturation (Porter Novelli Public Services, 2014).

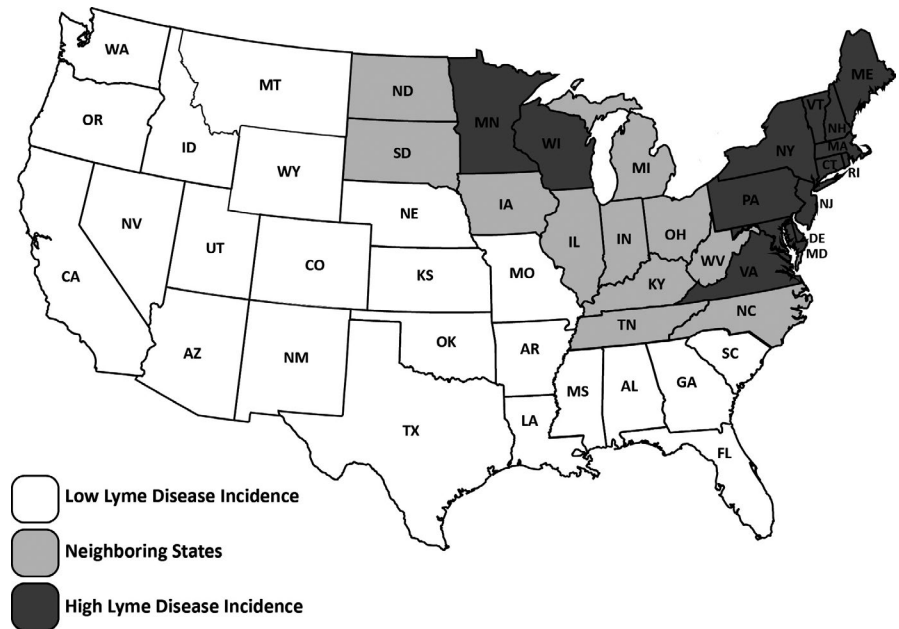
The survey questions pertaining to tick bites and LD were as follows:

- Q1 What steps do you routinely take to prevent tick bites?
(Select all that apply: I wear repellent; I shower soon after coming indoors; I wear insecticide-treated clothing; I check my body for ticks daily; I take other steps not listed here; I don't take any steps to prevent tick bites)
- Q2 In the past 12 months, has anyone in your household been bitten by a tick?
(Select all that apply: Yes, I was bitten; Yes, someone else in my household; No; Don't know)
- Q3 In the past 12 months, has anyone in your household been diagnosed with Lyme disease by a healthcare provider?
(Select all that apply: Yes, I was; Yes, someone else in my household; No; Don't know)

For the purposes of this analysis, state of residence was categorized by LD endemicity. States with high LD incidence (LDI) and states that bordered areas with high LDI, known as neighbouring LDI, were defined per the specifications from Schwartz et al., 2017. All other states were classified as low LDI. A map illustrating this classification is shown in Figure 1.

Data were analysed using SAS v. 9.4 (SAS Institute, Inc.). Chi-square tests were used to compare categorical data. Univariate logistic regression identified potential demographic, cultural and behavioural variables associated with the outcomes of interest: age, gender, education, employment, income, household size, presence of children in the household, language spoken at home, survey language (if the survey was administered in English or Spanish), media language (respondent's preference for English media, Spanish

FIGURE 1 Image by Nawrocki and Hinckley (2021)



media or both), sources of health information and LD endemicity. In order to assess sources of health information, questions analysed included:

- When you need information about a health condition that you are unfamiliar with, where do you obtain the information first? (*healthcare providers, community members, internet search or other*)
- When you use the internet for personal reasons (not for work), what do you do or look for? Please select each of the following that you have done in the past month. (*Looked for health information, yes or no*)
- In the past year, do you remember hearing about health or disease information that came from the Centers for Disease Control and Prevention, known as CDC? (*yes or no*)

Variables significant at $p < .20$ in univariate analyses were included in multivariable regression analysis. Backward stepwise selection retained variables significant at $p < .05$.

3 | RESULTS

A total of 2,649 surveys were released and 1,006 completed surveys returned, yielding a response rate of 38%. Demographic and cultural characteristics of survey respondents are shown in Table 1. Approximately half of respondents were male (50.8%) and a plurality was aged 30–44 years (34.8%). Over half of respondents were employed (57.9%).

The largest share of respondents (48.2%) reported Spanish as their primary language at home and 59.6% completed the survey in Spanish. Slightly over half of respondents (52.0%) reported that they had lived in the United States for ≥ 20 years and 48.3% identified as somewhat or much closer to Hispanic or Latino culture. Most respondents

(76.8%) lived in low LDI states, 16.1% of respondents lived in high LDI states, and 7.1% in neighbouring LDI states.

3.1 | Tick bite prevention

Overall, 44.1% of respondents reported routinely practising at least one form of personal protection against tick bites. Wearing repellent was the most commonly reported method (28.5%), followed by daily tick checks (11.6%), showering soon after coming indoors (11.2%), and other steps not listed (9.0%; Table 2). Use of insecticide-treated clothing was infrequently reported (2.7%).

The overall likelihood of practising at least one prevention measure against tick bites differed by respondent characteristics. Survey respondents who lived in high LDI (OR = 2.1, 95% CI: 1.2–3.7) or neighbouring LDI states (OR = 3.7, 95% CI: 1.6–8.6) were more likely to practice at least one prevention measure against tick bites as compared to those from low LDI states. Respondents with household incomes $\geq \$80,000$ (OR = 2.4, 95% CI: 1.2–5.0) or under \$25,000 (OR = 1.9, 95% CI: 1.2–3.2) were also more likely to practice tick bite prevention as compared to the \$25,000–\$49,999 income group. Respondents who practised tick bite prevention were more likely to have medium or large households (OR = 1.8, 95% CI: 1.0–3.0; OR = 2.3, 95% CI: 1.1–4.5, respectively).

Use of specific methods to prevent tick bites also varied by respondent characteristics. Survey respondents with 3–4 household members were more likely to report checking for ticks daily (OR = 2.4, 95% CI: 1.2–4.8) or routinely showering soon after coming indoors (OR = 2.1, 95% CI: 1.1–3.9) to prevent tick bites as opposed to respondents with 2 or fewer household members. Respondents who reported using other steps not listed in the survey to prevent tick bites were more likely to use media in both English and Spanish versus English alone (OR = 3.0, 95% CI: 1.3–6.8).

TABLE 1 Demographic and cultural characteristics of survey respondents

	Unweighted No.	Weighted %
Overall (n)	1,006	N/A
Sex		
Male	496	50.8
Female	510	49.2
Age group (years)		
18–29	260	28.8
30–44	362	34.8
45–59	277	25.0
≥60	107	11.4
Education ^a		
Less than high school	179	35.3
High school degree	214	27.1
Some college or technical school	376	23.5
Bachelor's degree or higher	237	14.1
Household income		
<\$25,000	509	29.2
\$25,000–\$49,999	282	28.5
\$50,000–\$79,999	142	30.0
≥\$80,000	73	12.3
Employment ^b		
Employed	551	57.9
Unemployed	151	12.0
Other	304	30.1
Media habits		
Spanish media mostly/only	325	30.1
Spanish and English media equally	390	35.8
English media mostly/only	291	34.1
Language at home		
Spanish mostly/only	486	48.2
Spanish and English equally	283	24.8
English mostly/only	237	27.0
Household size		
Small (1–2 residents)	269	40.4
Medium (3–4 residents)	485	39.3
Large (>5 residents)	252	20.3
Cultural self-identification		
Somewhat/much closer to Hispanic/Latino culture	495	48.3
Equally close to both cultures	355	33.3
Somewhat/much closer to U.S. culture	156	18.4
Years in the United States		
0–19	516	48.0
≥20	490	52.0
Heritage		
Central American	52	4.9
Cuban	110	8.8

(Continues)

TABLE 1 (Continued)

	Unweighted No.	Weighted %
Dominican	26	2.5
Mexican	607	64.1
Puerto Rican	78	8.8
South American	116	8.8
Spanish	17	2.0
Survey language		
English	378	40.4
Spanish	628	59.6
LD endemicity of state of residence		
High	171	16.1
Neighbouring	77	7.1
Low	758	76.8

Abbreviation: LD, Lyme disease.

^aThose who reported a trade or technical school or graduation from a 2-year college for education were categorized as 'some college'.

^bThose who identified as students, retirees or homemakers were categorized as 'other'.

TABLE 2 Weighted percentages (%) of survey respondents who reported use of tick bite prevention methods in states with high, neighbouring and low Lyme disease incidence^a

Prevention method ^b	High LDI	Neighbouring LDI	Low LDI	Total
Wear repellent	38.1	39.9	25.4	28.5
Daily tick checks	17.4	12.7	10.3	11.6
Shower soon after coming indoors	15.9	14.8	9.9	11.2
Insecticide-treated clothing	2.7	3.5	2.7	2.7
Other steps not listed	11.5	13.0	8.1	9.0
None	41.5	35.9	60.8	55.9

Abbreviation: LDI, Lyme disease incidence.

^aValues are weighted % unless otherwise indicated.

^bMultiple answers were allowed. Totals may exceed 100%.

Sources of health information were significantly associated with practising tick bite prevention. Respondents who practised at least one method of prevention against tick bites were more likely to seek healthcare providers when in need of information about an unfamiliar health condition rather than from online sources (OR = 2.0, 95% CI: 1.2–3.4). Respondents who reported daily tick checks or other prevention steps not listed were more likely to have looked for health information when using the internet in the past month (OR = 2.6, 95% CI: 1.5–4.6; OR = 2.5, 95% CI: 1.2–5.2, respectively). Lastly, respondents who reported using other prevention steps were also more likely to have remembered hearing about health or disease information that came from the Centers for Disease Control and Prevention in the past year (OR = 2.8, 95% CI: 1.3–6.0).

3.2 | Tick bites

In total, 71 respondents (6.0%) reported a tick bite for either themselves or someone in their household during the previous 12 months. Respondents who reported a tick bite (for themselves or a household

member) were more likely to have had some college or a bachelor's degree as opposed to a high school education or less (OR = 3.6, 95% CI: 1.5–8.8). They were also more likely to have taken the survey in Spanish (OR = 2.8, 95% CI: 1.3–6.1). Respondents with a child under the age of 18 did not report significantly more tick bites among themselves or household members than those without a child under the age of 18 (8.1% vs. 4.0%, $p = .07$), nor did respondents who identified as a parent or caregiver for a child aged 12 years or younger (7.9% vs. 4.9%, $p = .20$).

Among those only reporting a tick bite for themselves ($n = 32$, 2.9%), there were no significant differences by gender ($p = .11$). However, reported tick bites differed by age group. Those in the 45–59 age group had significantly lower reported tick bites than all other age groups ($p < .0001$).

3.3 | Lyme disease diagnoses

A total of 25 LD diagnoses were reported by respondents for either themselves or someone in the household (1.9%). Proportionally,

more diagnoses were reported by respondents in households from high LDI states (5.2%) than neighbouring (3.2%) or low (1.0%) LDI states ($p < .01$). New York and New Jersey accounted for all LD diagnoses from high LDI states ($n = 8$, $n = 1$, respectively), while the highest proportion of diagnoses from low LDI states were from California ($n = 6$). Diagnoses from neighbouring LDI states were reported from respondents in Illinois and North Carolina. Respondents with a child under the age of 18 reported significantly more household LD diagnoses than those without a child under the age of 18 (3.8% vs. 0.11%, $p < .001$).

There were 13 LD diagnoses reported by the respondent for only themselves in the previous year (0.74%). Twelve of the 13 respondents who reported a LD diagnosis for themselves were between the ages of 18 and 44. Self-reported LD diagnoses did not differ by gender ($p = .11$) or survey language ($p = .72$). Among only those reporting a diagnosis for themselves, the estimated annual incidence of healthcare provider-diagnosed LD in the survey population was 7.4 cases/1,000 persons.

4 | DISCUSSION

Results from this nationwide survey contribute to improving the understanding of prevention practices, frequency of tick bites and LD diagnoses among U.S. Hispanic adults. We found that slightly less than half of respondents reported routinely practising at least one form of personal protection against tick bites. Wearing repellent was the most commonly reported prevention method, followed by daily tick checks and showering soon after coming indoors to prevent tick bites. Approximately one in ten respondents checked for ticks daily or showered soon after coming indoors to prevent tick bites.

In nationwide cross-sectional surveys of tickborne disease attitudes and behaviours among the U.S. public from 2013 to 2015 (herein referred to as ConsumerStyles), 20.6% of respondents wore repellent, 15.5% showered after coming indoors and 19.4% checked for ticks daily (Nawrocki & Hinckley, 2021). Results from a 2015 survey of Hispanic adults from outpatient clinics and community centres in Maryland and Virginia indicated that 36% of respondents wore repellent, 36% showered after coming indoors and 17% checked for ticks daily (Hu et al., 2019). The corresponding rates observed in our study were 29%, 11% and 12%, respectively. Use of insecticide-treated clothing was similar across surveys, consistently reported by approximately 2%–3% of respondents.

Approximately 6% of respondents reported a tick bite for either themselves or someone in their household in the previous year. Respondents who reported a tick bite (for themselves or a household member) were more likely to have some college education or higher as compared to a high school education or less. This parallels findings from a recent analysis of tick encounters at the household level for endemic areas in the Northeast, where among households reporting an attached tick, a graduate level education for the head of household was associated with increased odds of any tick encounter

(Hook et al., 2021). Further, having at least some college education was associated with increased odds of finding a tick crawling on a household member (Hook et al., 2021). Nawrocki and Hinckley (2021) found that 12.3% of ConsumerStyles respondents reported a tick bite for themselves or a household member in the last year, including 9.4% in low LDI states. With 76.8% of the Estilos population residing in low LDI states, our overall percentage of 6% is comparable. Unlike Nawrocki and Hinckley (2021), we did not see any statistical differences for household tick bites among respondents from high, neighbouring or low LDI states.

The annual incidence of healthcare provider-diagnosed LD reported by survey participants was 7.4 cases/1,000 persons, which is higher than the incidence of LD reported for U.S. Hispanic persons through national surveillance during 2000–2013 (0.8 cases/100,000 persons; Nelson et al., 2016). Despite a higher incidence of reported LD in men aged 65–74 years among both Hispanic and non-Hispanic persons from national surveillance data, we did not see any statistical differences for self-reported diagnoses by gender, and most were reported by survey respondents between the ages of 18 and 44. Additionally, our estimate of participants who reported a LD diagnosis for themselves or someone in their household (1.9%) was slightly higher than reports from ConsumerStyles surveys, where 0.9% of survey respondents reported an individual or household LD diagnosis in the previous year (Nawrocki & Hinckley, 2021).

Although the frequency of LD diagnoses reported by participants from was highest in high LDI states, as expected, those diagnoses were confined to New York and New Jersey. The lack of diagnoses reported from other high LDI states is most likely due to a low survey sample size in the Northeast, with no respondents from ME, NH or VT, therefore, under-representing Hispanic persons from this geographical region in this study. While some LD diagnoses were reported by respondents from low LDI states, it should be noted that diagnoses were analysed by state of residence and not by state of exposure. Therefore, it is possible that these diagnoses were among persons who had recently traveled to or worked in LD endemic areas. Since many of the diagnoses in low LDI states were from California, it is also plausible that exposure occurred in the few counties of California with local risk for LD.

Respondents with a child under the age of 18 years did not report significantly more tick bites among themselves or household members than those without a child under the age of 18, nor did respondents who identified as a parent or caregiver for a child aged 12 years or younger. However, respondents with a child under the age of 18 years reported significantly more household LD diagnoses than those without a child under the age of 18 years. The reason for this is unclear. It is possible that households with children practice tick bite prevention more frequently, as was reported here for larger households, though less effectively (e.g. ticks more often found and removed after transmission occurs). Alternatively, families with children and those with higher reports of LD may reflect larger household sizes and thus a higher proportional likelihood of infection. In either case, the sample size here is limited and may not represent a valid estimate.

There are several limitations to this analysis. First, as in most self-reported surveys, selection bias might limit representativeness of these results and response bias may limit interpretability. Second, it was not possible to assess the frequency of tick bites or LD diagnoses in children since we did not have information from respondents under the age of 18 years. However, to indirectly ascertain information about children, we analysed questions about presence of children or child caretakers in the household as well as number of household residents. Some questions were answered for a household on behalf of the individual survey respondent, which may further introduce reporting or recall bias. Third, information about survey respondent occupation, timing of disease onset or manifestations of LD was not available. All LD diagnoses were survey-reported and were not validated by external sources. Lastly, the sample from which the survey population was drawn only includes the top five percent of most active panelists from the QueOpinas panel. Those without internet or television access are likely underrepresented in this study since television advertising is used for panel recruitment and internet access is necessary to respond to the survey. Based on the survey sample and aforementioned considerations, these results are not generalizable to the broader U.S. Hispanic population. Lastly, the LDI classification scheme does not take into consideration other tick species or tick-borne diseases, and this should be kept in consideration for reported tick bites by participants from low LDI states.

5 | CONCLUSIONS

As the annual incidence of LD continues to increase, it is important to ensure equitable access to information about LD, including disease transmission, manifestations and prevention recommendations. Results from this survey can help to inform appropriate educational outreach focused on effective tick bite prevention methods. Relied upon sources for health information reported by respondents, including healthcare providers, should be sought out for prevention messaging. Effective tick bite prevention recommendations underutilized by survey respondents, such as daily tick checks, showering soon after coming indoors from tick habitat and use of permethrin-treated clothing, should be encouraged.

Future prospective studies are needed to better characterize experiences with ticks, tick bites and LD for U.S. Hispanic populations living in high LDI areas to contribute to informed public health action and address these highlighted racial and ethnic disparities.

ACKNOWLEDGEMENTS

The authors thank Anna Perea from the Centers for Disease Control and Prevention (CDC) for her work that contributed to the development of this article including creation of Figure 1.

CONFLICT OF INTERESTS

The authors have no conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are subject to licensing from Porter Novelli Public Services, Inc. Restrictions apply to the availability of these data, which were used under license for this study

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How to cite this article: Beck A, Solomon J, Hinckley AF, Nelson CA. Tick bite frequency, prevention practices and Lyme disease diagnoses among U.S. Hispanic survey respondents. *Zoonoses Public Health*. 2021;00:1–8. <https://doi.org/10.1111/zph.12864>