# High frequency of Tuberculosis in households of patients with Pulmonary Tuberculosis in Mzimba, Malawi.

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**Summary.**

**A case-control study was carried out in Mzimba district to determine whether household members of a patient with pulmonary tuberculosis (PTB) had an increased frequency of TB compared with households where no TB had been previously diagnosed. There were 79 patients with PTB (66 with smear-positive PTB and 13 with smear-negative PTB) and 79 controls, matched by age and sex. Household compositions were similar. During a mean period of observation of 35 months, 8 household members from PTB patient households developed TB compared with no household members from control households (RR 1.99, 95% CI 1.81 - 2.18). The case notification rate of TB in household members from patients with all types of PTB was calculated at 1221 / 100,000/ year: the rates were 1233 / 100,000 / year for household members from patients with smear-positive PTB and 1127 for household members from patients with smear-negative PTB. The frequency of TB in households of TB patients is significantly higher than in households of control persons who have not suffered from TB.**

## Introduction

Since 1984 Malawi has had a well functioning tuberculosis control programme (NTP), based on the principles of the World Health Organization's "DOTS" TB control strategy. Despite this, the number of TB case notifications has increased annually, and in 2000 nearly 25,000 cases were registered and treated nationally. The increase in TB cases is linked to HIV infection, and in 2000 77% of TB patients country-wide were HIV-seropositive[1]. As an additional strategy to "DOTS", the NTP is considering the use of isoniazid preventive therapy to HIV-positive persons in order to reduce the incidence of TB[2]. This method of control is difficult to implement on a country-wide scale, and therefore the effectiveness of targeting high risk groups will be explored.

A high risk group that may warrant TB preventive therapy is the household of an index patient with tuberculosis. However, little is known at present in Malawi about the extent of household TB transmission and the risk of TB in households of index TB patients. We therefore conducted a case-control study in one district to determine whether household members of a patient with pulmonary tuberculosis (PTB) had an increased frequency of TB compared with households where no TB had been previously diagnosed.

## Methods

A case-control study was performed in Mzimba, a rural district in the Northern Region of Malawi with an estimated population in 1998 of about 610,000. In 1997 and 1998, the health services included one government district hospital, three mission hospitals and 40 health centres.

Cases. All patients who were diagnosed and treated for PTB at Mzimba District Hospital in 1997 and 1998 were identified from the TB registers, and the names and addresses of those who completed treatment were listed. The households of these patients were visited by TB programme staff in 2000, and patients who were still alive were interviewed using a structured proforma. Prior to these visits, NTP staff received training and briefing about how to conduct the interviews using the same structured proformas. The time from diagnosis of PTB up to the time of the interview was defined as the period of observation of the household, and was measured in months. Patients were asked about monthly cash income, the number of household members (including age, sex and relationship to the patient) and whether any member had been diagnosed and treated for TB during the period of observation. If a household member had been diagnosed with TB, details were obtained and verified in TB registers wherever possible.

Controls. In the village where the patient lived, a person of the same sex and within 5 years of the age of the PTB patient and living near to the patient's home was selected as a control, provided that person had not previously suffered from TB. Control persons were asked about monthly cash income, the number of household members and whether any member had been diagnosed and treated for TB during the same period of observation that applied to the index patient with PTB with whom they were paired.

In patients, controls and their respective households, HIV-serostatus was not determined due to lack of resources and infrastructure.

Analysis. Categorical variables were compared using X2 test, differences at the 5% level being regarded as significant. Relative risks (RR) with 95% confidence intervals were calculated where appropriate.

## Results.

One hundred and forty nine patients with PTB completed treatment. Of these, 39 had died, 14 had moved to another district by the time of the interview, and one patient on re-checking was found to have been wrongly registered. 95 patients were interviewed. Of these, 16 questionnaires were badly completed, leaving 79 patients (32 males and 47 females, whose mean age was 35 years) with properly completed questionnaires. There were 66 patients who had been diagnosed with smear-positive PTB and 13 with smear-negative PTB. There were 79 controls, 32 males and 47 females, whose mean age was 34 years.

Median monthly cash income for PTB patients, known by 73 patients, was 200 MK (70MK = 1USD at the time of the study). Median monthly cash income for controls, known by 58 persons, was 400 MK. Characteristics of households, periods of observation and the number of household members who developed TB for both groups are shown in Table 1.

**TABLE 1: Characteristics, periods of observation and development of tuberculosis in households of patients with pulmonary tuberculosis and controls.**

| Characteristics | Pulmonary TB Patients | Control Persons |
|---|---|---|
| Number | 79 | 79 |
| No. household members: | 229 | 218 |
| parents | 24 | 14 |
| siblings | 32 | 36 |
| children | 91 | 97 |
| spouse | 41 | 42 |
| relatives / other | 41 | 29 |
| Mean age of household members in years | 23 (N=196) | 20 (N=180) |
| Period of observation for all households in months: | 2727 | 2727 |
| No. household members who developed TB | 8 | 0 |

For patients and controls, the composition of the households was similar, and the mean period of observation was 35 months. During this period, 8 household members, each one from a different household, developed TB in the PTB patient households compared with no household members in control households (RR 1.99, 95% CI 1.81 - 2.18, $p < 0.05$). The types of TB in household members are shown in Table 2.

**TABLE 2: Types of Tuberculosis in household members of pulmonary Tuberculosis patients.**

| TB status of Index Patient | Household member's: Relationship to Index Patient | Age | Sex | Type of TB |
|---|---|---|---|---|
| Smear-positive PTB | Sister | 20 | F | TB lymphadenopathy |
| Smear-positive PTB | Spouse | 28 | F | PTB (smear status unknown)* |
| Smear-positive PTB | Aunt | 40 | F | TB lymphadenopathy |
| Smear-positive PTB | Spouse | 22 | F | Smear-positive PTB |
| Smear-positive PTB | Parent | 57 | M | Smear-positive PTB |
| Smear-positive PTB | Brother | 22 | M | PTB (smear status unknown)* |
| Smear-positive PTB | Relative | 25 | F | PTB (smear status unknown)* |
| Smear-negative PTB | Spouse | 41 | M | Smear-positive PTB |

* Registration details not verified.

The case notification rate of TB in household members from patients with all types of PTB was calculated at 1221 / 100,000/ year [based on 8 members developing TB; 229 household members with a total of 7873 months of observation]. The case notification rate of TB in household members from patients with smear-positive PTB was calculated at 1233 / 100,000/ year [based on 7 members developing TB; 195 household members with a total of 6807 months of observation]. The case notification rate of TB in household members from patients with smear-negative PTB was calculated at 1127 / 100,000/ year [based on 1 member developing TB; 34 household members with a total of 1066 months of observation].

## Discussion

This retrospective case-control study in a rural district in Malawi shows that the frequency of TB in the households of TB patients was significantly higher than in the households of control persons who had not suffered from TB. Household members of TB patients had a case notification rate of TB in excess of 1000 / 100,000 per year, this rate being higher in households where the index patient had smear-positive PTB. This is in keeping with well known observations that patients with smear-positive PTB are more infectious than those with smear-negative PTB, although recent studies using DNA fingerprinting suggest that patients with smear-negative PTB may contribute up to 20% of tuberculosis transmission within a community[3].

Within the constraints of this type of operational research, the households of PTB patients and controls were reasonably matched with similar compositions and low median monthly cash incomes. HIV-infection is a major factor for the development of active TB in a community[4,5], and one of the limitations of our study was not ascertaining the HIV-serostatus in patients, controls and their households.

The results of this study in Malawi on household TB support the results of other operational studies showing a higher frequency of household TB transmission amongst diagnosed TB cases.

Prospective studies on the magnitude of TB transmission should now be undertaken, as well as studies in the routine setting which explore ways to reduce the risk of transmission. These might include:- a) active screening of household members for TB, b) offering voluntary counselling and HIV testing to patients and household members, and c) offering isoniazid preventive therapy to those who test HIV-positive and to all children under 5 years of age, provided that active TB can be excluded.

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