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Tiago Ricardo Moreira[I]

Eliana Zandonade[II]

Ethel Leonor Noia Maciel[II]

Risk of tuberculosis infection among community health agents

ABSTRACT

OBJECTIVE: To estimate the risk of tuberculosis infection among community health agents involved in disease control.

METHODS: A prospective cohort was followed up from April 2007 to May 2008 in the municipality of Cachoeiro de Itapemirim, Southeastern Brazil. The cohort was composed of 61 community agents, divided between unexposed individuals (n = 37) and exposed individuals (who were following up tuberculosis patients; n = 24). Over the 12-month follow-up, the tuberculin test was performed, using the tuberculin PPD RT23. The relative risk and 95% confidence interval were calculated, and the correlation between tuberculin response and the agents' occupational history was evaluated by means of Pearson's correlation.

RESULTS: The incidence of the response was 41.7% in the exposed group and 13.5% in the unexposed group. The annual risk of infection was 52.8% in the exposed group and 14.4% in the unexposed group (p = 0.013). An association between tuberculin response and exposure to patients with tuberculosis was observed (RR = 3.08; 95% CI: 1.201;7.914).

CONCLUSIONS: The agents who followed up tuberculosis patients during their routine work presented a greater risk of infection than did those who were not following up such patients. Implementation of routine administrative biosafety measures, among which the tuberculin test, should be prioritized, given the high risk of acquiring tuberculous infection among community health agents.

DESCRIPTORS: Tuberculosis, nursing. Caregivers. Exposure to Biological Agents. Occupational Exposure. Occupational Risks. Community Health Centers.

[I] Programa de Pós-Graduação em Saúde Coletiva. Centro de Ciências da Saúde (CCS). Universidade Federal do Espírito Santo (UFES). Vitória, ES, Brasil

[II] Núcleo de Doenças Infecciosas. CCS-UFES. Vitória, ES, Brasil

Correspondence:
Ethel Leonor Maciel
Núcleo de Doenças Infecciosas
Centro de Ciências da Saúde
Universidade Federal do Espírito Santo
Av. Marechal Campos, 1468 – Maruipe
29040-091 Vitoria, ES, Brasil
E-mail: emaciel@ndi.ufes.br

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INTRODUCTION

Tuberculosis (TB) is currently one of the most important causes of morbidity-mortality in the world,[20] although it has been neglected in developing countries. Some studies[3,6,7,9,10,13,17,18,a] have dealt with healthcare professionals' risk of infection and becoming ill with *Mycobacterium tuberculosis*. However, in Brazil, only one study has looked into this risk among community health agents (CHAs).[14]

As a means of facing up to the TB situation better, the National Tuberculosis Control Program (*Programa Nacional de Controle da Tuberculose*, PNCT) relies on the strategies of the Family Healthcare Program and CHAs for expanding the TB control actions. From this perspective, the actions of these teams enables improvements in adherence to treatment and reduces the dropout rate, through the possibility of expanding case detection.[11]

Care for TB patients is one of the activities performed by CHAs, and this presents a high risk of infection for these health professionals. This problem, which had been neglected for a long time, has now come back into discussion through several studies that have emphasized the increased risk of infection by *M. tuberculosis* among health professionals or students working in this field.[6,16]

Studies[3,4,13,19] have indicated that there is a greater risk of infection among professionals acting in healthcare establishments, and have drawn attention to length of service, delays in diagnosis and laboratory proof, professional category, working in certain locations (such as emergency services, hospital admission units and laboratories) and lack of respiratory protection (masks), as factors that may influence the degree of contagion. However, none of these studies evaluated the risk of infection among CHAs. A study conducted recently in the municipality of Cachoeiro de Itapemirim, Southeastern Brazil, indicated that CHAs had a sixfold greater chance than did domestic employees (controls) of becoming infected with *M. tuberculosis*.[14]

In this light, the aim of the present study was to estimate the incidence of infection by *M. tuberculosis* among CHAs of the Family Healthcare Program.

METHODS

This was a prospective cohort study conducted between April 2007 and May 2008. It was composed of CHAs with and without exposure to TB patients within their professional activities.

The estimated population of the municipality of Cachoeiro de Itapemirim, state of Espírito Santo, was 201,665 inhabitants in 2006, according to the Brazilian Institute for Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística*, IBGE).[b] This is a priority municipality for the PNCT,[c,d] given the high number of new cases and high incidence. In 2006, 94 new TB cases were notified in the municipality, corresponding to an incidence of 47.4 cases/100,000 inhabitants.[e]

In March 2007, 196 CHAs were working in 19 Family Healthcare Units in the municipality. To calculate the sample size, the Epi Info 3.3.2 software was used. In the absence of studies with estimates of the strength of TB infection among CHAs, we used the odds ratio observed by Rodrigues et al (OR = 10).[14] The test reaction rate in the unexposed group was taken to be 10%, with a test power of 80% and significance level of 5%, for a ratio of exposed to unexposed cases of 1:1.5. With an allowance of 20% for possible losses, the minimum sample size was calculated as 21 CHAs for the exposed group and 34 for the unexposed group, thus totaling 55 CHAs.

Four CHAs were drawn from each of the 19 municipal Family Healthcare Units. Out of the 76 individuals selected, four were excluded because they were off work due to health problems unrelated to TB. The remaining 72 underwent the tuberculin test. Of these, 11 CHAs presented strong reactions to the test and 61 had a negative result. These 61 CHAs were invited to participate in the study. Of these, 24 followed up TB patients and 37 did not follow up TB patients between the first and second tests and in preceding years.

To confirm whether the CHAs had been exposed to TB, the Municipal Tuberculosis Control Program supplied a list of names and addresses of TB patients who were undergoing treatment at the time of the study and over the preceding seven years. From these addresses, the microareas and respective primary healthcare units

[a] Silva JA. O agente comunitário de saúde do projeto qualis: agente institucional ou agente da comunidade? [tese de dourado]. São Paulo: Faculdade de Saúde Pública da USP; 2001.
[b] Instituto Brasileiro de Geografia e Estatística. Estimativas populacionais dos municípios em 2006. Disponível em: http://www.ibge.gov.br/home/estatistica/populacao/estimativa2006/POP_2006_DOU.pdf
[c] Ministério da Saúde. Fundação Nacional de Saúde. Controle da tuberculose: diretrizes do plano de ação emergencial para os municípios prioritários. Brasília; 1997.
[d] Ministério da Saúde. Secretaria de Vigilância em Saúde. Programa Nacional de Controle da Tuberculose. Brasília; 2002.
[e] Ministério da Saúde. Secretaria de Vigilância em Saúde. Sistema Nacional de Vigilância em Saúde: relatório de situação, Espírito Santo. 2. ed. Brasília; 2006

were identified. The CHAs were then asked about visits to these patients' homes, in order to confirm any such exposure. There was only one CHA for whom the exposure information diverged from the microarea information given by the control program, and this was because the CHA was new to the microarea and had not been responsible for following up the patient. This CHA was therefore excluded from the study.

The following criteria were used for CHAs to be included in the study: a negative result in the tuberculin test and voluntary agreement to participate in the study. The exclusion criteria were: a positive result in the tuberculin test, a previous history of TB (during the last five years),[2] use of immunosuppressive treatment or vaccination with BCG within the last two years (self-reported). The data were collected by a trained interviewer, using a questionnaire consisting of closed questions seeking demographic and occupational data, clinical histories and exposure levels. The interviews were held during the visit when the tuberculin test results were given to the CHAs.

The CHAs' clinical histories were evaluated in relation to the following variables: previous TB treatment, booster dose of BCG, presence of BCG scar, use of medications, contact with TB patients outside of work settings and presence of family members with TB. Based on the information regarding exposure to TB cases within work settings, the CHAs were categorized as exposed or unexposed. CHAs who were confirmed as exposed were then asked to provide the following information: number of patients that they had followed up, number of patients that they were following up at that moment, number of visits per week made to each TB patient's home, length of time for which they had been following up the TB patients (in months), whether they were using any protection measures and what these measures were.

The tuberculin tests on the CHAs were performed using the tuberculin PPD RT23, applied intradermally in the middle third of the anterior face of the left arm. The tests were assessed 72 hours after the application, by a single professional with certification from the Ministry of Health. A millimeter ruler was used to measure the greatest diameter across the palpably hardened area, in accordance with the Manual of Tuberculosis Control Standards.[a] A hardened area greater than or equal to 10 mm in diameter was considered to represent a positive response to the tuberculin test. The test was applied by a professional who had been trained and certified by the State Health Department of Espírito Santo with a degree of concordance between readings of 94%. The tuberculin response (study outcome) was defined as an increase in the tuberculin response of at least 10 mm.[6] Subjects who presented a tuberculin result < 4 mm (weakly reactive) were considered to be negative.

The sample was formed by subjects with a mean age of 40 years and mean schooling level of ten years who were living in households with an average of three other people (Table 1). Women made up 98.4% of the sample (60) and men made up 1.6% (one individual). Regarding work location, 11 CHAs (18.0%) worked in the rural zone and 50 CHAs (82.0%) in the urban zone of the municipality. The groups were homogenous, without statistically significant differences relating to the variables cited.

The data were analyzed using the SPSS 12.0 software. For descriptive analyses on the quantitative variables, means and standard deviations were used, while for categorical variables, absolute and relative frequencies were used. The frequency measurement used was the accumulated incidence. The relative risk and 95% confidence interval were calculated. The χ^2 test, or Fisher's exact test when indicated, was used for association tests, while Student's t test was used for comparisons between means. The significance level was taken to be 5%. Furthermore, the correlation between the tuberculin response and the CHAs' occupational history was evaluated by means of Pearson's correlation coefficient.

The risk of infection with *M. tuberculosis* was calculated using the formula suggested by Ruffino-Neto, expressed as a percentage:[15]

Where: N_0 = number of individuals free from infection at the baseline; N = number of individuals who remained free from infection after the time t; t = time elapsed between the two tuberculin tests.

The study project was authorized by the Municipal Health Department of Cachoeiro de Itapemirim and received approval from the Research Ethics Committee of the Centro de Ciências da Saúde, Universdade Federal do Espírito Santo, under the number 127/06. All the participants signed a free and informed consent statement.

RESULTS

After following up the cohort for 12 months, 46 CHAs remained negative to the tuberculin test (75.4%): 14 in the exposed group and 32 in the unexposed group. Thus, the incidence of tuberculin response was 24.6% (15 CHAs), corresponding to 41.7% of the exposed group and 13.5% of the unexposed. The annual risk of infection was calculated as 52.8% in the exposed group and 14.4% in the unexposed group.

Regarding clinical histories (Table 2), two CHAs reported that they had had previous treatment for TB,

[a] Ministério da Saúde. Secretaria de Políticas Públicas. Plano de Controle da Tuberculose no Brasil de 2001-2005. Brasília; 2007.

Table 1. Distribution of the study subjects (exposed and unexposed), according to age, schooling level (years) and number of people living in the household. City of Cachoeiro de Itapemirim, Southeastern Brazil, 2007-2008.

Variable	Exposed n=24 Mean (SD)	Unexposed n=37 Mean (SD)	p
Age	41.33 (9.22)	39.37 (11.25)	0.48
Schooling level (years)	10.17 (1.31)	10.49 (1.91)	0.441
Number of people living in the household	3.21 (1.47)	3.41 (1.30)	0.585

during childhood. Eighty-three percent of the individuals in the sample presented a BCG vaccination scar. Only eight CHAs had been revaccinated during the three years preceding the study, and one of these presented tuberculin conversion according to the criteria used. Presence of TB within the family during the past year was reported by one subject, and contact with TB outside of work settings was reported by 21 CHAs. Of these individuals, 66.7% were in the unexposed group. Thus, the results in Table 2 show that there was no relationship between the variables within the CHAs' clinical history and their exposure.

An association was observed between tuberculin response and exposure to TB patients (p = 0.013). The relative risk (RR) was 3.08 (95% CI: 1.20;7.91) times greater than in the unexposed group. Among the results presented in Table 3, it can be seen that there was no association between tuberculin response and the number of patients followed up or the number of visits per week made to TB patients' homes (p > 0.05).

Only 5/24 (21%) of the CHAs said that they used any protection measures, i.e. keeping a distance from TB patients or remaining in ventilated locations during the visit.

DISCUSSION

CHAs are professionals who are trained to carry out disease prevention and health promotion activities through individual and collective actions at household and community levels, developed in accordance with the guidelines of the Brazilian National Health System (*Sistema Único de Saúde*, SUS). Under supervision by the local administrator, CHAs act to advise and follow up families and communities with regard to caring for their own health.[12] These professionals present special characteristics because they work within the communities where they live and become reference points for the populations of their areas.[8]

The reason why only a single study[14] on occupational risks among CHAs was found through surveying the

Table 2. Variables within community health agents' clinical histories in relation to exposure. City of Cachoeiro de Itapemirim, Southeastern Brazil, 2007-2008.

Variable	Exposed n=24 n (%)	Unexposed n=37 n (%)	p
Previous TB treatment			
Yes	2 (8.3)	-	0.150[a]
Booster dose of BCG			
Yes	4 (16.6)	4 (10.8)	0.700[a]
Presence of BCG scar			
Yes	21(87.5)	30 (81.1)	0.726[a]
Use of medication			
Yes	12 (50)	20 (54)	0.756
Contact with TB patients outside of work settings			
Yes	7 (29.3)	14 (37.7)	0.486
Presence of family members with TB			
Yes	-	1 (2.7)	1.000[a]

[a] Fisher's exact test
TB: tuberculosis
BCG: Bacillus Calmette-Guérin

Table 3. Correlation between response to tuberculin test among community health agents in the exposed group and their follow-up of patients with tuberculosis. City of Cachoeiro do Itapemirim, Southeastern Brazil, 2007-2008.

Variable	Response (correlation coefficient)	p
Length of time working as a community agent	0.131	0.316
Number of patients that had been followed up	0.258	0.223
Number of patients that were being followed up	0.152	0.241
Length of time for which TB patients were being followed up	0.138	0.289
Number of visits per week to the homes of TB patients	0.332	0.124

literature may be the short time since CHAs were incorporated into TB control actions (since 2004).[a]

The mean risk found in the two groups was 27.9%. This was similar to the result from Rodrigues et al,[14] who found a prevalence of 26.7% among CHAs in Cachoeiro de Itapemirim, which was significantly greater than their domestic worker controls (3.3%).

One limitation of this study was the lack of a second tuberculin test performed two to three weeks after the first one, to evaluate the booster phenomenon. The Centers for Disease Control and Prevention of the United States (CDC) recommend that when periodic tests are performed as annual monitoring on hospital personnel, individuals with a negative response to the initial skin test should repeat it one week later. This procedure avoids classification of false negatives.[1]

Oliveira et al[13] found that the prevalence of the booster effect was 8.4% among the professionals of a university hospital in the city of Campo Grande, Centeral-Western Brazil. In a study among medical students at a university in Rio de Janeiro, Silva et al[17] found a positive booster effect in 1.3%. This was similar to the result from Maciel et al,[7] with a positive booster effect in 1%, among groups of medical, nursing and economics students at a university in Espírito Santo. Although this last study[7] was also carried out in the state of Espírito Santo, we cannot make the inference that those results from analysis of the booster effect could be extrapolated to our sample.

The high proportion of CHAs who were following up TB patients or undertaking supervised treatment without using personal protection equipment reinforces the need to formulate public policies for this professional group. CHAs' participation in combating TB has strengthened the fight against this disease, but it has exposed thousands of these professionals to a high risk of infection. This increased risk of infection by *M. tuberculosis* puts the benefits of including these professionals in the TB combat program into question unless the preventive measures available are adopted. Moreover, the force of infection among the two study groups was greater than the force among the general population.[5]

Routine biosafety measures need to be implemented, given the high risk of tuberculous infection among CHAs. These measures include periodic tuberculin tests in accordance with the length of exposure and location of contact with patients and use of masks.

[a] Ministério da Saúde. Secretaria de políticas Públicas. Plano de controle da tuberculose no Brasil de 2001-2005. Brasília; 2007.

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