SPATIAL ANALYSIS SPOTLIGHTING EARLY CHILDHOOD LEPROSY TRANSMISSION IN A HYPERENDEMIC AREA OF THE BRAZILIAN AMAZON REGION

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Leprosy new case detection rates

BRAZIL (2012)

New cases = 33,303
Detec. Rate = 17.2/100,000

Highly endemic

Weekly epidemiological record.
No. 35, 2013, 88, 365–380
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No. 35, 2013, 88, 365–380
UNEQUALLY DISTRIBUTION

10 clusters in Brazil (2005–2007)

Emerging Infectious Diseases. Vol. 15, No. 4, April 2009
UNEQUALLY DISTRIBUTION

Brazilian Amazon Region
UNEQUALLY DISTRIBUTION

Leprosy detection rate (per 100,000 population), 1990 - 2012.

Emerging Infectious Diseases. Vol. 15, No. 4, April 2009

BRAZIL. Ministry of health, 2012.
Contacts examination in Pará

34%

(2003-2007)

BRAZIL. Ministry of health, 2009.
Active transmission is ongoing

Hyperendemic in children

Source: Demato-Immunology Laboratory – Federal University of Para.


BRAZIL. Ministry of health, 2012.
Leprosy is hyperendemic among children in the State of Pará, Brazil.

Detection rate < 15 years old = 15/100,000
GIS and spatial analysis

• Developed enormously in the last two decades
• Pattern of disease transmission
• Space and time
• Clusters of high endemicity
• High risk areas to be target
Serology anti-PGL-1

• Biomarker of subclinical infection in the general population.

• Not every seropositive will progress to overt disease.

Objectives

1. Identify the spatial distribution of leprosy in a hyperendemic municipality of the Brazilian Amazon.

2. Associate the spatial pattern with the occurrence of leprosy and subclinical infections among household contacts and school children.
Methods

City of Castanhal, Pará, Brazil. Detec. rate = 73/100,000 (2012).
Methods

Mapped the residences of those individuals affected by leprosy in the urban area (2004-2010).
Methods

• Spatial statistics:
  – Global and local Moran’s I
  – Kulldorff spatial scan statistics
  – Ripley’s K-function
  – Knox space-time test
Methods

• Cross-sectional study:
  – 302 household contacts (HHC)
  – 188 school children (SC)
  – Clinical and serological (ELISA anti-PGL-I IgM)
Results

• 633 new cases of leprosy (2004 to 2010)

• 10% among children <15 years old
Spatial distribution and density of leprosy cases

- Leprosy cases

Kernel density estimation
- High: 191
- Low: 0

499 (87%) mapped cases
Clusters of leprosy ($p<0.01$)
### Knox space-time clustering analysis for leprosy cases*

<table>
<thead>
<tr>
<th>Space-time lag (meter-years)</th>
<th>Number of cases</th>
<th>p-value (999 Monte Carlo simulations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 - 1</td>
<td>91</td>
<td>0.013</td>
</tr>
<tr>
<td>50 - 2</td>
<td>108</td>
<td>0.012</td>
</tr>
<tr>
<td>100 - 1</td>
<td>226</td>
<td>0.010</td>
</tr>
<tr>
<td>100 - 2</td>
<td>259</td>
<td>0.012</td>
</tr>
<tr>
<td>100 - 3</td>
<td>289 (58%)</td>
<td>0.019</td>
</tr>
<tr>
<td>100 - 4</td>
<td>307</td>
<td>0.011</td>
</tr>
<tr>
<td>200 - 2</td>
<td>406 (81%)</td>
<td>0.009</td>
</tr>
</tbody>
</table>

*Only statistically significant space-time lags are shown here (p < 0.05). Total number of analyzed cases = 499.
Spatial and temporal clusters

$p < 0.05$
Clinical and serological results

• Household contacts (302)
  – 118 (39%) seropositivity
  – 8 (2.6%) new cases

• School children (188)
  – 125 (66.5%) seropositivity
  – 9 (4.8%) new cases
Other 7 cities in Pará
Conclusions

1. Spatial analysis revealed a clustering pattern of leprosy cases in this hyperendemic city.
Conclusions

2. The high rate of undiagnosed cases and of subclinical infection among both HHC and SC suggests that there are many active foci of infection and that *M. leprae* is circulating in this population.
Conclusions

3. Joining clinical, epidemiological, serological and spatial data provided a better understanding of the transmission dynamics of leprosy at fine spatial scales and evidenced high rates of childhood leprosy transmission in Castanhal.
Acknowledgments