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## Risk Perceptions Regarding Tuberculosis Among Hispanic Adults — United States, 2020–2022

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### Abstract

**Purpose:** Risk perception for tuberculosis (TB) and previous receipt of a TB test and/or vaccine were assessed to inform TB prevention efforts.

**Design:** Cross-sectional.

**Setting:** The 2020, 2021, and 2022 *Estilos* survey data.

**Subjects:** 2837 U.S. Hispanic adults (≥18 years).

**Measures:** Self-reported receipt of a TB test and/or vaccine, perceived risk for TB, and demographic characteristics.

**Analysis:** Weighted proportions and 95% Confidence Intervals (CIs) were calculated.

Associations between demographic characteristics and TB questions were assessed using chi-square tests. Multinomial logistic regression was used to examine perceived risk for TB among those who received a TB test and/or vaccine vs those who did not.

**Results:** Overall, 7.2% (95%CI [4.8, 10.5]) of U.S. Hispanic adults reported receiving a TB test but not a vaccine, 15.3% (95%CI [12.5, 18.7]) reported receiving a vaccine but not a test, and 28.3% (95%CI [24.7, 32.2]) reported receiving both a TB test and TB vaccine. Respondents who

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#### Author Contributions

EC contributed to conceptualization, formal analysis, methodology, and writing – original draft. JMM contributed to conceptualization, methodology, and writing – review & editing. AM, BB, and ND contributed to conceptualization and writing – review & editing.

#### Ethical Considerations

CDC licensed *Estilos* survey data from Porter Novelli. No personal identifiers were included in the data files provided to CDC. This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy (See eg, 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.).

#### Consent to Participate

Informed online written consent was obtained during the panel recruitment process.

#### Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

#### Disclaimer

The contents of this article do not necessarily represent the official position of the Centers for Disease Control and Prevention.

reported previous receipt of a TB test, with or without previous receipt of a TB vaccine, had a significantly higher odds of feeling any risk for TB than those without previous receipt of a TB test or vaccine (aOR = 2.79, 95% CI = 1.19-6.52 for those tested but not vaccinated; aOR = 1.89, 95% CI = 1.11-3.20 for those both tested and vaccinated).

**Conclusion:** Findings can help inform education and interventions to raise awareness and encourage TB testing for those at risk for TB.

### Keywords

tuberculosis; health promotion; latent tuberculosis infection; risk assessment

### Purpose

Globally, tuberculosis (TB) is among the deadliest infectious diseases.<sup>1</sup> Although the United States has a TB rate below most other countries,<sup>1</sup> annual case counts and incidence rates increased during 2021-2023.<sup>2</sup> Alongside the increases in U.S. TB incidence, disparities in rates by origin of birth, race, and ethnicity persist. U.S. TB rates rose most substantially among individuals born outside of the United States, accounting for 76% of U.S. TB cases in 2023 provisional data, representing an 18% relative increase from 2022.<sup>2</sup> Among non-U.S.-born persons with TB in the United States in 2023, the most common country of birth was Mexico and 40% identified as Hispanic.<sup>2</sup> Among U.S.-born persons, provisional 2023 data indicate that TB rates rose from 2022 among Native Hawaiian or other Pacific Islander persons (20%), Black persons (12%), Hispanic persons (11%), and White persons (4%).<sup>2</sup> Regardless of birth origin, in 2022 the percentage of TB cases that occurred in Hispanic or Latino (34%), Black or African American (16%), and Asian (34%) persons was higher than represented by the percentage of these groups in the U.S. population.<sup>3</sup> These disparities are consistent with previous years of TB data.<sup>3</sup> Addressing TB disparities is key to achieving the U.S. TB elimination goal (<1 case per 1 million population by 2035).<sup>4</sup> Disparities in U.S. TB rates are often caused by risk factors that place certain people at higher risk for TB.<sup>5</sup>

Risk for TB is generally due to risk for acquiring TB infection and risk for developing TB disease. Risk factors for acquiring TB infection include contact with someone who has infectious TB disease, work or residency in congregate settings (such as correctional and detention centers, homeless shelters, nursing homes, or other settings), and birth in or frequent travel to countries with high TB incidence.<sup>6</sup> Risk factors for TB disease include recent infection with TB bacteria and having a medical condition or taking medication that weakens the immune system.<sup>6</sup> Medical conditions that confer increased risk for TB disease include HIV infection, diabetes, kidney disease, liver disease, renal failure, solid organ transplant, and substance misuse (specifically, injection drug use) disorder.<sup>6</sup> Young children are also at risk for progression to TB disease due to immature cell-mediated immunity.

Many people who are at risk for TB may not know it, given reports of low levels of knowledge of TB and low perceived risk of TB among U.S. adults.<sup>7,8</sup> Additionally, previous research suggests that risk perceptions for TB may be influenced by prior Bacille Calmette-Guérin (BCG) TB vaccination.<sup>9</sup> The BCG TB vaccine is not widely used in the United States but is often given to infants and small children in many countries where

TB is common. BCG immunization is thought to decrease the risk of severe, disseminated TB in young children, but is not thought to prevent TB disease in the lungs, the most common manifestation in the United States.<sup>10</sup> Adults who received the BCG vaccine might incorrectly believe they are immune to pulmonary TB.

Risk perception is an important contributor to health behavior.<sup>11</sup> Several health behavior theories incorporate aspects of risk perception, including (but not limited to) the Health Belief Model, Social Cognitive Theory, and the Transtheoretical Model.<sup>12</sup> The Health Belief Model has been used widely in TB work since its development when it was used to examine TB preventative behaviors in the early 1950s.<sup>13-16</sup> The model's constructs include perceived susceptibility, perceived severity, benefits to action, barriers to action, cues to action, and self-efficacy.<sup>17,18</sup> Risk perception is aligned with the construct of perceived susceptibility, or a person's subjective perception of the risk of acquiring an illness or disease. Previous research suggests that individuals' risk perceptions of TB differ by acculturation level.<sup>19</sup>

The Centers for Disease Control and Prevention (CDC) conducts education, communication, and community outreach to encourage those at risk for TB to ask their doctor about TB testing and treatment. Continual assessment of TB-related perceptions and preventative care is important to have updated information on trends. The primary objective was to assess risk perception for TB and previous receipt of a TB test and/or vaccine among Hispanic adults in the United States to inform future TB prevention efforts.

## Methods

### Design

Data from the 2020, 2021, and 2022 Porter Novelli Estilos survey were used for this analysis. Estilos is a cross-sectional survey of U.S. Hispanic adults ages 18 or older administered by Offerwise through its QueOpinias panel. Estilos survey respondents were recruited through English and Spanish network television. Estilos surveyed 1000 consumers each year with caps on age, language, acculturation level, region, gender, and heritage to prevent unbalanced results. The survey was available in English and Spanish. The survey was sent to 2524 individuals in 2020 with a 40% response rate, to 2669 individuals in 2021 with a 37% response rate, and to 2884 individuals in 2022 with a 35% response rate. The median time to complete the survey was 21, 19, and 18 minutes in 2020, 2021, and 2022. Respondents were not required to answer any of the questions and could end the survey at any time. Respondents who completed the survey received cash-equivalent reward points worth approximately \$15.<sup>20</sup>

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<sup>1</sup>See eg, 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.

## Sample

For analysis, data from the three survey years were combined by retaining variables that were consistent between the years and respondents' most recent year of data if they participated in more than 1 year. The resulting dataset was weighted based on eight factors: gender, age, household income, household size, education, census region, country of origin, and acculturation. The 2022 U.S. Census American Community Survey (ACS) was used for proportions of all factors except for acculturation, which is not captured in the ACS. Acculturation was measured based on years living in the U.S., language spoken at home, cultural self-identification, and use of Spanish language media. Response options for each of the acculturation variables were assigned points which were summed to create an overall acculturation level. Proportions were set to match the Offerwise panel composition (25% low, 50% medium and 25% high).<sup>20</sup> Porter Novelli provided a variable with weights in the dataset that was used for analyses. Data from 2837 Estilos respondents were analyzed.

## Measures

Respondents were asked two questions about TB. Previous receipt of a TB test and/or vaccine was determined by the question: "Have you ever been tested or vaccinated for Tuberculosis (TB)?" Respondents were asked to select one of the following: not tested and not vaccinated; yes tested, but not vaccinated; not tested, but yes vaccinated; yes, both tested and vaccinated; not sure; and prefer not to answer. Perceived risk for TB was determined by the question: "What are your chances of getting Tuberculosis (TB)?" Respondents were asked to select one of the following: high risk; medium risk; low risk; no risk; already had tuberculosis (TB); or not sure. This question was modeled after a previous survey about TB risk perceptions.<sup>8</sup> Responses of high, medium, and low risk were grouped into the category of any risk for some analyses.

Demographic variables included in the analyses were age, gender, education level, annual household income, U.S. Census Bureau region of residence, and acculturation. Age groups were 18-34 years, 35-54 years, and 55 years and over. Gender was categorized as male or female. Education levels included less than high school, high school, some college, and bachelor degree or higher. Annual household income was grouped as ≤\$24,999, \$25,000-39,999, \$40,000-59,999, and \$60,000 or more. U.S. Census Bureau regions were defined as Northeast, Midwest, South, and West.<sup>21</sup>

Demographic variables of specific relevance to TB were also included in the analyses. These included having/had diabetes, determined by the question: "During the past year, have you had (or do you currently have) any of these health conditions?" Respondents were instructed to select or not select options including diabetes. A variable was created to identify if participants reported Hispanic heritage aligned with any of the top 30 countries of birth among non-U.S.-born persons diagnosed with TB in the United States from 2020-2022.<sup>21</sup> This was determined by the question: "When thinking of your Hispanic heritage, what do you consider yourself?" with instructions to choose from a list of country identifiers (eg, Mexican, Peruvian, Guatemalan) (hereinafter, "Hispanic heritage").<sup>22</sup>

## Analysis

Weighted proportions and 95% confidence intervals (CIs) were calculated for demographic and TB variables. Bivariate associations between demographic characteristics and responses to TB variables were assessed using the second-order Rao-Scott correction to the Pearson's chi-square test. Associations were considered statistically significant with  $P$ -values  $< 0.05$ . Multinomial logistic regression analysis was used to calculate adjusted odds ratios (aORs) and 95% CIs to examine perceived risk for TB among those who received a TB test and/or vaccine vs those who did not. Those who reported being not tested and not vaccinated were the reference group. The model controlled for age, gender, education level, annual household income, Census Bureau Region of residence, acculturation, having/had diabetes, and Hispanic heritage. Multicollinearity among control variables was assessed prior to analyses. Analyses were conducted in R (version 4.3.0) within RStudio (version 2023.6.0.421) using the Survey and svyVGAM packages to account for complex sample weights.<sup>23,24</sup> Subpopulation analyses were performed by taking a subset of the survey design object while keeping all records in the dataset.

## Results

Table 1 presents demographic characteristics of the sample. Overall (unweighted  $n = 2837$ ), 17.4% of U.S. Hispanic adults reported never receiving a TB test or vaccine, 7.2% received a test but not a vaccine, 15.3% received a vaccine but not a test, and 28.3% received both, while 28.6% were not sure, and 3.2% preferred not to answer the question (Table 2). Responses differed by age group ( $P = 0.002$ ), education level ( $P = 0.023$ ), annual household income ( $P = 0.011$ ), acculturation level ( $P = 0.004$ ), and Hispanic heritage ( $P = 0.040$ ). Receipt of both a TB test and vaccine was reported by 42.4% of respondents ages 55 years and over, by 26.8% of those 35-54 years, and by 20.8% of those 18-34 years. Being unsure of previous receipt of a TB test and/or vaccine was reported by 33.0% of those with less than a high school education, 36.3% of those with a high school education, 23.6% of those with some college education, and 17.5% of those with a bachelor degree or higher. No previous receipt of a TB test or vaccine was reported by 22.0% of respondents categorized as unacculturated, by 19.0% of respondents categorized as bicultural, and by 9.7% of those categorized as acculturated. Compared with their counterparts, respondents with Hispanic heritage from one of the top 30 countries of birth reported for non-U.S.-born persons diagnosed with TB in the United States from 2020-2022 had a slightly lower percentage reporting no receipt of either a TB test or vaccine (16.4% compared with 21.6%) and slightly higher percentage reporting receipt of a test alone (7.5% compared with 5.7%), vaccine alone (16.6% compared with 10.1%), and both a test and vaccine (29.3% compared with 24.2%).

Regarding risk perceptions for getting TB among U.S. Hispanic adults who did not have TB before (unweighted  $n = 2796$ ), 19.5% reported feeling any risk (low, medium, or high risk), 42.6% reported no risk, and 38.0% were not sure (Table 3). Responses differed by education level ( $P = 0.004$ ), annual household income ( $P = 0.048$ ), having/had diabetes ( $P = 0.031$ ), and Hispanic heritage ( $P = 0.001$ ). No risk for TB was reported by 36.0% of those with a less than high school education, 40.4% of those with a high school education,

44.4% of those with some college education, and 52.1% of those with a bachelor degree or higher. Feeling any risk for TB was reported by 14.1% of those with an annual household income  $\leq$ \$24,999, 14.7% of those with an annual household income of \$25,000-39,999, 17.2% with an annual household income of \$40,000-59,999, and 23.6% of those with an annual household income of \$60,000 or more. Thirty one percent of respondents who have/had diabetes in the past year reported any risk for TB, while 18.0% of those who did not report any risk. Respondents with Hispanic heritage from a country among the top 30 countries of birth reported for non-U.S.-born persons diagnosed with TB in the United States from 2020-2022 less frequently reported any risk or no risk than their counterparts (17.8% compared with 26.7% reporting any risk; 41.2% compared with 48.0% reporting no risk), and more often were unsure of their risk level (41.0% compared with 25.3%). Among U.S. Hispanic adults who reported feeling any risk for TB (unweighted  $n = 493$ ), 80.9% reported feeling low risk, 13.4% medium risk, and 5.7% high risk (Figure 1).

After controlling for demographic variables (age, gender, education level, annual household income, U.S. Census Bureau region of residence, acculturation, having/had diabetes, and Hispanic heritage), respondents who reported previous receipt of a TB test, either with or without previous receipt of a TB vaccine, had a significantly higher odds of feeling any risk for TB than those without previous receipt of a TB test or vaccine (aOR = 2.79, 95% CI = 1.19-6.52 for those tested but not vaccinated; aOR = 1.89, 95% CI = 1.11-3.20 for those both tested and vaccinated) (Table 4). Respondents who reported just having a TB vaccine did not have significantly different odds of reporting feeling any TB risk than those without previous receipt of a TB test or vaccine (aOR = 1.72, 95% CI = 0.90-3.29).

## Discussion

Among Hispanic adults residing in the United States, 7.2% reported receiving only a TB test, and just over one quarter (28.3%) reported receiving both a TB test and TB vaccine. CDC and the United States Preventive Services Task Force recommend health care providers test persons at increased risk for TB infection as part of routine health care.<sup>25,26</sup> While not all Hispanic persons are at risk for TB, incidence rates are disproportionately high among Hispanic persons in the United States. An interaction between risk factors for infection, such as birth in countries with higher TB prevalence than the United States, and risk factors for progression, such as diabetes, could contribute to incidence rates.<sup>27,28</sup> Along with promptly diagnosing and treating TB infection, treating risk factors for TB, such as diabetes, might help reduce the burden of TB among Hispanic persons in the United States.

About one third (31.0%) of U.S. Hispanic adults who have/had diabetes in the past year felt any perceived risk for TB. Globally among persons living with diabetes who acquire TB infection and do not take prophylactic treatment, the risk of developing TB disease is approximately 30% over a lifetime, or 3 times higher than among individuals with TB infection alone.<sup>29</sup> Intervention, education, or communications tailored for persons with diabetes who have TB infection to facilitate timely treatment may help prevent development of TB disease. Additional efforts to engage with those at increased risk for TB could include education for individuals born in a high TB incidence country to help increase knowledge of risk for having TB infection, and could be integrated with diabetes management programs.

These findings can also help inform tailoring of current work CDC is doing to increase awareness of risk for TB such as the Think. Test. Treat. TB communications campaign and community engagement efforts through the TB Elimination Alliance.<sup>30,31</sup>

The perception of any TB risk was 19.5% among U.S. Hispanic adults, somewhat higher than previous reports of perceived risk for TB among U.S. adults overall.<sup>7,8</sup> Perception of low TB risk has been documented as a reason why people decline TB testing and treatment and is a topic for health care providers to address when recommending TB testing and treatment.<sup>9</sup> One possible reason for the increased odds of feeling any TB risk among those with a TB test could be effective communication between health care providers and patients, leading to TB test administration, or persons who believe they might be at risk for TB asking for a test. Further research could explore this, as the cross-sectional nature of this analysis cannot determine directionality or causality. Additionally, those with only a TB vaccine did not have significantly different odds of TB risk perceptions than those without a TB test or vaccine. Results may have been impacted by confusion around the difference between a TB test and vaccine, which has been previously reported.<sup>16</sup> However, further investigation is needed, as knowledge of the difference between a TB test and TB vaccine was not assessed, and other factors may contribute to this such as the BCG vaccine typically being administered during infancy.

Risk perception is documented in TB literature as an important contributor to TB preventative health behaviors as 1 of 6 constructs of the Health Belief Model.<sup>13-16</sup> Reported findings only represent a piece of this larger model, and other factors are also important in determining health behavior. For instance, a study of Hispanic adults in Utah found that in addition to knowledge and perception of TB, practical barriers to health care such as transportation and cost were cited as reasons why participants would not engage in TB prevention behaviors.<sup>32</sup> Further, social inequities drive many risk factors that lead to disparate TB rates,<sup>33</sup> and beyond individual-level health behaviors, factors at the interpersonal, community, and societal levels are also critical in shaping health outcomes.<sup>18</sup> These include structural barriers to TB preventative care, such as access to health care, which could be examined in future work as an avenue to improve health outcomes.

These findings are subject to several limitations. First, surveys rely on self-reported data which is susceptible to recall and social desirability biases. Respondents may have over- or under-estimated their previous TB testing and vaccination behaviors. Second, while the survey is weighted to be nationally representative, participants may differ from the general U.S. Hispanic population due to the online panel recruitment method and the need to use an electronic device with internet access. Additionally, not all risk factors for TB were available to include in analyses, and respondents' risk perceptions may be influenced by factors not captured here. This includes country of birth, as Hispanic heritage is not a direct measure of country of birth. Further, a study was not conducted to validate measures prior, although perceptions of risk were asked about using language from a previous survey. Finally, closed-ended questions did not allow for nuance in response. Despite these limitations, findings provide valuable insights to inform future TB prevention work.

This report provides a nationally representative analysis of reported previous receipt of a TB test and/or TB vaccine, and TB risk perceptions among U.S. Hispanic adults. Findings suggest that there is a need for education and intervention for those at risk for TB. Future research could expand on these analyses by employing an intersectional approach to examining demographic characteristics and investigating subgroup differences in more detail. Further efforts are needed to reduce disparities in U.S. TB rates and progress toward the U.S. TB elimination goal.

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## Data Availability Statement

The data that support the findings of this study are available from Porter Novelli but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Porter Novelli.

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### So What?

**What is already known on this topic?**

Risk perception is an important contributor to health behavior. Although the United States has a TB rate below most other countries, annual case counts and incidence rates increased during 2021-2023.

**What does this article add?**

This analysis provides an overview of reported receipt of a TB test and/or TB vaccine, and TB risk perceptions among U.S. Hispanic adults. Respondents who reported previous receipt of a TB test, with or without previous receipt of a TB vaccine, had a significantly higher odds of feeling any risk for TB than those without previous receipt of a TB test or vaccine.

**What are the implications for health promotion practice or research?**

Education and interventions to raise awareness of risk could help encourage TB testing for those at risk for TB. Routine healthcare that includes education about TB for those with increased risk may help address perceptions of risk.

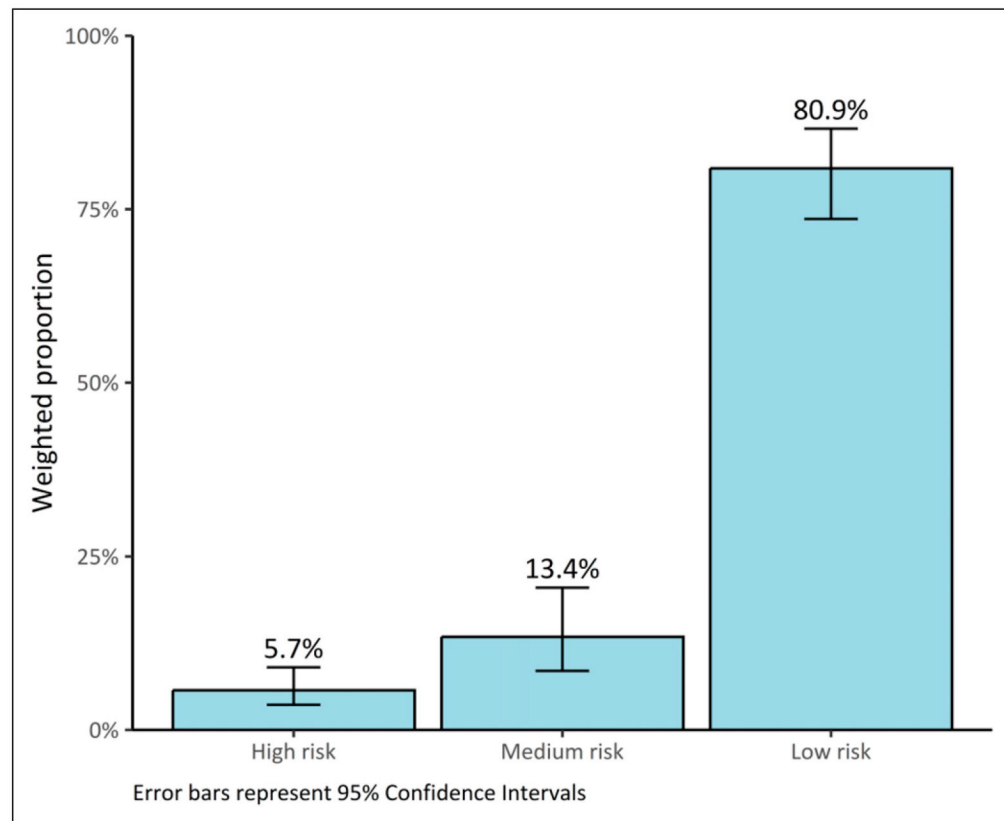


**Figure 1.**  
Levels of Risk for TB Reported by U.S. Hispanic Adults Who Felt Any Level of Risk and did Not Previously Have TB (Unweighted  $N = 493$ )

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**Table 1.**  
Descriptive Characteristics of Sample (*N* = 2837) — Porter Novelli Estilos Survey, United States, 2020–2022

| Characteristic                              | Unweighted No. | Weighted % (95% CI) |
|---------------------------------------------|----------------|---------------------|
| Age group (years)                           |                |                     |
| 18–34                                       | 1197           | 38.1 (34.4–41.9)    |
| 35–54                                       | 1245           | 37.8 (34.0–41.7)    |
| 55 and over                                 | 395            | 24.2 (20.2–28.7)    |
| Gender                                      |                |                     |
| Male                                        | 1278           | 49.9 (45.8–54.0)    |
| Female                                      | 1559           | 50.1 (46.0–54.2)    |
| Education level                             |                |                     |
| Less than high school                       | 614            | 27.6 (24.0–31.6)    |
| High school                                 | 775            | 28.1 (24.6–31.9)    |
| Some college                                | 661            | 24.6 (21.0–28.7)    |
| Bachelor degree or higher                   | 787            | 19.7 (17.1–22.5)    |
| Annual household income                     |                |                     |
| Less than \$25K                             | 1395           | 19.1 (17.2–21.2)    |
| \$25–39K                                    | 519            | 13.6 (11.3–16.2)    |
| \$40–59K                                    | 406            | 16.8 (14.4–19.5)    |
| \$60K or more                               | 517            | 50.5 (46.4–54.6)    |
| U.S. Census Bureau Region <sup>a</sup>      |                |                     |
| Northeast                                   | 504            | 14.2 (11.8–17.0)    |
| Midwest                                     | 250            | 9.6 (7.4–12.3)      |
| South                                       | 1314           | 38.2 (34.6–42.0)    |
| West                                        | 769            | 38.0 (33.8–42.4)    |
| Acculturation <sup>b</sup>                  |                |                     |
| Unacculturated                              | 1245           | 25.0 (22.2–28.0)    |
| Bicultural                                  | 1321           | 50.0 (45.9–54.1)    |
| Acculturated                                | 271            | 25.0 (20.7–29.8)    |
| Have/had diabetes in past year <sup>c</sup> |                |                     |
| Yes                                         | 266            | 11.3 (8.9–14.1)     |

| Characteristic                                                                                                                                                                        | Unweighted No. | Weighted % (95% CI) |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------|
| No                                                                                                                                                                                    | 2571           | 88.7 (85.9-91.1)    |
| Hispanic heritage is aligned with a country among the top 30 countries of birth reported for non-U.S.-born persons diagnosed with TB in the United States from 2020-2022 <sup>d</sup> |                |                     |
| Yes <sup>e</sup>                                                                                                                                                                      | 2068           | 80.9 (78.1-83.4)    |
| No                                                                                                                                                                                    | 769            | 19.1 (16.6-21.9)    |

CI, confidence interval.

<sup>a</sup> [https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us\\_regdiv.pdf](https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf).

<sup>b</sup> Based on years living in the United States, language spoken at home, cultural self-identification, and use of Spanish language media.

<sup>c</sup> Determined by the question: “During the past year, have you had (or do you currently have) any of these health conditions?”

<sup>d</sup> Determined by the question: “When thinking of your Hispanic heritage, what do you consider yourself?”

<sup>e</sup> <https://www.cdc.gov/tb/statistics/reports/2022/table9.htm>.

Table 2.

Previous Receipt of a TB Test and/or Vaccine Reported by U.S. Hispanic Adults, by Characteristic ( $N = 2837$ ) — Porter Novelli Estilos Survey, United States, 2020-2022

| Characteristic                         | Not tested and not vaccinated (unweighted $N = 523$ , weighted row % (95%CI)) | Yes tested, but not vaccinated (unweighted $N = 171$ , weighted row % (95%CI)) | Not tested, but yes vaccinated (unweighted $N = 368$ , weighted row % (95%CI)) | Yes, both tested and vaccinated (unweighted $N = 792$ , weighted row % (95%CI)) | Not sure (unweighted $N = 829$ , weighted row % (95%CI)) | Prefer not to answer (unweighted $N = 154$ , weighted row % (95%CI)) | P-value <sup>d</sup> |
|----------------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------------------|----------------------|
| Total                                  | 17.4 (14.7-20.5)                                                              | 7.2 (4.8-10.5)                                                                 | 15.3 (12.5-18.7)                                                               | 28.3 (24.7-32.2)                                                                | 28.6 (25.1-32.2)                                         | 3.2 (2.4-4.4)                                                        | N/A                  |
| Age group (years)                      |                                                                               |                                                                                |                                                                                |                                                                                 |                                                          |                                                                      |                      |
| 18-34                                  | 19.7 (15.9-24.0)                                                              | 6.9 (4.3-11.0)                                                                 | 19.4 (14.5-25.6)                                                               | 20.8 (17.3-24.8)                                                                | 28.7 (24.1-33.9)                                         | 4.4 (2.7-7.0)                                                        | 0.002 *              |
| 35-54                                  | 15.6 (12.1-19.8)                                                              | 9.2 (4.6-17.7)                                                                 | 14.1 (10.3-18.9)                                                               | 26.8 (22.5-31.6)                                                                | 30.5 (24.9-36.7)                                         | 3.9 (2.7-5.6)                                                        |                      |
| 55 and over                            | 16.8 (10.0-26.8)                                                              | 4.3 (2.5-7.3)                                                                  | 10.9 (6.0-18.9)                                                                | 42.4 (31.9-53.6)                                                                | 25.2 (17.8-34.5)                                         | 0.4 (0.2-0.9)                                                        |                      |
| Gender                                 |                                                                               |                                                                                |                                                                                |                                                                                 |                                                          |                                                                      |                      |
| Male                                   | 20.4 (16.6-24.9)                                                              | 7.9 (4.2-14.5)                                                                 | 11.2 (8.3-14.9)                                                                | 27.5 (21.9-33.8)                                                                | 30.0 (24.7-35.9)                                         | 3.0 (2.1-4.4)                                                        | 0.067                |
| Female                                 | 14.4 (10.7-19.2)                                                              | 6.5 (4.4-9.5)                                                                  | 19.5 (14.9-25.1)                                                               | 29.1 (24.8-33.8)                                                                | 27.1 (23.0-31.7)                                         | 3.4 (2.1-5.5)                                                        |                      |
| Education level                        |                                                                               |                                                                                |                                                                                |                                                                                 |                                                          |                                                                      |                      |
| Less than high school                  | 15.3 (11.0-20.9)                                                              | 5.3 (3.4-8.1)                                                                  | 13.9 (8.7-21.4)                                                                | 27.7 (19.6-37.5)                                                                | 33.0 (26.4-40.4)                                         | 4.8 (3.3-6.9)                                                        | 0.023 *              |
| High school                            | 18.6 (13.3-25.3)                                                              | 5.1 (3.0-8.6)                                                                  | 13.3 (8.2-20.8)                                                                | 23.7 (18.5-29.8)                                                                | 36.3 (29.2-43.9)                                         | 3.0 (1.7-5.3)                                                        |                      |
| Some college                           | 15.0 (10.4-21.2)                                                              | 12.1 (5.2-25.7)                                                                | 16.9 (11.2-24.7)                                                               | 29.2 (21.8-37.8)                                                                | 23.6 (17.3-31.2)                                         | 3.2 (1.3-7.7)                                                        |                      |
| Bachelor degree or higher              | 21.7 (15.5-29.5)                                                              | 6.6 (4.1-10.4)                                                                 | 18.3 (13.5-24.2)                                                               | 34.6 (28.9-40.7)                                                                | 17.5 (12.2-24.4)                                         | 1.4 (0.7-2.5)                                                        |                      |
| Annual household income                |                                                                               |                                                                                |                                                                                |                                                                                 |                                                          |                                                                      |                      |
| Less than \$25K                        | 18.9 (16.1-22.1)                                                              | 6.7 (4.8-9.2)                                                                  | 11.5 (9.3-14.2)                                                                | 23.1 (19.9-26.7)                                                                | 33.2 (29.5-37.1)                                         | 6.6 (4.9-8.8)                                                        | 0.011 *              |
| \$25-39K                               | 8.4 (5.9-11.8)                                                                | 6.3 (4.0-9.8)                                                                  | 19.6 (11.2-32.1)                                                               | 30.6 (22.4-40.2)                                                                | 29.8 (23.0-37.6)                                         | 5.4 (3.5-8.1)                                                        |                      |
| \$40-59K                               | 16.0 (9.6-25.4)                                                               | 9.6 (6.0-15.0)                                                                 | 8.9 (6.0-13.0)                                                                 | 33.9 (26.9-41.8)                                                                | 29.5 (23.6-36.3)                                         | 2.1 (1.0-4.4)                                                        |                      |
| \$60K or more                          | 19.8 (15.3-25.3)                                                              | 6.8 (3.1-14.2)                                                                 | 17.8 (13.1-23.6)                                                               | 27.8 (21.8-34.6)                                                                | 26.1 (20.3-32.9)                                         | 1.8 (0.7-4.3)                                                        |                      |
| U.S. Census Bureau Region <sup>b</sup> |                                                                               |                                                                                |                                                                                |                                                                                 |                                                          |                                                                      |                      |
| Northeast                              | 22.9 (14.6-34.1)                                                              | 5.9 (3.1-11.0)                                                                 | 11.0 (6.0-19.1)                                                                | 23.2 (16.7-31.2)                                                                | 33.2 (25.2-42.3)                                         | 3.8 (2.0-7.4)                                                        | 0.466                |
| Midwest                                | 18.3 (8.7-34.7)                                                               | 3.3 (1.4-7.5)                                                                  | 15.3 (8.0-27.5)                                                                | 28.9 (19.5-40.6)                                                                | 30.0 (19.2-43.5)                                         | 4.2 (2.0-8.5)                                                        |                      |
| South                                  | 18.5 (15.1-22.6)                                                              | 5.7 (3.9-8.3)                                                                  | 17.5 (12.9-23.2)                                                               | 27.8 (23.1-32.9)                                                                | 26.9 (22.9-31.4)                                         | 3.6 (2.6-5.1)                                                        |                      |
| West                                   | 14.0 (10.2-18.9)                                                              | 10.1 (5.1-19.0)                                                                | 14.8 (10.2-21.1)                                                               | 30.6 (23.6-38.6)                                                                | 28.1 (21.6-35.6)                                         | 2.4 (1.1-5.2)                                                        |                      |
| Acculturation <sup>c</sup>             |                                                                               |                                                                                |                                                                                |                                                                                 |                                                          |                                                                      |                      |

| Characteristic                                                                                                                                                                        | Not tested and not vaccinated (unweighted N = 523), weighted row % (95% CI) | Yes tested, but not vaccinated (unweighted N = 171), weighted row % (95% CI) | Not tested, but yes vaccinated (unweighted N = 368), weighted row % (95% CI) | Yes, both tested and vaccinated (unweighted N = 792), weighted row % (95% CI) | Not sure (unweighted N = 829), weighted row % (95% CI) | Prefer not to answer (unweighted N = 154), weighted row % (95% CI) | P-value <sup>d</sup> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------------------|----------------------|
| Unacculturated                                                                                                                                                                        | 22.0 (17.8-26.8)                                                            | 3.0 (2.0-4.6)                                                                | 12.8 (9.4-17.4)                                                              | 25.2 (19.9-31.4)                                                              | 32.7 (27.9-37.9)                                       | 4.2 (3.1-5.7)                                                      | 0.004 *              |
| Bicultural                                                                                                                                                                            | 19.0 (14.8-24.0)                                                            | 6.2 (4.4-8.7)                                                                | 13.1 (9.9-17.2)                                                              | 29.8 (25.7-34.3)                                                              | 28.9 (24.3-34.1)                                       | 2.9 (2.1-4.1)                                                      |                      |
| Acculturated                                                                                                                                                                          | 9.7 (6.0-15.5)                                                              | 13.2 (6.1-26.4)                                                              | 22.3 (14.3-32.9)                                                             | 28.3 (18.7-40.4)                                                              | 23.6 (15.9-33.6)                                       | 2.9 (1.0-8.2)                                                      |                      |
| Have/had diabetes in past year <sup>d</sup>                                                                                                                                           |                                                                             |                                                                              |                                                                              |                                                                               |                                                        |                                                                    |                      |
| Yes                                                                                                                                                                                   | 19.6 (12.8-28.6)                                                            | 6.1 (3.3-11.0)                                                               | 13.6 (7.2-24.0)                                                              | 31.2 (20.9-43.6)                                                              | 28.7 (17.8-42.8)                                       | 1.0 (0.4-2.0)                                                      | 0.723                |
| No                                                                                                                                                                                    | 17.2 (14.2-20.5)                                                            | 7.3 (4.8-11.1)                                                               | 15.6 (12.5-19.2)                                                             | 27.9 (24.2-32.0)                                                              | 28.5 (25.0-32.4)                                       | 3.5 (2.6-4.8)                                                      |                      |
| Hispanic heritage is aligned with a country among the top 30 countries of birth reported for non-U.S.-born persons diagnosed with TB in the United States from 2020-2022 <sup>e</sup> |                                                                             |                                                                              |                                                                              |                                                                               |                                                        |                                                                    |                      |
| Yes <sup>f</sup>                                                                                                                                                                      | 16.4 (13.3-20.0)                                                            | 7.5 (4.8-11.6)                                                               | 16.6 (13.1-20.7)                                                             | 29.3 (25.0-33.9)                                                              | 27.2 (23.5-31.3)                                       | 3.0 (2.1-4.3)                                                      | 0.040 *              |
| No                                                                                                                                                                                    | 21.6 (16.5-27.8)                                                            | 5.7 (3.5-9.4)                                                                | 10.1 (7.4-13.7)                                                              | 24.2 (19.4-29.8)                                                              | 34.2 (26.8-42.4)                                       | 4.1 (2.3-7.1)                                                      |                      |

TB, tuberculosis; CI, confidence interval.

\* Value is statistically significant at  $P < 0.05$ .

<sup>a</sup> Associations between characteristics and response to TB variable were calculated using the second-order Rao-Scott correction to the Pearson's chi-square test.

<sup>b</sup> [https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us\\_regdiv.pdf](https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf).

<sup>c</sup> Based on years living in the United States, language spoken at home, cultural self-identification, and use of Spanish language media.

<sup>d</sup> Determined by the question: "During the past year, have you had (or do you currently have) any of these health conditions?"

<sup>e</sup> Determined by the question: "When thinking of your Hispanic heritage, what do you consider yourself?"

<sup>f</sup> <https://www.cdc.gov/tb/statistics/reports/2022/table9.htm>.

**Table 3.**

Risk Perceptions for TB Among U.S. Hispanic Adults Who Have Not had TB before, by Characteristic (Unweighted  $N = 2796$ ) — Porter Novelli Estilos Survey, United States, 2020–2022

| Characteristic                         | Any risk (unweighted $N = 493$ ),<br>weighted row % (95%CI) <sup>a</sup> | No risk (unweighted $N = 1260$ ),<br>weighted row % (95%CI) | Not sure (unweighted $N = 1043$ ),<br>weighted row % (95%CI) | P-value <sup>b</sup> |
|----------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------------|----------------------|
| Total                                  | 19.5 (16.4–23.1)                                                         | 42.6 (38.6–46.6)                                            | 38.0 (34.0–42.1)                                             | N/A                  |
| Age group (years)                      |                                                                          |                                                             |                                                              |                      |
| 18–34                                  | 20.3 (16.2–25.1)                                                         | 41.6 (36.1–47.2)                                            | 38.2 (32.8–43.8)                                             | 0.782                |
| 35–54                                  | 17.1 (13.5–21.4)                                                         | 43.1 (37.0–49.3)                                            | 39.8 (33.6–46.5)                                             |                      |
| 55 and over                            | 22.1 (13.5–34.0)                                                         | 43.4 (33.3–54.0)                                            | 34.6 (25.0–45.6)                                             |                      |
| Gender                                 |                                                                          |                                                             |                                                              |                      |
| Male                                   | 21.4 (16.5–27.3)                                                         | 42.2 (36.4–48.3)                                            | 36.4 (30.4–42.8)                                             | 0.501                |
| Female                                 | 17.6 (14.0–21.9)                                                         | 42.9 (37.6–48.3)                                            | 39.5 (34.3–44.9)                                             |                      |
| Education level                        |                                                                          |                                                             |                                                              |                      |
| Less than high school                  | 21.4 (13.8–31.7)                                                         | 36.0 (28.8–43.9)                                            | 42.6 (34.8–50.7)                                             | 0.004 <sup>*</sup>   |
| High school                            | 15.2 (10.6–21.3)                                                         | 40.4 (33.4–47.9)                                            | 44.4 (37.1–52.0)                                             |                      |
| Some college                           | 16.9 (12.2–23.1)                                                         | 44.4 (35.4–53.9)                                            | 38.6 (29.5–48.6)                                             |                      |
| Bachelor degree or higher              | 26.2 (21.2–31.9)                                                         | 52.1 (45.0–59.1)                                            | 21.8 (15.8–29.2)                                             |                      |
| Annual household income                |                                                                          |                                                             |                                                              |                      |
| Less than \$25K                        | 14.1 (11.6–17.0)                                                         | 41.1 (37.2–45.1)                                            | 44.8 (40.9–48.8)                                             | 0.048 <sup>*</sup>   |
| \$25–39K                               | 14.7 (9.9–21.2)                                                          | 44.6 (35.2–54.4)                                            | 40.8 (31.7–50.5)                                             |                      |
| \$40–59K                               | 17.2 (12.6–23.1)                                                         | 42.2 (35.3–49.5)                                            | 40.6 (33.0–48.7)                                             |                      |
| \$60K or more                          | 23.6 (18.1–30.3)                                                         | 42.7 (35.9–49.8)                                            | 33.7 (27.0–41.2)                                             |                      |
| U.S. Census Bureau Region <sup>c</sup> |                                                                          |                                                             |                                                              |                      |
| Northeast                              | 13.2 (9.3–18.3)                                                          | 53.6 (44.2–62.7)                                            | 33.3 (25.4–42.3)                                             | 0.321                |
| Midwest                                | 24.7 (14.4–38.9)                                                         | 35.5 (25.2–47.2)                                            | 39.9 (27.0–54.3)                                             |                      |
| South                                  | 19.3 (15.4–23.8)                                                         | 42.6 (37.5–47.9)                                            | 38.1 (33.1–43.4)                                             |                      |
| West                                   | 20.8 (14.7–28.4)                                                         | 40.2 (32.7–48.2)                                            | 39.0 (31.3–47.3)                                             |                      |
| Acculturation <sup>d</sup>             |                                                                          |                                                             |                                                              |                      |
| Unacculturated                         | 14.7 (11.5–18.6)                                                         | 41.9 (36.6–47.4)                                            | 43.4 (37.7–49.4)                                             | 0.261                |
| Bicultural                             | 21.9 (17.8–26.5)                                                         | 44.5 (39.4–49.7)                                            | 33.6 (28.9–38.7)                                             |                      |

| Characteristic                                                                                                                                                                        | Any risk (unweighted $N = 493$ , weighted row % (95%CI) <sup>d</sup> | No risk (unweighted $N = 1260$ , weighted row % (95%CI) | Not sure (unweighted $N = 1043$ , weighted row % (95%CI) | P-value <sup>b</sup> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------|----------------------|
| Acculturated                                                                                                                                                                          | 19.6 (11.6-31.2)                                                     | 39.3 (28.9-50.9)                                        | 41.1 (30.0-53.1)                                         |                      |
| Have/had diabetes in past year <sup>e</sup>                                                                                                                                           |                                                                      |                                                         |                                                          |                      |
| Yes                                                                                                                                                                                   | 31.0 (20.9-43.3)                                                     | 40.4 (28.5-53.6)                                        | 28.6 (20.0-38.9)                                         | 0.031 *              |
| No                                                                                                                                                                                    | 18.0 (14.8-21.8)                                                     | 42.8 (38.6-47.1)                                        | 39.2 (34.9-43.6)                                         |                      |
| Hispanic heritage is aligned with a country among the top 30 countries of birth reported for non-U.S.-born persons diagnosed with TB in the United States from 2020-2022 <sup>f</sup> |                                                                      |                                                         |                                                          |                      |
| Yes <sup>g</sup>                                                                                                                                                                      | 17.8 (14.2-21.9)                                                     | 41.2 (36.7-45.9)                                        | 41.0 (36.3-45.9)                                         | 0.001 *              |
| No                                                                                                                                                                                    | 26.7 (20.5-33.9)                                                     | 48.0 (40.8-55.3)                                        | 25.3 (20.1-31.2)                                         |                      |

TB, tuberculosis; CI, confidence interval.

\* Value is statistically significant at  $P < 0.05$ .

<sup>a</sup> Response options of high risk, medium risk, and low risk were combined for analysis.

<sup>b</sup> Associations between characteristics and response to TB variable were calculated using the second-order Rao-Scott correction to the Pearson's chi-square test.

<sup>c</sup> [https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us\\_regdiv.pdf](https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf).

<sup>d</sup> Based on years living in the United States, language spoken at home, cultural self-identification, and use of Spanish language media.

<sup>e</sup> Determined by the question: "During the past year, have you had (or do you currently have) any of these health conditions?"

<sup>f</sup> Determined by the question: "When thinking of your Hispanic heritage, what do you consider yourself?"

<sup>g</sup> <https://www.cdc.gov/tb/statistics/reports/2022/table9.htm>.

Adjusted Odds Ratios and 95% Confidence Intervals Comparing Risk Perceptions for TB Among U.S. Hispanic Adults Who Have Not had TB before, by Previous Receipt of a TB Test and/or TB Vaccine (Unweighted *N* = 2796) — Porter Novelli Estilos Survey, United States, 2020-2022

Table 4.

| Previous receipt of a TB test and/or TB vaccine | Level of perceived risk for TB, aOR (95% CI) <sup>a</sup> |                    |
|-------------------------------------------------|-----------------------------------------------------------|--------------------|
|                                                 | Any risk <sup>b</sup>                                     | Not sure           |
| Not tested and not vaccinated                   | Ref                                                       | Ref                |
| Yes tested, but not vaccinated                  | 2.79 (1.19-6.52) *                                        | 1.60 (0.59-4.30)   |
| Not tested, but yes vaccinated                  | 1.72 (0.90-3.29)                                          | 0.91 (0.47-1.73)   |
| Yes, both tested and vaccinated                 | 1.89 (1.11-3.20) *                                        | 0.47 (0.27-0.81) * |
| Not sure                                        | 0.81 (0.42-1.57)                                          | 1.57 (0.96-2.58)   |
| Prefer not to answer                            | 0.11 (0.03-0.37) *                                        | 0.87 (0.39-1.90)   |

TB, tuberculosis; aOR, adjusted Odds Ratio; CI, confidence interval; Ref, reference.

\* Statistical difference at *P* < 0.05 compared with reference group.

<sup>a</sup> aORs and 95% CIs calculated using a multinomial logistic regression model that controlled for: age group, gender, education level, annual household income, U.S. Census Bureau region, acculturation, have/had diabetes in past year, and Hispanic heritage aligned with a country among the top 30 countries of birth reported for non-U.S.-born persons diagnosed with TB in the United States from 2020-2022. The reference group was reporting no perceived risk for TB.

<sup>b</sup> Response options of high risk, medium risk, and low risk were combined for analysis.