The acquired immunodeficiency syndrome (AIDS) and leprosy are both endemic in Uganda. As of 1 November 1992, the cumulative number of AIDS cases in Uganda was reported as 34,611 (17). Uganda also was included among 25 African countries with a significant leprosy problem (19). At the end of 1992, the prevalence of registered leprosy patients in the country was reported as 1.3 per 10,000 population with a new case detection rate of about 1.1 per 10,000 population (Uganda National Tuberculosis/Leprosy Programme. Annual Leprosy Statistics, 1992).

Various speculations about the possible interaction between infection with the human immunodeficiency virus (HIV) and leprosy have been recorded (6, 9, 11, 16). It has been suggested that the effect of HIV on cell-mediated immunity can lead to conversion of subclinical cases to tuberculoid cases, downgrading of paucibacillary (PB) cases to multibacillary (MB) cases, and an increased incidence of type 2 leprosy reactions (16).

This case-control study was carried out to investigate if there is any relationship between HIV seropositivity and leprosy in Uganda.

MATERIALS AND METHODS

The study was carried out in part of the leprosy control project area of the St. Francis Leprosy Centre, Buluba. The area, covering eight Ugandan districts, has a population of about 4,910,700 persons (Republic of Uganda Provisional Results of the 1991 Population-Housing Census).

Leprosy case detection in the area occurs mainly through voluntary reporting. The patients, once diagnosed, are looked after through a network of clinics which are professionally supervised from St. Francis Leprosy Centre, Buluba.

All newly detected cases of leprosy from among the resident population of the study area during January 1991 to June 1992 were requested to participate in the study but were only included in the study if they consented. All cases registered in this study reported voluntarily for diagnosis. The cases were given a clinical examination following a standard Ugandan Ministry of Health format. Skin smears were taken in and reported on at the laboratory of St. Francis Leprosy Centre, Buluba.

Using the clinical data and results of the skin-smear examinations, the patients were classified as tuberculoid (TT), borderline tuberculoid (BT), borderline lepromatous (BL) and lepromatous (LL) as per the Ridley-Jopling scale (13). The diagnoses and classifications initially made by paramedical supervisors were confirmed by medical officers. Histopathological examinations were only carried out in doubtful cases.

Up to three controls were chosen for each patient. The controls were matched with patients for sub-county of residence and age, within 5-year age groups up to age 40, and within 10-year age groups thereafter. Matching by sub-county of residence was achieved by selecting suitable controls from the nearest households. Only one adult female from each household was recruited into each matched set. In the case of those few leprosy patients below the age of 15 years, an attempt was made to select controls within a 2-year age difference. There is a high chance that young patients would be HIV negative and that controls up to 5 years older may have a higher HIV seroprevalence.

Cases and controls were visited at their homes by paramedical supervisors. Information obtained from the visits was recorded on the questionnaires designed for that purpose. Five ml blood samples were
TABLE 1. Distribution of patients and controls in HIV/leprosy study by sex and district of residence.

| District | Patients |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          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|          |          |          |          |          |          |          |          |          :
positive for HIV antibodies. Out of 481 serum samples collected from controls, 88 (18.3%) were positive for HIV antibodies. The distribution of HIV-seropositive patients and controls by district of residence is shown in Table 4.

Tests of association for the whole sample population had a p value of p = 0.176. Going by this result, we conclude that there is not enough evidence to show that HIV seropositivity and leprosy are related. When a Cochran-Mantel-Haenszel analysis was used to test the hypothesis of no association using the districts as a controlling factor, the results were very similar, p = 0.198.

When the test was repeated for each of the individual districts and the results of Fisher's exact test for association analyzed, in all the districts except Rakai, no association was found. A reversed association was found in the case of Rakai District (0.04 < odds ratio (OR) < 0.61, p = 0.00175).

The proportion of HIV-seropositive leprosy patients was almost equal in males and females. In the control group there were more HIV-seropositive males than females (Table 5).

Of the 189 leprosy patients studied, 138 (73%) had PB leprosy and the remaining 51 (27%) had MB leprosy. Out of the 23 HIV-seropositive patients, 12 (52.2%) were PB and 11 (47.8%) were MB. In this population of leprosy patients HIV seropositivity was significantly more frequent among MB than PB patients (Table 6).

**DISCUSSION**

It has been recorded that the selective tropism of HIV-1 for T-4 lymphocytes leads to T-cell depletion and the lowering of T-cell defenses, giving way to a variety of opportunistic infections (4).

Several studies have already shown that there exists a number of leprosy patients who are dually infected with HIV-1 and *Mycobacterium leprae* (7, 8). We report here 23 patients (perhaps the largest number reported from a single study) arising from a
population where both AIDS and leprosy are significant public health problems. The outcome of this case-control study, although not necessarily representing the situation in the whole of Uganda, concurs with the conclusions drawn by others (11, 16) that there is, so far, not enough evidence to show that leprosy and HIV seropositivity are related.

The results of this study show that infection with HIV-1 may be expected to occur in about 12% of newly recognized leprosy patients in Uganda. As long as both HIV-1 infection and leprosy continue to be endemic in Uganda, it remains important to study the implications of the dual infection on the clinical presentation of leprosy, the response to chemotherapy, the frequency and pattern of leprosy reactions, the outcome of their management, and the influence on relapse rates. Some of the observations made on the dually infected patients in the course of this study have been published (4) elsewhere.

A pattern similar to the one in Rakai District where HIV-1 infection was significantly more frequent in the control population than among the new leprosy patients, has been recorded in at least one other study (14). Although this could be simply the results of a sampling error or other methodological biases, we find it hard to ignore the observation, since Rakai District has one of the most severe HIV-1/AIDS problems in Uganda (Uganda Ministry of Health AIDS Surveillance Report, December 1991).

It has been suggested that the immunological changes in lenti-virus infections may resemble those of lepromatous leprosy (1). In the population studied, HIV-1 seropositivity was significantly more frequent among MB than PB patients. The mean age of the HIV-1 seropositive patients did not differ significantly (39.2 years in PB and 37.9 years in MB).

Earlier observations on ELISA and Western blot (WB) assays used for confirmation of HIV-1 infection had indicated that false-positivity and crossreactivity by WB assays could occur (3, 12). A particularly high rate of crossreactivity, 64%, was reported from India by Shiraj and others (15). These authors recommended that in countries where leprosy and tuberculosis are highly prevalent, the results of the WB assays should be interpreted with great caution. They suspected that there could be a common antigenic pattern between HIV-1 and mycobacteria, especially M. leprae. In our study, WB was only employed in cases where results from ELISAs were found discrepant. Some further insight into this situation may be gained through continuing to follow up the seropositive patients in this study with the view to observing the transformation from HIV infection to AIDS.

The inter-relationship between HIV-1 infection and leprosy still deserves further study because so far the immunology of leprosy has not yet been exhaustively studied and the absence of a relationship between the two remains hard to explain.

### TABLE 5. Sex distribution of HIV sero-positive patients and controls.

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>99</td>
<td>90</td>
<td>188</td>
</tr>
<tr>
<td>HIV+</td>
<td>12</td>
<td>11</td>
<td>23</td>
</tr>
<tr>
<td>% Positive</td>
<td>12.2%</td>
<td>12.2%</td>
<td>12.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>237</td>
<td>244</td>
<td>481</td>
</tr>
<tr>
<td>HIV+</td>
<td>49</td>
<td>39</td>
<td>88</td>
</tr>
<tr>
<td>% Positive</td>
<td>20.7%</td>
<td>16%</td>
<td>18.3%</td>
</tr>
</tbody>
</table>

### TABLE 6. Distribution of HIV-seropositive cases by leprosy type.

<table>
<thead>
<tr>
<th></th>
<th>Paucibacillary</th>
<th>Multibacillary</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Totals</td>
</tr>
<tr>
<td>All patients</td>
<td>45</td>
<td>93</td>
<td>138</td>
</tr>
<tr>
<td>HIV+</td>
<td>4</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>% Positive</td>
<td>8.7%</td>
<td>8.6%</td>
<td>8.7%</td>
</tr>
</tbody>
</table>

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SUMMARY

Both leprosy and infection with the human immunodeficiency virus (HIV) are endemic in Uganda. Various speculations about a possible interaction between the two infections have been put forward but not confirmed.

A case-control study involving 189 new leprosy patients and 481 matched controls, resident in eight Ugandan districts, was carried out to investigate if any relationship exists between leprosy and infection with HIV-1 in Uganda. Serum samples from 23 (12.2%) of the 189 leprosy patients tested positive for HIV-1 antibodies as compared to 88 (18.3%) of the 481 control sera. The two proportions of HIV seropositivity are not different statistically. A stratified analysis of the data by districts was done and showed a negative relationship between leprosy and HIV infection in the case of Rakai District (0.04 < odds ratio < 0.61, p = 0.002).

It is recommended that studies seeking to observe the clinical progress of dually infected patients might help to reveal new knowledge about a possible relationship between HIV and leprosy and about the immunology of leprosy in general.

REFERENCES