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SHORT COMMUNICATION

Increase in tuberculosis incidence among the staff working at the Tuberculosis Demonstration and Training Centre in Addis Ababa, Ethiopia: a retrospective cohort study (1989–1998)

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SUMMARY

The incidence rate of tuberculosis was studied among the staff of the Tuberculosis Demonstration and Training Centre (TDTC) of Addis Ababa between 1989 and 1998, by reviewing all clinical charts of the 175 staff members for evidence of tuberculosis. During the study period, 24 cases of tuberculosis were diagnosed, including 12 who were bacteriologically confirmed. The incidence rate of tuberculosis increased from 1695 per 100 000 person-years (py) in 1989 to 5556/100 000 py in 1998 (test for trend, $P < 0.001$). Urgent measures are required for better protection of the staff from human immunodeficiency virus infection and tuberculosis.

KEY WORDS: human immunodeficiency virus; tuberculosis; opportunistic infections; nosocomial transmission; Africa

INDIVIDUALS co-infected with the human immunodeficiency virus (HIV) and *Mycobacterium tuberculosis* have a 5% to 8% annual risk of developing active tuberculosis.[1] Health workers in Africa, who are subject to similar rates of HIV infection as the general population,[2] and who are exposed to a large number of patients with tuberculosis, may[3,4] or may not[5] have higher tuberculosis incidence than the general population. Health workers employed in tuberculosis diagnosis and treatment centres are particularly exposed to tuberculosis, and have to our knowledge never been studied as a group. In this article, we report the results of a retrospective cohort study of tuberculosis incidence and mortality among workers of the Tuberculosis Demonstration and Training Centre (TDTC), Addis Ababa, Ethiopia.

METHODS

The TDTC of Addis Ababa was, until 1993, one of three referral centres for tuberculosis diagnosis and treatment in all of Ethiopia. Since then, the gradual decentralisation of the National Tuberculosis and Leprosy Control Programme has given rise to numerous district centres for the diagnosis and management of tuberculosis. As a result, the number of patients seen for suspicion of tuberculosis at the TDTC decreased from 23 667 in 1993 to 16 952 in 1998, and the number of tuberculosis cases diagnosed from 5249 in 1993 to 4862 in 1998. In this crowded working environment, health staff collect and examine sputum samples from more than 200 patients every day. The laboratory is equipped with ordinary microscopes, and does not have a safety hood.

For the purpose of this study, the medical charts of all workers employed at the TDTC since 7 September 1988 were reviewed for indications of tuberculosis treatment. It is expected that any worker with tuberculosis suspicion would be evaluated first at the TDTC, as the services provided there were of better quality, more elaborate (possibility of chest radiography and sputum cultures), and free.

Diagnosis of pulmonary tuberculosis was said to be confirmed when based on a positive sputum smear or culture, or suspected when based on clinical and radiological findings (improvement following anti-tuberculosis treatment was required for suspected cases). For tuberculous lymphadenitis, diagnosis was said to be confirmed when based on a positive biopsy (i.e., showing caseum or with a positive smear from the cut surface) or culture, or suspected when based on clinical findings and improvement under anti-tuberculosis

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treatment. The study protocol was approved by the Ethiopian Health and Nutrition Research Institute Ethics Committee.

For each worker, person-time at risk for tuberculosis was calculated from study entry (7 September 1988 for staff then working at the TDTC, or employment date for staff joining later) to date of tuberculosis diagnosis, date of leaving the TDTC, or date of study closure (6 September 1998), whichever came first. The incidence rates of tuberculosis were calculated per 100 000 person-years (py) of work at the TDTC. Incidence rates were compared among calendar years (Mantel trend test for person-time data), and among staff categories (exact *P* values for person-time data). Incidence rates for 1998 were calculated for the adults (>15 years of age) living in the TDTC catchment area (Woreda 7), using the 1994 census data for the calculation of the denominator. All individuals in a district who are diagnosed with tuberculosis are referred for treatment to their district health facility, which, for people living in Woreda 7, is the TDTC. An incidence rate ratio (RR) and its 95% confidence interval (95%CI) were calculated (assuming a Poisson distribution of events), comparing the incidence rate of tuberculosis among the TDTC workers to that of the adult population of the TDTC catchment area. To study the changes in mortality in the staff population in recent years, we retrieved information on the vital status of all individuals employed at the TDTC during the study period, including those departing before the end of the period. For each worker, person-time at risk for death was calculated from study entry (7 September 1988 for staff then working at the TDTC, or employment date for staff joining the TDTC later) until date of death, or date at which last information on the vital status of the staff was available, or date of study closure (6 September 1998), whichever came first. Mortality rates were calculated per 100 000 py of follow-up, and changes in mortality rates were compared among calendar years using a Mantel trend test for person-time data.

RESULTS

Between 7 September 1988 and 6 September 1998, 175 individuals were employed at the TDTC, contributing to a total period of 1094 py of follow-up. The median age at study enrolment was 34 years for males ($n = 102$) and 31 years for females ($n = 73$). During the study period, 24 cases of tuberculosis were diagnosed: 17 pulmonary, six extra-pulmonary, and one combined. Of these, 12 were confirmed, and 12 were suspected. With specific treatment, 13 (54%) patients were cured, but 11 died during or shortly after treatment; death occurred within 2 years of starting treatment for all but one, who died 4 years after starting treatment.

The incidence rate of tuberculosis increased from 1695/100 000 py in 1989 to 5556/100 000 py in 1998 (test for trend, $P < 0.001$) (see Figure 1). Of the 12 confirmed cases, seven (58%) were diagnosed during the last 3 years of the study (1996–1998), and when the analysis was restricted to confirmed cases, the incidence rate of tuberculosis increased from 847/100 000 py in 1989 to 3333/100 000 py in 1998 (test for trend, $P = 0.04$). Among staff categories that accumulated at least 50 py of follow-up during the study period, the incidence rates of tuberculosis/100 000 py of follow-up, ranging from highest to lowest, were 7042 (5/71) for drivers, 4545 (3/66) for laboratory technicians, 2239 (3/134) for cleaners,

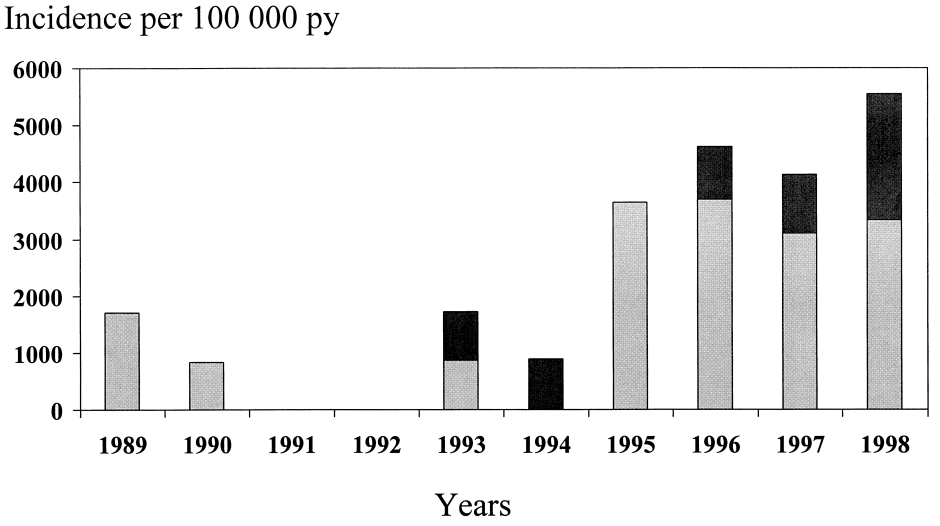

Figure 1 Incidence of pulmonary (light grey) and extra-pulmonary (dark grey) tuberculosis (per 100 000 py) among the staff working at the Tuberculosis Demonstration and Training Centre, Addis Ababa, 1989–1998. One case combining pulmonary and extra-pulmonary manifestations in 1998 was counted as pulmonary only. py = person-years.

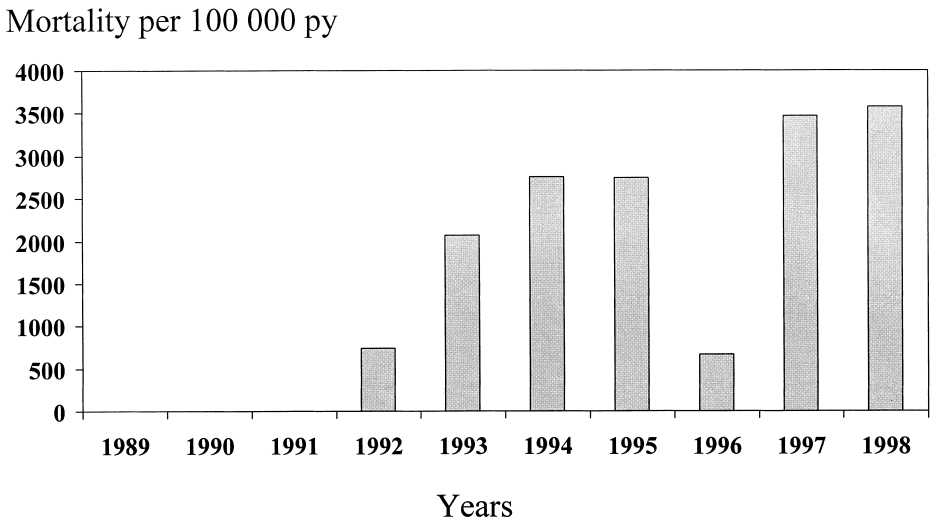

Figure 2 Mortality rate (per 100 000 py) among the staff working at the Tuberculosis Demonstration and Training Centre, Addis Ababa, 1989–1998. py = person-years.

2013 (3/149) for laboratory assistants, 1754 (1/57) for medical doctors, 1587 (2/126) for guards, 1550 (4/258) for administrative staff, 833 (1/120) for nurses, and 0 (0/50) for X-ray technicians. The difference in tuberculosis incidence for each staff category, compared to all other categories combined, was statistically significant only for drivers ($P = 0.02$). Finally, the incidence rate of tuberculosis among adults (≥15 years of age) living in the TDTC catchment area was 777 per 100 000 py (461/59 304, 95%CI 708–852), and the incidence rate ratio of the tuberculosis incidence rate among TDTC workers to that of adults in the TDTC catchment area in 1998 was 7.15 ([5/90] / [461/59 304], 95%CI 2.31–16.80).

Information on the vital status of the staff was available for 1381 py of follow-up (for this analysis, on the date of study closure, no vital status information was available for 7% [12/175] of study subjects; for these subjects, follow-up was censored at the last date with vital status information available). During this period, 23 deaths occurred; mortality increased from 0 in 1989 to 3571/100 000 py in 1998 ($P = 0.001$, test for trend) (Figure 2). Of the 23 deaths, 11 (48%) occurred in individuals who had received a previous diagnosis of tuberculosis.

DISCUSSION

This study demonstrated a large increase in tuberculosis incidence between 1989 and 1998 among the staff working at the TDTC of Addis Ababa. This increase was associated with a rapidly expanding HIV epidemic in the capital city of Ethiopia, whereby HIV prevalence rose in the general population from about 2% in 1988 to 10-18% in 1997.[6,7] Although data were not available on individual HIV status among the staff who developed tuberculosis, it is reasonable to speculate that the two epidemics are linked. The large concurrent increase in staff deaths, of which half occurred in subjects previously diagnosed with tuberculosis, supports this assumption and underlines the impact of the HIV epidemic on health care workers, already a scarce resource for developing countries.[8]

The finding that in 1998, the incidence rate of tuberculosis was more than seven times higher in the staff compared to the general population suggests nosocomial transmission of tuberculosis at the TDTC, through exposure to patients in the wards or to mycobacteria in the laboratory. Other explanations, such as increased detection of tuberculosis among TDTC staff due to higher awareness and immediate access to diagnostic facilities, or increased HIV prevalence among the TDTC staff compared to the surrounding population, could contribute to the difference in tuberculosis incidence compared to the general population. It would not explain a seven-fold difference, however, particularly since HIV prevalence in the TDTC catchment area (21.5% among pregnant women in 1996) is considered high for Addis Ababa, based on HIV sentinel surveillance data collected at antenatal care centres in the city.[6] The higher tuberculosis incidence among drivers compared to other workers may be the result of higher HIV prevalence among professional drivers compared to the general population,[7] combined with exposure to patients in the closed environment of a car during transportation to the nearby referral hospital.

Our findings highlight the necessity of offering better protection from tuberculosis to the staff working with tuberculosis patients. Harries et al. recently reviewed several general measures to protect workers from tuberculosis in the context of sub-Saharan Africa's health care facilities.[9] Some measures were

based on improvement of tuberculosis case management, such as tuberculosis suspects seen as outpatients, use of a fluorescent microscope for quicker diagnosis, dissolution of sputum in household bleach; others reflected better safety and hygiene in the working environment, such as use of laminar flow, hoods and exhaust fans, and provision of proper sunlight and ventilation in the wards. These measures are of obvious benefit and should be implemented wherever possible. In addition, it is suggested to provide voluntary HIV testing and counselling to health workers and avoid exposure to *Mycobacterium tuberculosis* of workers who test positive for HIV antibodies. As the latter measure would be difficult to implement without jeopardising the confidentiality of HIV test results and the workers' employment rights, its feasibility and acceptability among workers should be carefully studied. Alternatively, or in complement, HIV-infected health workers may be offered isoniazid preventive therapy after careful exclusion of active tuberculosis. Also effective would be the treatment of HIV infection with anti-retroviral drugs where available, as the restoration of the immune system under treatment would lead to reduced incidence of tuberculosis. Finally, HIV prevention among health workers and the population at large should be supported, because HIV is the underlying cause of the recent tuberculosis epidemic.

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RÉSUMÉ

Le taux d'incidence de la tuberculose a été étudié au sein du personnel du Centre de Démonstration et de Formation sur la Tuberculose à Addis Abeba entre 1989 et 1998, grâce à une revue de l'ensemble des dossiers cliniques à la recherche de signes de tuberculose chez les 175 membres du personnel. Au cours de la période d'étude, nous avons diagnostiqué 24 cas de tuberculose, parmi lesquels 12 cas avec confirmation bactériologique. Le taux d'incidence de la tuberculose a augmenté de 1.695 pour 100.000 personnes-années en 1989 à 5.556 pour 100.000 personnes-années en 1998 (test de tendance, $P <$ 0,001). Des mesures urgentes s'imposent pour mieux protéger le personnel contre l'infection due au virus de l'immunodéficience humaine et la tuberculose.

RESUMEN

Se estudió la tasa de incidencia de tuberculosis en el personal del Centro de Demostración y de Formación en Tuberculosis de Addis Ababa entre 1989 y 1998. Se revisaron todas las fichas clínicas de 175 miembros del personal, en búsqueda de evidencias de tuberculosis. Durante el período de estudio se diagnosticaron 24 casos de tuberculosis, de los cuales 12 tuvieron confirmación bacteriológica. La tasa de incidencia de tuberculosis aumentó de 1695 por 100 000 años-persona en 1989 a 5556 por 100 000 años-persona en 1998 (test de tendencia, $P <$ 0,001). Se imponen medidas urgentes para proteger al personal de la infección al virus del inmunodeficiencia humana y de la tuberculosis.