Latent tuberculosis in migrants travelling through the northeast regions of Mexico

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A R T I C L E   I N F O

Keywords:
Tuberculosis
Latent tuberculosis
Migrants
Interferon-gamma release assays
Enzyme-linked immunosorbent assay

A B S T R A C T

Background: Latent tuberculosis infection (LTBI) affects nearly a quarter of the global population. Public health interventions aimed at interrupting tuberculosis transmission do not routinely include systematic screening of migrant populations for LTBI in Mexico, nor other high-income countries. However, early detection and treatment of LTBI in immigrant populations from high-burden countries are recommended by the World Health Organization.

Objective: The objective of this study was to determine the proportion of migrants with LTBI in shelters in northeastern Mexico.

Methods: In this cross-sectional study, blood samples were obtained from 455 migrants living in shelters in northeastern Mexico during January 2017 to October 2019. LTBI was diagnosed using the QuantiFERON®-TB Gold Plus test.

Results: Most of the migrants evaluated in this study were from Honduras; ~86% were male; the average age was 29 ± 10 years. LTBI was identified in 18.4% of those from Central America. Migrants from El Salvador and Nicaragua were more likely to have LTBI than those from Honduras or Guatemala. Overweight or obese persons and older persons had a higher prevalence of LTBI. We detected no significant differences with respect to LTBI when the results were compared based on gender, education, or marital status.

Conclusion: The LTBI rates amongst migrants from Central America recently screened in shelters in northeastern Mexico appears to be relatively low given recent estimates of LTBI prevalence in Mexico.

1. Introduction

According to the World Health Organization (WHO), latent tuberculosis infection (LTBI) affects 1.7 billion people, a number that represents ~23% of the global population [1], ~12% of whom will ultimately develop active disease [2–4].

In Mexico, in 2016, the most recent year for which published state-specific tuberculosis (TB) case rates are available, the published national incidence of TB was reported to be 13.8 cases per 100,000 persons [5]. In the states of Nuevo León and Coahuila on the Mexico-U.S. border, the comparable TB prevalence published by the same source was higher than the national average, with case rates of disease in 24.4 and 14.6 cases per 100,000 persons, respectively [5].

Interferon-Gamma Release Assays (IGRAs), including the commercially-available QuantiFERON®-TB Gold Plus (Qiagen, Hilden, Germany), are amongst the most widely used tests for detecting LTBI since the assay helps discriminate between those who have LTBI and those who do not have LTBI but have been vaccinated with Bacille Calmette Guérin (BCG), and, as a consequence, may react positively to a tuberculin skin test (TST) [6–9].

A large number of studies have shown that the QuantiFERON®-TB Gold Plus’s sensitivity and specificity for detecting LTBI are equal or superior to those of the TST in evaluations carried out in children, adults, and those chronically-infected with human immunodeficiency virus (HIV) [8–12].

Reactivation of latent infection is a commonplace occurrence...
amongst immigrants; latent infection may remain undetected for several years after arrival in the new host country [13]. Early detection and treatment of LTBI in immigrant populations from high-burden countries have been recommended to reduce the prevalence of active TB as part of an overall strategy aimed at eliminating TB [14].

The principal aim of this study was to evaluate a population of migrants recently in transit through Northeast Mexico to determine what percentage test positive for LTBI using the Quantiferon®-TB Gold Plus assay.

2. Methods

2.1. Population

This study focused on migrants residing while in transit in two large shelters within the states of Nuevo Leon and Coahuila, respectively, during the period of January 2017 to October 2019. The study included 455 persons > 12 years old residing in the shelters temporarily and migrating to the United States from any part of Central America or Mexico. Persons with chronic cough and/or active TB, those with clinical characteristics compatible with a diagnosis of TB, or those with positive smears and/or positive cultures were excluded from the study. Persons who were unable to respond to the questionnaire or to participate in blood sampling, for reasons such as blindness or difficult venous access, were also excluded. Amongst those initially enrolled, persons who did not complete the questionnaire, or on whom blood was not drawn, or whose blood samples were insufficient in quantity for evaluation were removed from the study. After exclusions, everyone completed the questionnaire; however, blood samples were collected from only 316 persons. For the cross analysis, data for migrants from Costa Rica, Cuba, and Ecuador were sparse (each < 1%) and were excluded. Therefore, the cross-analysis tables only include data from 297 persons.

2.2. Study design

The present study was observational, descriptive, and cross-sectional. This was registered with the University of Monterrey Research Committee, after which appropriate permits were obtained from the migrant home administrators, and study visits were made every 15 days. Two shelters were reviewed; they are located in the states of Nuevo Leon and Coahuila, respectively, on an ELISA plate reader. A positive QFT®-Plus response is one in which the IFN-γ (IU/ml) response to either TB antigen is significantly higher than the response measured in the negative control tube. A diagnosis of LTBI was made according to the results of the QFT®-Plus test. The results were considered positive, negative or undetermined according to criteria established by the manufacturer’s software (QIAGEN, Hilden, Germany).

2.5. Statistical analysis

All questionnaire data were maintained in a Microsoft Office Excel database. Statistical analysis was performed using the statistical package of SPSS version 25.0. For the statistical analysis, the proportions were calculated by dividing the value obtained from the total of the participants who answered the questionnaire or took the measurement. For the cross analysis, the data of migrants from Costa Rica, Cuba and Ecuador were excluded because of sparse data. Frequency differences, identified in the crossover analysis, were evaluated using chi-square test with Yates correction, while mean differences were determined using Student’s t-test. Statistical significance was defined as \( p \leq 0.05 \).

3. Results

Our study enrolled 455 migrants; their countries of origin are included in Table 1. Most of the participants were from Honduras (71%). Only 6.4% of the migrants were Mexicans and one migrant (0.2%) was from South America. A large fraction (88.5%) of the participants who answered the survey was male; the vast majority was unmarried with only a primary education (Table 2). The mean age was 29 ± 10 years, mean weight was 67.5 ± 12.9 kg and mean height was 1.66 ± 0.08 m. Mean values for blood glucose, BMI and blood pressure were within normal ranges (data not shown).

The principal comorbidities reported by the participants in this study were being overweight, obesity, and diabetes. The proportion of participants reporting these disorders is shown in Table 2.

Only 316 of the 455 participants gave blood samples for testing.
Using the QuantiFERON TB Gold, 18.4% (51/277) of the migrants from Central America (excluding migrants from Mexico, Costa Rica, Cuba and Ecuador) were diagnosed with LTBI. In the cross analysis (Table 3), we found that participants originally from El Salvador and Nicaragua were more likely to test positive for LTBI; those originally from Honduras and Guatemala were less likely to test positive, and LTBI rates were lower given to monitoring migrants from El Salvador and Nicaragua more closely than from other Central American countries due to the high rates of TB in these countries [23–24]. The correlation of having LTBI with age is easily explained as older populations have had more time and exposure to acquire TB infection. In general, the migrants in this study were young people with little comorbidity; for this reason, although a cross analysis was performed, some of the cross analysis boxes had data too sparse to observe or infer statistically significant differences between populations."

Screening of refugees in travel is neither carried out on a routine basis in Mexico, nor is it standard procedure in other high income countries [23–24]. This study presents a unique picture of a select population of refugees in Mexico on which few current data exist; this population may go on to influence TB case rates both in Mexico and in the United States. The results of this study suggest that consideration be given to monitoring migrants from El Salvador and Nicaragua more closely than from other Central American countries due to the high rates of LTBI observed in this sample population, travelling under conditions that may also predispose them to disease reactivation. However, the LTBI rates amongst migrants from Central America recently screened in shelters in northeastern Mexico appears to be relatively low given recent estimates of LTBI prevalence in Mexico.

### Table 2
**Sociodemographic characteristics of migrants in shelters participating in evaluation for latent tuberculosis infection, Coahuila and Nuevo Leon, Mexico, 2017–2019.**

| Characteristic | Frequency (n) | Percentage (%) |
|----------------|---------------|----------------|
| Sex            |               |                |
| Male           | 394           | 88.5           |
| Female         | 51            | 11.5           |
| No response    | 10            |                |
| Marital status |               |                |
| Single         | 274           | 63.8           |
| Married        | 62            | 14.5           |
| Consensual union | 85         | 19.8           |
| Separated/divorced | 8        | 1.8            |
| No response    | 26            |                |
| Education      |               |                |
| Primary school | 205           | 49.8           |
| Secondary school | 117        | 28.5           |
| High school    | 48            | 11.7           |
| College/university | 21      | 5.1            |
| No education   | 20            | 4.8            |
| No response    | 44            |                |
| "Diabetes      |               |                |
| Yes            | 22            | 5.8            |
| No tested      | 353           | 94.2           |
| No             | 80            |                |
| "Overweight    |               |                |
| Yes            | 115           | 26.5           |
| No             | 318           | 73.5           |
| No tested      | 22            |                |
| "Obesity       |               |                |
| Yes            | 47            | 10.8           |
| No             | 386           | 89.2           |
| No tested      | 22            |                |

a Diabetes: Fasting blood glucose levels > 120 mg/dL.

b Overweight: BMI > 25 kg/M² SC.

c Obesity: BMI > 30 kg/M² SC.

### Table 3
**Cross-analysis of QuantiFERON TB Gold Plus results of migrants in shelters participating in evaluation for latent tuberculosis infection, Coahuila and Nuevo Leon, Mexico, 2017–2019.**

| Variable              | Positive QFT®-Plus | Negative QFT®-Plus | p     |
|-----------------------|--------------------|--------------------|-------|
| Age                   |                    |                    |       |
| Honduras              | 34.31 ± 9.94       | 29.13 ± 9.63       | 0.001 |
| El Salvador           | 10 (41.7%)         | 14 (58.3%)         | 0.001 |
| Nicaragua             | 7 (43.8%)          | 9 (56.3%)          |       |
| Guatemala             | 4 (19.0%)          | 17 (81.0%)         |       |
| Mexico                | 6 (30.0%)          | 14 (70.0%)         |       |
| Sex                   |                    |                    |       |
| Male                  | 49 (19.1%)         | 208 (80.9%)        | 0.955 |
| Female                | 7 (19.4%)          | 29 (80.6%)         |       |
| Marital status        |                    |                    |       |
| Single                | 32 (17.9%)         | 147 (82.1%)        | 0.602 |
| Married               | 10 (27.0%)         | 27 (73.0%)         |       |
| Consensual union      |                    |                    |       |
| Separated/divorced    | 2 (33.3%)          | 4 (66.7%)          |       |
| Education             |                    |                    |       |
| Primary school        | 22 (16.8%)         | 109 (83.2%)        | 0.710 |
| Secondary school      | 20 (24.1%)         | 63 (75.9%)         |       |
| High school           | 7 (17.9%)          | 32 (82.1%)         |       |
| College/university    | 4 (26.7%)          | 11 (73.3%)         |       |
| No education          | 2 (12.5%)          | 11 (84.6%)         | 0.610 |
| "Diabetes"            |                    |                    |       |
| Yes                   | 4 (26.7%)          | 11 (73.3%)         |       |
| No tested             | 45 (18.0%)         | 205 (82.0%)        |       |
| "Overweight or Obesity" |                   |                    |       |
| Yes                   | 33 (27.0%)         | 89 (73.0%)         | 0.003 |
| No tested             | 20 (12.4%)         | 141 (87.6%)        |       |

p = The chi-square statistic with Yates correction for qualitative variables, Student’s t-test for quantitative variables.

a Diabetes: Fasting blood glucose levels > 120 mg/dL.

b Overweight: BMI > 25 kg/M² SC.

c Obesity: BMI > 30 kg/M² SC.
Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We must thank the Casa Nicolas refuge, the government of the state of Nuevo León and the University of Monterrey for their support in carrying out and publishing this work.

Ethical considerations

This work complies with established general health laws on research in Mexico and the Declaration of Helsinki for human research.

This work has been approved by the Research Ethics Committees of the University of Monterrey, Nuevo León, Mexico, with the number 042016-CIE. All participants provided their written informed consent before being included in the study.

Funding

This research received support from the Secretariat of Social Development of Nuevo León government. No funding was received from agencies in the commercial or not-for-profit sectors.

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