Tuberculosis Screening at 2 San Diego High Schools With High-Risk Populations

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Background: High immigration rates contribute to the high incidence of pediatric tuberculosis (TB) in San Diego, Calif. Adolescents frequently have poor access to health care and may not receive appropriate TB screening. School-based screening has been ineffective in detecting TB in other parts of the country.

Objective: To determine the prevalence of TB infection and disease in a high-risk population of high school students through school-based screening.

Design and Participants: Cross-sectional study of TB prevalence and an analysis of risk factors for TB infection in students attending 2 San Diego high schools with high percentages of non-US-born students.

Main Outcome Measures: Positive induration (≥10 mm) with Mantoux tuberculin skin test. A chest radiograph or clinical findings consistent with active TB.

Results: A total of 744 (36%) students at high school 1 and 860 (57%) students at high school 2 participated. Ninety-five (12.8%) and 207 (24.1%) students, respectively, had positive tuberculin skin test results. One student had a chest radiograph that showed active TB. Smear for acid-fast bacteria and culture for Mycobacterium tuberculosis had negative results. Vietnamese, Filipino, and Latino ethnic groups were significantly more likely to have positive tuberculin skin test results than the white population (P < .05). Non-US-born students were significantly more likely to have positive tuberculin skin test results than US-born students in all ethnic groups except the Latino group.

Conclusion: Although treatment of TB coupled with aggressive public health investigation is the most cost-beneficial way of preventing TB, targeted school-based screening may be an effective way of detecting TB infection in high-risk populations with poor access to health care.


Editor’s Note: This study shows that all national recommendations must be viewed in the context of local populations. It also provides an example of how effective school-based screening can be.

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PATIENTS AND METHODS

The project was a cross-sectional design study, involving high school students during the 1994-1995 school year. Two high schools in San Diego with 35% to 43% non–US-born students were selected. These schools were selected purposely because of known ethnic diversity and expected higher rates of TB infection than in other schools. The protocol was approved by the institutional review board at the University of California San Diego Medical Center. All students enrolled in the high schools were eligible for the study. Participation in the project was voluntary, and informed consent in writing was obtained from parents and students. Tuberculin skin tests were performed by the Mantoux method (0.1 cm² of 5-TU strength purified protein derivative). Placement of skin tests was performed by school nurses and a nurse from the University of California San Diego Medical Center’s skin testing office. Tests were read by the nurses after 48 hours. A positive test result was defined as induration of more than 10 mm. Skin testing materials were supplied by the San Diego Department of Health Services.

Demographic information was collected on all participating students through school records and questionnaires. Students with positive TST results were given the option of being examined by 1 of 3 study physicians (B.J.A., R.E.B., or A.L.P.) and having chest radiographs done either at a local hospital or by the health department or seeing their own physicians for examinations and chest radiographs. These students who saw their own physicians were asked to return questionnaires completed by their physicians.

Statistical analysis was performed with Epi Info, Version 6.11 Frequency distributions and 2 × 2 contingency tables were constructed and used to evaluate data. P values were considered significant at less than .05. Relative risk and 95% confidence intervals were calculated to evaluate potential risk factors for TB infection.

RESULTS

A total of 1645 skin tests were placed between February 21, 1995, and March 14, 1995. Thirty-nine (2.4%) students did not return for skin test readings. Of the remaining 1606 (97.6%) students whose tests were evaluated, 2 were not included in further analysis because of late (>72 hours) readings of induration. Seven hundred forty-four (36.4%) students had skin tests placed and read at high school 1 and 860 (56.7%) at high school 2. Positive TST results were found in 95 (12.8%) students tested at high school 2. Skin test induration ranged from 10 to 76 mm (median, 17 mm). Of the students with positive results, 71.5% had induration of 15 mm or more and 38.7% had induration of 20 mm or more. There were 767 male and 837 female students tested. Equal proportions of male and female students had positive skin test results. Ages ranged from 11 to 20 years (median, 16 years). Increasing age was significantly associated with positive TST reactions ($\chi^2$ test for trend: high school 1, $P = .007$; high school 2, $P = .05$). However, when controlled for ethnicity, this relationship remained only for Vietnamese and Filipino ethnic groups at high school 1.

Ethnicity data of the schools are shown in Table 1. The ethnic distributions of the students tested were representative of the overall ethnic distribution of each school. Skin test results by ethnicity are shown in Table 2 and Table 3. At high school 1, Latino, Filipino, and Vietnamese ethnic groups were more likely to have positive TST results than whites. At high school 2, Latino and Vietnamese ethnic groups were more likely to have positive TST results than whites.

Skin test results by ethnicity and place of birth are shown in Table 4 and Table 5. Except for the Latino group at high school 1, students born outside of the United States were more likely to have positive TST results than those of the same ethnic group born in the United States.
Among non–US-born students, there were no significant differences in positive TST result rates between different ethnic groups. Among US-born students at high school 1, Latino and Vietnamese ethnic groups were more likely to have positive TST results than whites. At high school 2, only Latino students were at higher risk.

Of all students whose test results were positive, 67 (22.1%) gave histories of positive TST results. However, only 25 (37.3%) students with a positive TST history produced documentation of completed therapy with isoniazid. Chest radiographs were completed in 230 (76.1%) students with positive TST results. One hundred forty-four (62.6%) chest radiographs and physical examinations were performed as part of school-based directly observed preventive therapy, the other 86 (37.3%) radiographs and examinations were performed by private physicians. Only 1 student had findings compatible with active TB. Smears and cultures were negative for acid-fast bacteria. Forty-seven students (15.6% of those with positive TST results) failed to provide documentation of a chest radiograph or documentation of completed therapy. Excluding these 47 students, the rate of TB in those receiving the TST was 0.06%.

Results of skin testing in these 2 high schools suggest a high rate of TB infection among subpopulations within San Diego. The average positive TST result rate of 18.4% was higher than rates seen in elementary schools. The active disease rate was low at 0.06%, demonstrating, as in other studies, that TST screening is not highly effective in detecting active disease.

In a nationwide survey of school-based TSTs, Driver et al.12 reported 6-fold to 24-fold higher rates of positive TST results in non–US-born populations. Results of the present study confirm the increased prevalence of TB infection in non–US-born populations in all ethnic groups. The effect of birthplace, however, appeared to be less dramatic in the Latino population. Compared with other ethnic groups in high school 1, positive TST results were noted in fewer non–US-born (15.4%), and in a larger percentage of US-born (16.7%), Latino students. This may not be significant since there were relatively few Latino students tested in this school (37 students). In high school 2, however, which enrolled a greater number of Latino students (211 students), positive TST results were found in 44.4% of non–US-born and 12.5% of US-born students. The rate of positive TST results in the US-born Latino students was higher than in other US-born ethnic groups. A previous study13 of TSTs in Latino children reported similar rates of 53% of non–US-born and 9% of US-born subjects. The higher rate of positive TST results seen in US-born Latino students may reflect the close relationship between Latino populations on either side of the US-Mexico border. It is more difficult for other ethnic groups to travel regularly back and forth from their countries of origin, and, therefore, those born in the United States are less likely to be exposed to populations with a high prevalence of TB. An explanation for the higher incidence of positive TST results in US-born students who are of Vietnamese ethnicity in high school 1 is unclear, but may be related to immigrant contacts.

Past vaccination with the BCG vaccine is a potential source of false-positive TST results. However, the vaccination is usually given in infancy, and its effect is unlikely to persist 5 to 10 years after it is given.14 We were not able to obtain reliable data on BCG vaccination, since most of the students could not recall having had the vaccine and documentation of scars was incomplete. Correlation of BCG vaccination with size of skin test induration could not be observed.

The efficacy of the screening process would improve if testing were restricted to non–US-born stu-
Mohle-Boetani et al\textsuperscript{1} showed that screening all children is in populations with a low prevalence of TB infection. The positive predictive value of the Mantoux skin test decreases with prevalence of disease in the population. Therefore, the positive TST results in high schools 1 and 2 would have anticipated at each school. This may have introduced a self-selection bias in the study population. If, for example, participation in this study was voluntary, and only 36.4\% and 56.7\% of students participated at high school 1 and 2, respectively. Students attending high school 2 would still be considered a high-risk population, but those at high school 1 may not. It is unlikely, however, that nonparticipating students would be more or less likely to have positive TST results than those in the study.

Screening is only worthwhile if those identified as infected with TB can be adequately evaluated and treated. Sixty-seven students gave histories of positive TST results, yet few (25 students) had a history of treatment. In fact, only 37.3\% of those with positive TST results in the past had been evaluated and completed therapy. In this study, follow-up evaluation for evidence of TB was obtained in 76.1\% of those with positive skin test results, yet few (25 students) had a history of treatment. Sixty-seven students gave histories of positive TST results, with 47 students (15.6\%) unavailable for follow-up. Successful evaluations achieved by this project depended greatly on having a full-time coordinator, on-site physicians, accessible radiograph facilities, and extra responsibilities for school nurses. This level of financial and personnel support does not currently exist in many schools.

Furthermore, even when evaluations are obtained, compliance in the adolescent population with daily medications necessary for TB preventive therapy is a potential problem. School-based delivery of medication by school personnel could theoretically be an ideal way to

| Table 4. Positive Tuberculin Skin Test Results in Major Ethnic Groups by Birthplace for High School 1\textsuperscript{*} |
|---|---|---|
| **Ethnic Group** | **Non-US-Born Students†** | **US-Born Students†** |
| | **Who Received TST, No.** | **With Positive TST Results, No. (%)** | **Who Received TST, No.** | **With Positive TST Results, No. (%)** | **RR (95% CI)** |
| White | 12 | 3 (25.0) | 213 | 2 (0.9) | 26.6 (4.9-144.6) |
| Vietnamese | 65 | 29 (44.6) | 28 | 3 (10.7)† | 4.1 (1.4-12.5) |
| Latino | 13 | 2 (15.4) | 24 | 4 (16.7)† | 0.9 (0.2-4.3) |
| Filipino | 98 | 30 (30.6) | 153 | 3 (2.0) | 15.6 (4.9-49.7) |
| African American | 2 | 1 (50.0) | 35 | 2 (5.7) | 8.7 (1.3-60.3) |
| Other | 46 | 12 (26.1) | 35 | 2 (0.9) | 4.6 (1.1-19.1) |
| **Total** | **236** | **77 (32.6)** | **488** | **16 (3.3)** | **9.9 (5.9-16.6)** |

\textsuperscript{*} TST indicates tuberculin skin test; RR, relative risk; CI, confidence interval.
\textsuperscript{†} These data exclude those with unknown birthplace.
\textsuperscript{‡} P < .05, compared with white population.

| Table 5. Positive Tuberculin Skin Test Results in Major Ethnic Groups by Birthplace for High School 2\textsuperscript{*} |
|---|---|---|
| **Ethnic Group** | **Non-US-Born Students†** | **US-Born Students†** |
| | **Who Received TST, No.** | **With Positive TST Results, No. (%)** | **Who Received TST, No.** | **With Positive TST Results, No. (%)** | **RR (95% CI)** |
| White | 19 | 12 (63.1) | 112 | 2 (1.8) | 35.4 (8.6-145.7) |
| Vietnamese | 123 | 55 (44.7) | 16 | 0 (0) | NA |
| Latino | 99 | 44 (44.4) | 112 | 14 (12.5)† | 3.6 (2.1-6.1) |
| African American | 66 | 30 (45.4) | 105 | 1 (0.9) | 47.7 (6.7-341.7) |
| Other | 96 | 39 (40.6) | 37 | 3 (8.1) | 5.0 (1.6-15.2) |
| **Total** | **488** | **160 (40.6)** | **382** | **20 (5.2)** | **8.5 (5.5-13.2)** |

\textsuperscript{*} TST indicates tuberculin skin test; RR, relative risk; CI, confidence interval; and NA, not applicable.
\textsuperscript{†} These data exclude those with unknown birthplace.
\textsuperscript{‡} P < .05, compared with white population.
provide directly observed preventive therapy and follow-up nursing care.

The American Academy of Pediatrics has recently shifted the focus for TB prevention away from universal screening toward more focused approaches aimed at high-risk groups. The results of this study support this recommendation and show that, in San Diego, non-US-born adolescents represent a particularly high-risk group for TB infection. In addition, the Latino population had a high rate of TB infection regardless of birthplace.

The value of school-based screening is to prevent future cases of active disease. Therefore, screening these adolescents for TB will only be worthwhile if treatment services are linked to screening. Feasibility and cost analysis of directly observed therapy in the schools will be important determinants of whether school-based screening is worthwhile. Additionally, further studies are needed to test other innovative approaches to delivering preventive therapy to infected children.

Clearly, the highest priorities for health departments are insuring completion of therapy for persons with active TB and conducting contact investigations. These measures will do more to prevent the current spread of TB than population-based screening for infection. However, after these 2 areas have been addressed, targeted screening linked to preventive therapy should be considered for populations with elevated rates of TB infection because future cases of active TB will come from these groups. School-based screening of high-risk individuals linked with evaluation and treatment is one way this can be accomplished.

Accepted for publication January 26, 1998.

This study was conducted with financial support from the American Lung Association, San Diego City Schools, and the County of San Diego Department of Health Services, San Diego, Calif. Dr Pong was supported in part by Institutional National Research Services Award Training Grant P32-PE10005 from the Health Resources and Services Administration, Washington, DC.

Data presented as a poster at the National Research Service Award Trainees Research Conference, Chicago, Ill, June 3, 1995, and as a poster at the meeting of the Ambulatory Pediatric Association, Washington, DC, May 2-6, 1997.

We thank Judy Beck, PhD, Susie Horn, RN, Elizabeth Spurgeon, RN, and Jan Stollenwerk, RN, from the San Diego City Schools for their enthusiasm and hard work in completing this project.

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