Incidence of leprosy in Agra District

ANIL KUMAR, ANITA GIRDHAR & BHAWNESHWAR KUMAR GIRDHAR
National JALMA Institute for Leprosy & Other Mycobacterial Diseases (ICMR), Taj Ganj, Agra 282 001, India

Accepted for publication 22 February 2007

Summary This study presents estimates of incidence of leprosy among the familial contacts (FC) and non-familial contacts (NFC) of leprosy patients in Agra, a district endemic for leprosy. The study covers 42,113 persons followed up for 123,951.2 person years (PY) during which 77 individuals developed leprosy giving an incidence of 6.2/10,000 PY in the total leprosy-free population studied (TLPS). The incidence rate in NFCs was observed to be 4.6/10,000 PY while the FCs had a significantly higher incidence rate of 67.6/10,000 PY (P<0.001). Incidence rate among the FC of paucibacillary leprosy (PB) patients was 41.0/10,000 PY while the corresponding figure for multibacillary leprosy (MB) contacts was 131.3/10,000 PY (P<0.05). Applying methods of survival analysis, the incidence rate at the end of 1 year was observed to be 4.0 (per 10,000), increased to 12.0 by 2 years and 18.0 at the end of 3 years in TLPS. The incidence rate was almost similar in both the sexes and was found to increase significantly with age. The observations clearly indicate that leprosy is still endemic in the area and transmission continues.

Introduction

Periodic epidemiological evaluation of any disease is an important public health activity and it enables us to understand the trend of the disease under natural conditions or following interventions. Though there has been a marked decline in the total case load of leprosy in India,1 an understanding of the current magnitude is important for both the service providers and the community. Although prevalence and new case detection rates in leprosy are the routine monitoring tools and indicate partially about the transmission of the disease in a community, the incidence rate speaks entirely about transmission patterns in various groups and subgroups like contacts.

Leprosy control strategies had been based on total population surveys aiming at a high proportion of community coverage for detection and treatment. However, for some practical reasons this has not happened uniformly in India. As a result, community coverage for case detection had varied considerably at all levels resulting in significant hidden or missed cases.
This has been responsible for the continued exposure of the healthy population to the disease from undetected cases. It is thus important to have incidence estimates to plan better elimination strategies. Such studies from various geographical areas and population subgroups are required to understand the total transmission dynamics of leprosy.

In the past several attempts have been made from Tamilnadu, Uttar Pradesh and elsewhere to estimate the incidence of leprosy. Studies from South India have shown that household FCs of index leprosy cases had a higher risk of developing leprosy than NFCs. Workers from Uttar Pradesh, Mumbai and Wardha have looked at the overall crude incidence (irrespective of time frame). This study presents data on incidence rate (IR) among both family members and general population from Agra district in Uttar Pradesh – a north Indian state, where the disease prevalence still continues to be high.

Materials and Methods

As part of the project on epidemiology of leprosy in Agra, continuous house-to-house case detection activities have been undertaken since 1999. Published studies had indicated that both rural and urban areas of Agra are endemic for leprosy with an observed overall prevalence of 16.4/10,000 population examined. The population surveyed in the years 1999–2001 formed the basis of the present study. All the patients detected had been put on treatment. A re-survey was conducted in those (with or without leprosy) examined earlier. The total leprosy-free population studied (TLPS) included a) FCs – individuals who had a leprosy patient (index case) in the family and b) NFCs – those who did not have a case in the family. If any new case of leprosy was found among the earlier healthy population during re-survey, it was labelled as the incidence case of leprosy. On detection of an incidence case, the date of re-survey and time interval since the last examination of the family or individual, duration since the symptoms noticed, type of leprosy and other clinical details were recorded. A familial contact was defined as one who was living in the same house as the index case (whether blood relative or not). From this IRs have been estimated using PY of observations. Kaplan–Meier survival method was used to estimate incidence at 1, 2 and 3 years of follow-up. Log-rank test was used to compare the survival probabilities. The SPSS software (version 12.0) was used for the analysis.

Results

A total of 42,113 people were re-examined for leprosy from 2 to over 4 years after the initial survey. The TLPS comprised of 994 FCs of leprosy patients and 41,119 NFCs (Figure 1).

Figure 1. Details of studied population.
In the majority (70.1%), the time interval between initial and later examination was 2.5–3.5 years, about 14% were re-examined at about 2–2.5 years and the rest (15.9%) between 3.5 and 4.0 years of initial examination (mean 2.9 years). A total of 77 individuals who did not have leprosy in the initial survey were diagnosed with the disease, giving a crude cumulative IR (for 3 years) of 18.3/10,000 persons (77/42,113) (Table 1) and an overall IR of 6.2/10,000 PY. Of the detected cases, 71 (92.2%) were paucibacillary (PB) type.

INCIDENCE BY AGE AND SEX

The IR of leprosy was observed to have increased gradually and significantly with age ($P < 0.005$). Among children aged below 15, the IR was found to be 4.5/10,000 PY, increased to 5.2 by those aged 15–29, 7.8 in the age range 30–44, and further to 11.2 beyond the age of 44. The IR among males was found to be 6.6/10,000 PY, marginally higher than 6.0/10,000 PY among the females (Table 2).

INCIDENCE BY CONTACT STATUS AND TIME

Among 41,119 NFC who had been observed for 1,20,844.4 PY, 56 incident cases were detected, giving IR of 4.6/10,000 PY. This was significantly lower ($P < 0.01$) than the IR of

<table>
<thead>
<tr>
<th>Follow-up interval (years)</th>
<th>Number (% resurveyed)</th>
<th>Crude incidence rate/10,000 cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0–2.5</td>
<td>5814 (14.0)</td>
<td>110.1 (64)</td>
</tr>
<tr>
<td>2.5–3.5</td>
<td>29,541 (70.1)</td>
<td>4.1 (12)</td>
</tr>
<tr>
<td>&gt;3.5</td>
<td>6694 (15.9)</td>
<td>1.5 (1)</td>
</tr>
<tr>
<td>All</td>
<td>42,113 (100.0)</td>
<td>18.3 (77)</td>
</tr>
</tbody>
</table>

Table 1. Follow-up interval and crude incidence rate

<table>
<thead>
<tr>
<th>Group</th>
<th>Number examined (PY) observed</th>
<th>Incident cases</th>
<th>Incidence rate/10,000 PY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &lt; 15</td>
<td>18,745</td>
<td>55,266.0</td>
<td>25</td>
</tr>
<tr>
<td>15–29</td>
<td>9857</td>
<td>28,936.3</td>
<td>15</td>
</tr>
<tr>
<td>30–44</td>
<td>7446</td>
<td>21,867.3</td>
<td>17</td>
</tr>
<tr>
<td>&gt; 44</td>
<td>6065</td>
<td>17,881.6</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>42,113</td>
<td>123,951.2</td>
<td>77</td>
</tr>
<tr>
<td>Sex Male</td>
<td>14,806</td>
<td>44,118.4</td>
<td>29</td>
</tr>
<tr>
<td>Female</td>
<td>27,307</td>
<td>79,832.8</td>
<td>48</td>
</tr>
<tr>
<td>Contact status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-familial contacts (NFC)</td>
<td>41,119</td>
<td>120,844.4</td>
<td>56</td>
</tr>
<tr>
<td>Familial contacts (FC)</td>
<td>994</td>
<td>3106.8</td>
<td>21</td>
</tr>
<tr>
<td>FC-PB</td>
<td>681</td>
<td>2193.2</td>
<td>9</td>
</tr>
<tr>
<td>FC-MB</td>
<td>313</td>
<td>913.6</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 2. Incidence of leprosy by age/sex and contact status
leprosy among FC (67.6/10,000 PY). The IR was 41.0/10,000 PY among the FC of PB patients (FC-PB) and significantly (3.2 times) higher (131.3/10,000 PY) among FC of MB patients ($P < 0.05$).

The time related IR (1-survival probabilities)/10,000 among NFC has been estimated as 3, 9 and 14. The corresponding figures for FC at the end of 1, 2 and 3 years were 52, 158 and 208, respectively. The survival probability of remaining leprosy-free was significantly high among NFC than among FC of PB index case or MB index case (Log-Rank test $= 278.4$, DF $= 2$; $P < 0.00001$) (Figure 2).

The estimated incidence (1–survival probabilities)/10,000 of leprosy in the TLPS was 4.0 (per 10,000) at 1 year, 12.0 at 2 years and 18.0 at 3 years (Table 3).

Discussion

The incidence rate of leprosy among various population subgroups gives an idea of the level of transmission and indirectly about achievements following control activities. The overall incidence of 6.2/10,000 PY has been observed in the study area which has current leprosy prevalence of 16.4/10,000 in this area. The incidence of 4.6/10,000 PY in NFC indicates continued transmission of disease in the general population. In contrast, the high incidence rate of 41.0/10,000 PY in FC of PB patients and 131.3 among FC of MB patients indicates high infectivity of the index case to the family members and thus a higher risk of infection to the familial contacts with possible increased susceptibility. Length of infectivity of index case (i.e. duration of disease remaining untreated) could be an important factor to explain such a

![Figure 2. Cumulative incidence by contact status.](image)
difference. In the present study mean duration of untreated disease among FC was 27.3 months; 18.6 months in FC of PB and 42.6 months in FC of MB. This suggests that familial contacts were exposed to untreated index cases for a period of 27.3 months on average.

The present work indicates that the familial contacts of MB patients were at three times higher risk compared with those who had a PB patient in the family, who in turn were at a much higher risk than the NFC. This is similar to the observations made in South India. The estimated risk of getting leprosy in FC of MB patients was likewise significantly higher (3.2 times) in comparison to risk among FC of PB patients (Log-rank test = 6.99, DF = 1, P = 0.008). This could possibly be on account of exposure to large quantum of infection to FC of MB cases and/or genetic predisposition. Similar higher IR in the FC of PB patients could be related to close and prolonged contacts with smear negative PB cases (as seen in Africa7 and Agra12) as compared to lesser exposure (possibly indirect) among NFC.

The incidence was found to increase with age and this may be related to increasing length of exposure with leprosy cases and the long incubation period of the disease. This is in line with the estimated higher incidence rate related to time among the FC (Table 3). Unlike in other studies, the present study indicates no significant difference in incidence rate (6.6 vs 6.0) between the males and females. One of the reasons could be more thorough (total body) examination undertaken in the female population by the female worker of the survey team.

Time interval between two surveys, in determining incidence rates, has been a subject of debate, there being no unanimity. In this study, the minimum interval between the two surveys was 2 years. This has enabled us to base our findings on definite cases of leprosy that had developed into defined clinical type of the disease. It is possible that many of the early cases that might have appeared in the intervening period may have self-healed. Had the re-survey been done early (6–12 months interval), those self-healed cases too could have been picked up to further add to the incidence. The clinical presentations of incidence cases suggests that detection was not delayed as 46.8% (36/77) cases were detected when they had single lesion and another 35.1% (27/77) with two to three skin lesions only.

To conclude, new leprosy cases are continuing to appear and the incidence rate is still much higher (6.2 per 10,000 PY) compared to reported new case detection rate of 0.82/10,000 (proxy for incidence) by district health authorities (unpublished, 2005). Larger numbers of incident cases were observed among the FCs of leprosy, more so in the contacts of MB index cases. The reason for such a situation could be related to prolonged and close contact with the index case within the family and to the lesser extent in the community indicating the usefulness of contact surveys. Importantly of the 77 incident cases recorded, (92.2%) had PB leprosy, with 86.3% (63/77) with either single lesion or two to three skin lesions. It is possible that any delay in detection or reporting of these cases could have resulted in the disease progressing to MB type and/or increased occurrence of deformities in a proportion of cases.
Future research using large numbers of contacts could be resurveyed, that can throw more light on the transmission patterns with reference to contact’s status. Special observation on the treatment status of contacts and the duration of untreated disease can also lead to understanding if MDT really helps in containing transmission or if it could decline naturally.

Acknowledgements

The authors thankfully acknowledge the help provided by Dr V. M. Katoch, Director of the Institute to carry out this study, and also the assistance of field workers (PMWs) Mr Sanjeev Tiwari, Mr Rabendra Kumar, Mr Amar Singh, Mr G. P. Singh and Mr Raghvendra Singh.

References