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ABSTRACT

All locatable subjects ($n = 94$) for whom tuberculosis prevalence had been determined in an earlier study were tested with purified protein derivative (PPD) and control antigens, sputum sampling, and chest x-rays. Of the 46 who had been tuberculin negative (confirmed with control antigens) 3 years earlier, 2 had developed active tuberculosis in the interim and 14 (30%) were tuberculin positive. All had been engaged continuously in migrant farmwork. Lack of access to health care, an institutional feature of migrant farmwork, was significantly associated with primary infection. (*Am J Public Health*. 1994;84:1836–1838)

The Incidence of Tuberculosis among North Carolina Migrant Farmworkers, 1991

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Introduction

We recently reported a prevalence study of tuberculosis in a random sample of 543 migrant farmworkers.¹ The prevalence of active tuberculosis among African-American subjects was 3.6% (over 300 times the national prevalence) and exceeded the prevalence in any other population-based sample of immunocompetent nonhospitalized individuals.² We report here a follow-up study of tuberculosis infection and disease in a segment of these subjects.

Methods

Eligible subjects consisted of all former subjects who had been purified protein derivative (PPD)-tuberculin negative (reaction size < 10 mm) and control antigen-positive (reaction size > 5 mm) and had been employed continuously in farmwork since the 1988 prevalence study of tuberculosis.¹ The migrant farmworker population is typically without fixed addresses or telephone numbers. To relocate subjects for the 1991 follow-up study, two methods were employed: (1) visits to labor camps in the study area and (2) review of various listings of farmworkers. All labor camps in which subjects had previously resided were revisited. Interviews were conducted with individuals in these camps who knew the subjects and sometimes were able to provide information about their current whereabouts. Additional visits were made on the basis of this information. Other labor camps (between 20 and 30) in the area of the previous study were surveyed. These site visits recovered nearly all of the subjects finally enrolled. In addition, the outreach

records of migrant health centers and North Carolina Labor Department records were reviewed. All of these are partial listings of migrant farmworkers.

PPD-tuberculin and control antigen testing, sputum sampling, and radiography were conducted according to the methods of the initial study.¹ Questionnaires administered in English and Spanish assessed risk factors for tuberculosis and CAGE type questions estimated alcohol use.³

PPD converters were persons who were formerly PPD negative and control antigen-positive (reaction size > 5 mm) who had PPD reactions of more than 10 mm on retesting and an increase in reaction size greater than 5 mm. New tuberculosis patients were subjects who had previously been PPD-tuberculin negative who met the standard case definition criteria.⁴

Analysis included chi-square and Fisher's Exact tests, Student's t tests, and logistic regression analysis, performed with PC-SAS software (SAS Institute, Inc, Cary, NC). Variables found to be

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significant by bivariate analysis ($P < .05$) were tested by logistic regression models.

Results

Ninety-four former subjects were recontacted; 48 of these subjects had had positive PPD-tuberculin reactions during the initial study. The majority had received isoniazid prophylaxis at that time. These subjects were ineligible and were excluded from further study. Forty-six previously PPD-tuberculin-negative subjects were enrolled. The demographics of the follow-up group were similar to those of the original sample (Table 1). There were 46 Haitian subjects in 1988 and none in 1991. More African-American subjects than Hispanics reported residing in a camp with a person with active tuberculosis (Table 1) ($P = .006$, relative risk = 13.2, 95% confidence interval = 1.5, 114).

Fourteen (30%) of the subjects were converters, including 2 with new cases of active tuberculosis; 26 (56%) were PPD-tuberculin negative and control positive; and 6 were anergic (control reaction size < 5 mm). The PPD-tuberculin conversion rate was higher among African-Americans than among Hispanics (Table 2).

For the previous 3 years, 74% of the subjects reported having one or two encounters with health providers, 22% reported no encounters, and 61% reported being denied the medical access required by state law. A logistic regression model (with age, race, camp residence with a tuberculosis patient, familial tuberculosis, alcoholism, and number of medical visits as independent variables) with positive PPD-tuberculin reactions as the dependent variable found that only number of medical visits was significant, with an inverse association with positive PPD tests ($P = .04$). The mean number of visits to health centers by PPD-positive subjects was 0.66, vs 2.09 by PPD-negative subjects ($P = .0002$, Student's t test).

Sputum samples and chest x-rays, which were obtained from 10 of the 12 PPD-positive subjects and 3 of the 6 anergic subjects, were uniformly negative.

Two subjects, both middle-aged African-American men employed for more than 15 years in migrant farmwork, had been screened by local county health departments during the intertesting period, were found to have positive PPD-tuberculin tests, and subsequently had sputum cultures positive for *Mycobacterium tuberculosis*. The incidence of active

TABLE 1—Demographic Variables in a 1988 Random Sample and in a 1991 Follow-Up Tuberculin-Negative Sample of North Carolina Migrant Farmworkers

	African Americans		Hispanics		All Subjects	
	1988 (n = 282)	1991 (n = 34)	1988 (n = 215)	1991 (n = 12)	1988 (n = 543)	1991 (n = 46)
Mean age, y	38	32	26	25	34	30
Male:female ratio	6:1	6:1	6:1	6:1	5:1	6:1
Resided in labor camp with tuberculosis patient, %	52	54	6	8	32	44
History of familial tuberculosis, %	17	6	11	41	13	16
Positive response to CAGE questions, %	... ^a	56	... ^a	0	... ^a	42

^aInformation not obtained from subjects in 1988.

TABLE 2—Incidence of Tuberculosis among North Carolina Migrant Farmworkers, 1991 Follow-Up Study

	African Americans (n = 34)	Hispanics (n = 12)	All Subjects (n = 46)
Subjects tested with PPD in the interim period, %	44 ± 17	8 ± 53	35 ± 13
PPD-positive subjects, %	35 ± 16	17 ± 21	30 ± 13
Anergic subjects, %	18 ± 13	0	13 ± 9
Annual incidence of primary infection, %	12 ± 14	6 ± 13	10 ± 8
Annual incidence of tuberculosis, %	1.96 ± 5	0	1.4 ± 3

Note. PPD = purified protein derivative.

tuberculosis among the African-American subjects was 5.9% for the 3-year period. The annual incidence of active tuberculosis among African Americans was 1.96%.

Discussion

This is one of the few longitudinal studies of the incidence of tuberculosis. The very small sample size makes population estimates highly unstable, and the potential effects of selective sampling may bias the results. It is probable, however, that any bias in the selection process would be in the direction of recovering subjects whose working and living conditions were most similar to those at the time of their initial enrollment. This is suggested by the fact that all of the subjects in the follow-up study had been engaged in farmwork continuously during the interim period and were located in the same area at roughly the same time of year as when tested previously. Additional resources might have recovered subjects who had left farmwork or were living in

other states, but these individuals would have borne less resemblance to the initial group of subjects.

The booster effect probably did not influence the results. Only subjects who were initially PPD-negative and control antigen-positive were eligible, none had been tested with PPD-tuberculin during the previous 6 months, and most were younger than 50 years old. Boosting typically occurs with closely spaced testing^{5,6} and among the elderly.⁷

The high rates of active disease and primary infection we found are consistent with our previous study of prevalence. The incidence of active tuberculosis among African-American farmworkers, although based on the two new cases detected, is estimated at 200 times that of the general population.¹ Risk factors for tuberculosis infection among migrant farmworkers are difficult to measure. The transience of this population complicates the measurement of crowding in housing. Farmworkers are usually transported to work in overcrowded buses, which results in potential

transmission to nonroommates. For instance, a South Carolina outbreak of tuberculosis among schoolchildren resulted from overcrowding on buses.⁸ Alcoholism increases risk, but self-report is often unreliable. Although their responses to CAGE-type questions indicated that a large number of subjects had alcoholism, no association was found with primary infection. Malnutrition increases risk, and African-American farmworkers' intakes of vitamins and minerals have been reported to be below the recommended daily allowances.⁹ However, self-report of nutritional intake is also unreliable and we did not ask for this information.

We found that lack of access to health care was a significant risk factor for primary infection. Treatment delay worsens prognosis in active cases and also increases transmission. In our study of occupational injuries among a random sample of farmworkers (n = 287), 22% of the subjects reported no health care visits during the previous 3 years and 61% reported being denied access to medical services by their employers,¹⁰ results quite similar to those reported here.

The Centers for Disease Control and Prevention (CDC) oversees the funds provided to county health departments for tuberculosis control. Although some county health departments serve migrant farmworkers with commitment, we found that in many cases farmworkers are their lowest priority. County health departments are part of local government, and growers are politically powerful in counties with large numbers of farmworkers. We believe that the disregard for the health of farmworkers evinced by local government is sometimes replicated in the county health departments.

Health clinics for migrant workers employ bilingual personnel, often of the same culture as the local farmworkers, who are often more knowledgeable than county health department employees about the living and working conditions of farmworkers. Many migrant health clinics have outreach programs into which tuberculosis control could easily be integrated. We contend that in certain areas migrant health clinics could provide better tuberculosis surveillance and control than county health departments, yet none receive federal funds for this purpose. Enabling migrant health centers to more fully participate in tuberculosis control would at least be a valuable addition to existing efforts. We recommend that migrant health centers receive funding proportion-

ate to that of county health departments for tuberculosis surveillance.

Inadequate attention is given to tuberculosis among farmworkers by federal agencies. The CDC estimates that the annual risk for active tuberculosis for farmworkers is six times that of the general population⁴; this estimate is far lower than those of all published studies.^{1,11,12} Yet the CDC also estimates that the risk for active tuberculosis among African Americans is 7.9 times that of the general population,¹³ an improbable estimate that implies that farmwork is protective against tuberculosis in African Americans.

We found in our previous study that number of years in farmwork was the most significant risk factor for infection with tuberculosis, and we thus described tuberculosis as an occupational risk for farmworkers.¹ North Carolina has a larger number of farmworkers than any other state without workers' compensation for farmworkers. Effective workers' compensation, a prerequisite to improving the general health of farmworkers, will also reduce tuberculosis transmission. We reported elsewhere that farmworkers with acute work-related injuries are sometimes denied medical access by their employers.¹⁰ It is probable that access to health care for the chronic symptoms of tuberculosis may be more difficult to obtain.

In response to numerous convictions of employers of farmworkers on charges of slavery and peonage, the North Carolina state legislature introduced a bill in 1984 making slavery illegal in North Carolina. This bill was opposed by the North Carolina farm bureau and other grower organizations.¹⁴ In our view, the barriers to health care faced by farmworkers and the curtailment of individual liberty indicated by the continuing convictions for slavery and peonage make tuberculosis among farmworkers a civil and human rights issue.

The agricultural lobby in North Carolina, which opposed the slavery bill, was also responsible for preventing legislation by the North Carolina state legislature to extend workers' compensation to farmworkers, a move that was under consideration by a committee appointed by the legislature in 1992.¹⁵ It is difficult to avoid the conclusion that disregard for the health and welfare of farmworkers is institutionalized in North Carolina state government.

We believe it is essential that the CDC and the US Department of Health and Human Services broaden their per-

spective with regard to tuberculosis control efforts. Their first step should be to provide direct and aggressive support for universal workers' compensation for migrant farmworkers in all states. □

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