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Tuberculosis testing among populations with high HIV risk in Tijuana, Baja California, Mexico

Michele G. Velasquez[1], **Rafael Laniado-Laborin**[2], **Timothy C. Rodwell**[1], **Paris Cerecer**[3], **Remedios Lozada**[4], **Jazmine Cuevas-Mota**[1], **Jose Luis Burgos**[1], and **Richard S. Garfein**[1]

[1]University of California, San Diego, School of Medicine, San Diego, California, United States of America

[2]Universidad Autónoma de Baja California, Tijuana, Baja California, México

[3]Instituto de Servicios de Salud Pública, Baja California, México

[4]Patronato Pro-COMUSIDA, Tijuana, Baja California, Méico

Abstract

Objective—To assess the prevalence of prior tuberculin skin testing (TST) among populations at risk for HIV infection in Tijuana, Mexico, and to identify factors associated with TST.

Methods—Sex workers, injection drug users, noninjecting drug users, and homeless persons ≥ 18 years old were recruited by using targeted sampling for risk assessment interviews and serologic testing for HIV and *Mycobacterium tuberculosis* infection. Univariate and multivariate logistic regression were used to identify correlates of self-reported TST history.

Results—Of 502 participants, 38.0% reported prior TST, which was associated with previous incarceration in the United States of America [odds ratio (OR) = 13.38; 95% confidence interval (CI) = 7.37–24.33] and injection drug use (OR = 1.99; 95% CI = 1.27–3.11). Positive results on serologic tests for *M. tuberculosis* infection (57%) and HIV (4.2%) were not associated with a prior TST.

Conclusions—A history of TST was lower in HIV-positive participants even though TST is indicated for persons with HIV in Mexico. Fewer than half the individuals at high risk for HIV in this study had a history of TST; however, TST was fairly common among those individuals with a prior history of incarceration. Increased tuberculosis screening is needed for populations at risk of contracting HIV in Tijuana, particularly those outside of criminal justice settings.

Keywords

Tuberculosis; tuberculin test; drug users; HIV; Mexico

In 2007, a study was conducted to identify the prevalence and correlates of *Mycobacterium tuberculosis* (MTB) and HIV infection among marginalized populations with high risk for HIV infection in Tijuana, Baja California, Mexico (1). Test results using the QuantiFERON TB Gold in-Tube® (QFT) interferon gamma release assay indicated that 57% of participants overall had latent tuberculosis infection (LTBI). Although the prevalence of HIV was only 4.2%, the self-reported risk behaviors associated with HIV infection were highly prevalent, suggesting that these groups were at risk for HIV/tuberculosis (TB) coinfection.

Send correspondence to: Richard S. Garfein, rgarfein@ucsd.edu.

Individuals with LTBI and HIV coinfection have an annual risk of progressing to active TB disease of 10%, compared with individuals with intact immune systems who have only a 10% lifetime risk of reactivation (2). While an estimated one-third of HIV-infected individuals globally are coinfected with TB, and TB is the leading cause of death among persons with AIDS, only 1% of persons living with HIV/AIDS worldwide have been screened for TB (3). It is therefore critical that individuals infected or at risk for infection with HIV be tested for TB early and often.

A study in the four northern Mexico border states found that TB rates for Mexican-born persons were 5.0 times as high as those for persons born in the United States of America (4). The state of Baja California, Mexico, situated across the border from California, United States, has a TB disease incidence rate of 57.3 per 100 000 population (the highest incidence of pulmonary TB in Mexico) (5) and has a policy of screening HIV-infected individuals for LTBI. It is unknown, however, whether individuals with HIV infection or those at high risk for HIV infection have been screened for TB. Therefore, the prevalence of prior tuberculin skin testing (TST) among populations at risk for HIV infection in Tijuana, Mexico was assessed and factors associated with prior TST were identified.

MATERIALS AND METHODS

Study population

The aims of the parent study were to measure the prevalence of LTBI and active TB disease among these groups and to identify correlates of infection. This cross-sectional study collected data from April to July 2007 among individuals recruited through targeted sampling in Tijuana. Eligibility included age ≥ 18 years, willingness to provide signed informed consent, no plans to leave Tijuana in the next 30 days, and reporting any of the following in the six months before recruitment: illicit drug use (other than marijuana), injection drug use, receiving money or goods in exchange for sex, and homelessness (includes unstable housing defined as living mainly in a rented hotel room, migrant work camp, or medical/drug treatment facility).

Participants were recruited through targeted sampling using street-based outreach, word of mouth, and advertising (1). A recreational vehicle converted into a mobile health clinic was used to provide harm reduction education and basic health care services for high-risk populations and was used to access potential participants. All interviews were conducted at a storefront in a high-drug-use neighborhood in Tijuana. The study protocol was approved by the University of California, San Diego, Institutional Review Board (IRB) and the Tijuana General Hospital Ethics Board. Further approval for this analysis was obtained from the San Diego State University IRB.

Data collection

Participant risk assessment data were collected during one-on-one private interviews. Interviews were conducted in Spanish by local staff highly familiar with the target population and experienced in gaining participants' trust so they felt comfortable providing honest responses to sensitive questions. The interviews assessed sociodemographics, risk factors for MTB and HIV infection, TB knowledge and exposure history, prior TB testing, and presence of TB-related symptoms. The survey instrument was developed in English, translated into Spanish, and then back-translated into English to verify accuracy and meaning. After the interview, participants received pretest counseling and venipuncture for HIV and MTB testing. Monetary reimbursement equivalent to US$20 was given to participants for time and transportation.

Median age (36 years) was used to create a dichotomous age variable. Since very few participants identified as transgender, the male-to-female (MTF) group was categorized as female (No. = 10) and the female-to-male (FTM) group was categorized as male (No. = 3) for the purposes of this study. Lifetime measures included ever crossing the border into the United States; ever incarcerated (defined as having been detained in a jail, prison, or other adult detention center); country where incarceration occurred; and had health insurance in the past 6 months.

Self-reported lifetime history of sexually transmitted infections and positive TB results included only those diagnosed by a medical professional. TB knowledge was assessed using six TB knowledge questions:

- Can people have TB in their body that is sleeping and not an active form of disease?
- Does sharing dishes, bottles, or a toothbrush with someone who has TB increase a person's chance of getting TB?
- Can TB be spread from person to person through the air?
- Can TB be cured by taking medicines?
- Does receiving a BCG [bacillus Calmette–Guérin] vaccination protect you from TB for life?
- If someone has TB, would you think that they also have HIV?

Participants were given one point for each correct answer and their combined scores, ranging from 0 to 6, were analyzed as a continuous variable. TST history was assessed by asking participants if they had ever had a skin test for TB.

Laboratory testing

TB infection was detected using the QuantiFERON TB Gold in-Tube® assay ([QFT] Cellestis, Ltd. Carnegie, Australia), an in vitro test that detects infections but does not differentiate LTBI from active TB disease (6). The detection of antibodies against HIV was obtained by using the Determine Rapid HIV Antibody Test (Abbot Laboratories, Boston, Massachusetts, United States). Positive results were confirmed by enzyme-linked immunosorbent assay and immunofluorescent antibody assay at the San Diego County Public Health Laboratory. Participants with ≥ 1 acid fast bacillus-positive sputum smear or chest radiography readings consistent with TB diagnosis were determined likely to have active TB and were referred to the central public health clinic (Instituto de Servicios de Salud Pública del Estado de Baja California) for clinical confirmation and treatment through the national TB program (1). All participants were given an appointment to receive the results of their HIV and QFT tests, posttest counseling, and referrals for treatment as described elsewhere (1).

Statistical analyses

Variables were analyzed using means or medians for continuous measures and frequencies and percentages for categorical variables. The dependent variable for this analysis was self-reported lifetime history of TST (yes or no). Associations between independent variables and TST history were examined by using chi-square tests for categorical variables and *t*-tests or Wilcoxon rank-sum tests for continuous variables depending on whether the data were normally distributed. Logistic regression was used to assess the univariate and multivariate odds ratios (ORs) and 95% confidence intervals (CIs) of selected factors with TST history. All variables found to be significant ($P < 0.10$) in the univariate analysis were considered for inclusion in multivariate analysis. Backward stepwise regression was performed to produce

initial models. Factors that were independently associated with TST ($P < 0.05$) in multivariate analysis were considered statistically significant and maintained in the final model. The Hosmer– Lemeshow goodness-of-fit statistic and 95th percentile CIs were analyzed to determine the fit of the final model. Collinearity among independent variables was assessed by examining tolerance values. Analyses were performed with SPSS statistical software, version 16.0 (SPSS Inc., Chicago, Illinois, United States).

RESULTS

Only one participant answered “do not know” to the question on prior history of TST and was excluded; therefore, 502 participants were included in this analysis. Sixty-one percent of the sample were male (No. = 307), almost two-thirds were under 36 years old (No. = 264), and most (96.8%) were born in Mexico (No. = 487); however, 72.2% had ever crossed the border into the United States (No. = 363). Education was low, with only 10.9% completing more than a secondary school education (No. = 55), and 67.2% had ever been in jail (No. = 338). Thirty-eight percent of the sample reported ever receiving TST (No. = 191) and of those who had a previous skin test, 15.7% had tested positive (No. = 30). Past history of LTBI diagnosis was reported by 7.3% of participants (No. = 35). Of those with prior TST, 1.0% were HIV positive (No. = 2).

Serologic testing revealed that 56.9% were positive for TB infection by QFT assay (interferon gamma release assay) (No. = 286) and 4.2% were HIV positive (No. = 21). Of those who had reported having a previous TST, 58.1% (No. = 111) tested QFT positive (1).

Self-reported treatment for active and latent TB infection was also investigated. Of the 38.0% of the study population with a history of TST, 14.1% had been diagnosed with active TB by a medical professional (No. = 27). Most of those (81.5%) who had a previous active TB diagnosis were diagnosed in prison (No. = 22), and 88.9% had begun treatment (No. = 24). Half of those who had been treated (45.8%) had stopped treatment early (No. = 11). Of the 38.0% who had a prior TST, 16.8% had been previously diagnosed by a medical professional as having latent TB (No. = 32). The majority (78.1%) had been diagnosed in prison (No. = 25), and 93.8% had received treatment (No. = 30). Only 13.2% had stopped LTBI treatment early (No. = 4), defined as taking medications for less than 6 months.

Univariate analyses of factors associated with TST

The odds of a previous TST were greater among those older than 36 years (56.0% versus 42.1%), those who had crossed into the United States (86.9% versus 63.0%), those who had injected drugs in the past 6 months (59.2% versus 37.9%), and those who had ever been incarcerated (72.8% versus 19.0%) (all $P < 0.05$) (Table 1). The odds of a prior TST were lower among those who reported sex work (17.3% versus 26.4%), those who tested HIV positive (0.01% versus 6.1%), and those who had ever been diagnosed with a sexually transmitted infection (0.52% versus 8.4%) (all $P < 0.05$). No other factors investigated were associated with TST.

Multivariate logistic regression model of factors associated with TST

Considering all variables were associated with $P < 0.10$ in univariate analysis, the following remained statistically significant at a level of 0.05 in multivariate analysis. The odds of previous TST were 13.4 times greater among those who were incarcerated in the United States (95% CI = 7.37–24.33). The odds of a previous TST were higher among those who injected drugs in the past 6 months (OR = 1.99, 95% CI = 1.27–3.11) (Table 2). After adjusting for these variables, age, gender, and travel to the United States were no longer

significant. The Hosmer–Lemeshow goodness-of-fit test statistic was 0.250 (> 0.05), indicating that the logistic model was a good fit.

DISCUSSION

This study showed that among individuals at high risk for HIV and MTB infection, the odds of having been screened for TB were higher among those with a history of incarceration, especially in jails in the United States. These results align with the U.S. Marshals Service TB policy, which requires that prisoners be tested as soon as conveniently possible after intake at a jail or detention center (7). Previous studies have used jail as a forum to measure the spread and control of TB (8–10). These data suggest that prisoners are accessing care and screening more often than those who are not incarcerated. While jails and detention centers are a potential avenue for providing care, it is clear that more options for testing should be available to high-risk individuals who are not incarcerated.

This study also found that after adjusting for incarceration, the odds of a previous TST were greater among injection drug users (IDUs), suggesting that IDUs might be targeted for TB screening more often than those who do not inject drugs. It is possible that IDUs are tested in drug treatment programs. However, participants were not asked where they received TST or about a lifetime history of drug treatment. This differs from previous studies, which have described IDUs as having difficulty completing medical evaluations (11–13). Nonetheless, it is a positive finding given that IDUs are one of the highest risk groups for HIV infection in Mexico and that the prevalence of HIV among IDUs in Tijuana is increasing (14). Further research should be conducted on IDUs and access to care to understand if it is a potential area for leveraging health promotion with regard to TB screening and treatment.

Serologic test results for MTB infection (i.e., QFT) and HIV were included in the analysis to determine whether those who had a prior TST were more or less likely to be QFT positive or HIV positive. No association was found between QFT results and prior TST in univariate and multivariate analyses.

Of concern was the finding that the odds of a previous TST were lower in HIV-positive participants than in HIV-negative participants even though TST is indicated for persons with HIV in Mexico. This finding was consistent, however, with prior reports showing that only 1% of individuals with HIV/AIDS worldwide have a history of TST (3). Further efforts are needed in Tijuana to ensure that all persons with HIV are screened for active TB disease and LTBI.

Self-reported treatment for active and latent TB infection was examined and it was found that of those who had reported prior TST and diagnosis with latent or active TB infection, the majority had been diagnosed in prison. Almost half of those who had been diagnosed with active TB reported stopping treatment early. This is consistent with a previous study also conducted in Tijuana in a population at high risk for HIV, which found a little over half of the population was able to finish treatment (15).

Certain limitations should be considered in interpreting the study findings. The data collected for this study are cross-sectional, which limits our ability to determine the temporal relation between TST and the associated factors; therefore, none of the reported associations should be considered causal. Additionally, because the parent study was not designed to identify correlates of TST, some desired variables, such as place of testing and reasons for testing, were not assessed. Recall of lifetime factors could have led to misclassification of participants by TST status. However, since TST history was not an eligibility criterion for the study, such misclassification would likely be nondifferential;

thus, bias would result in a reduction in the observed ORs toward the null and strengthens our confidence in the results.

In a population with a high prevalence of MTB infection and high risk for HIV infection, an increase in HIV infection could fuel an outbreak of active TB disease. It is therefore important for persons with, or at risk for, HIV infection to know their TB status as treatment for LTBI is available. Since TST is known to cross-react with the bacillus Calmette–Guérin (BCG) vaccination (which is widely used in Mexico) (16), the use of TST was expected to be low in Tijuana. However, TST use was found to be fairly common but disproportionate and highly associated with a history of incarceration in the United States. Nonetheless, these findings indicate the need to increase TB screening among populations at risk for HIV in Tijuana, particularly those outside of criminal justice settings. Further research should be conducted to identify innovative ways to provide TB testing for populations at risk for HIV and TB coinfection in Mexico. One such innovation could include the use of interferon gamma release assays, which do not cross-react with the BCG vaccination (16), for diagnosing MTB infection in Mexico.

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TABLE 1

Univariate analysis of factors associated with self-reported lifetime history of tuberculin skin testing among populations at increased risk for HIV infection, PreveTB study, Tijuana, Baja California, Mexico, 2007

	History of tuberculin skin test						
	Yes		No				
Correlate	**No.**	**%**	**No.**	**%**	**OR**	**95% CI**	***P* value[a]**
Age (years)							
>36	107	45.0	131	55.0	1.75	1.22–2.52	0.002
≤36	84	31.8	180	68.2	1.00		
Gender							
Male	134	43.8	172	56.2	1.90	1.30–2.79	0.001
Female	57	29.1	139	70.9	1.00		
Housing status							
Homelessness or unstable housing	101	36.2	178	63.8	0.84	0.58–1.21	0.341
Stable housing	90	40.4	133	59.6	1.00		
Primary source of income comes from sex work[b]							
Yes	33	28.7	82	71.3	1.71	1.09–2.70	0.019
No	158	40.8	229	59.2	1.00		
Injection drug use[b]							
Yes	113	48.9	118	51.1	2.37	1.64–3.43	< 0.001
No	78	28.8	193	71.2	1.00		
Noninjected drug use[b]							
Yes	113	36.5	197	63.5	0.84	0.58–1.21	0.349
No	78	40.6	114	59.4	1.00		
Swallowed or smoked marijuana[b]							
Yes	35	36.8	60	63.2	0.95	0.58–1.55	0.79
No	156	38.3	251	61.7	1.00		
Ever crossed into United States							
Yes	166	45.9	196	54.1	3.90	2.41–6.29	< 0.001
No	25	17.9	115	82.1	1.00		

	History of tuberculin skin test						
	Yes		No				
Correlate	**No.**	**%**	**No.**	**%**	**OR**	**95% CI**	***P* value[a]**
Ever diagnosed with a sexually transmitted infection[c]							
Yes	1	8.3	11	91.7	0.14	0.02–1.12	0.035
No	190	38.8	300	61.2	1.00		
Has health insurance[b]							
Yes	7	35.0	13	65.0	0.87	0.34–2.23	0.775
No	184	38.2	298	61.8	1.00		
Ever been in jail							
Yes, only in United States, or in both United States and Mexico	139	70.2	59	29.8	18.10	10.27–31.91	< 0.001
Yes, only in Mexico	33	23.7	106	76.3	2.39	1.29–4.44	< 0.001
No	19	11.5	146	88.5	1.00		
TB knowledge score (mean ± standard deviation)	3.48	0.82	3.45	0.90	NA	NA	0.792
Tested QuantiFERON TB positive							
Yes	111	38.8	175	61.2	0.93	0.64–1.34	0.685
No	80	37.0	136	63.0	1.00		
Tested HIV positive[c]							
Yes	2	9.5	19	90.5	0.16	0.04–0.71	0.005
No	189	39.3	292	60.7	1.00		

OR: odds ratio, CI: confidence interval, TB: tuberculosis, NA: not applicable.

[a]Based on Wald chi-square test and $\alpha = 0.05$.

[b]In past 6 months.

[c]Based on Fisher's exact test and $\alpha = 0.05$.

TABLE 2

Multivariate logistic regression analysis of factors associated with self-reported history of tuberculin skin testing among populations at increased risk for HIV infection, PreveTB study, Tijuana, Baja California, Mexico, 2007 (n = 503)

Correlate	Adjusted OR[a]	95% CI	P value[b]
Injection drug use[c]			
Yes	1.99	1.27–3.11	0.003
No	1.00		
Ever crossed into United States			
Yes	1.63	0.93–2.88	0.090
No	1.00		
Ever been in jail			
Yes, only in United States or in both United States and Mexico	13.38	7.37–24.33	< 0.001
Yes, only in Mexico	1.87	0.99–3.54	0.056
No	1.00		

OR: odds ratio, CI: confidence interval.

[a] Adjusting for all other variables in the model.

[b] Based on Wald chi-square test and $\alpha = 0.05$.

[c] In past 6 months.