

# Leprosy and pregnancy: detection coefficient and proposal for a new index

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## ABSTRACT

**Introduction:** Our study presents a method to generate a novel detection coefficient for the association between leprosy and pregnancy (DCLP). **Methods:** The DCLP was calculated for women from the State of Pará (2007-2009), Brazil. Data were ordered, divided into five equal parts (corresponding to the P<sub>20</sub>, P<sub>40</sub>, P<sub>60</sub>, and P<sub>80</sub> percentiles), and classified as low, medium, high, very high, or hyperendemic. **Results:** Using the new index, we established the DCLP parameters for low (<0.36), medium (0.36-0.69), high (0.70-1.09), very high (1.10-1.50), and hyperendemic (>1.50). **Conclusions:** The new DCLP is more appropriate than the overall detection coefficient (DC), which does not take into account the particularities of the interaction between a disease and a specific physiological state.

**Keywords:** Leprosy. Pregnancy. Epidemiology.

In clinical practice, there are several ways to study the patterns of disease occurrence in a population. Analyses of the epidemiological factors related to behavioral, environmental, immunological, nutritional, and genetic aspects are among the most important approaches. These analyses can be performed by calculating epidemiological indicators, which are important tools for evaluating disease severity<sup>1</sup>. Among these indicators, detection coefficients (DCs) are important evaluation parameters, as they show the magnitude of disease occurrence in a population and can be easily calculated and interpreted<sup>2,3</sup>.

Brazil has the second highest incidence and prevalence of leprosy, an endemic disease affecting several countries worldwide<sup>4,5</sup>. DCs have been widely used to measure the evolution of this disease within a population (in particular, in the general population and children under 15 years of age). However, the rate of disease occurrence in pregnant patients has not yet been assessed, and studies on DCs that specifically assess the association between leprosy and pregnancy are lacking<sup>5,6</sup>. This points to an important information gap in evaluating leprosy severity among the population of pregnant women<sup>7</sup>. In general,

leprosy severity in pregnant patients is evaluated by the overall DC, which is calculated for the population as a whole and makes no distinction between women of fertile age and men<sup>3-6</sup>.

Thus, the objective of this study was to propose a new DC that assesses the association between leprosy and pregnancy, based on an epidemiological survey.

The database for this study was closed in November 2011.

A population-based survey with a focus on leprosy pregnant women from the State of Pará, Brazil, was conducted using data from 2007-2009. The study population consisted of 149 women, including 57 cases of pregnant women with leprosy detected in 2007, 47 in 2008, and 45 in 2009.

The variables of interest for this study were collected from data available in the National Health System Electronic Databases [*Departamento de Informática do Sistema Único de Saúde (DATASUS)*] and the Ministry of Health/Information System for Notifiable Diseases [*Sistema de Informação de Agravos de Notificação/Ministério da Saúde (SINAN/MS)*]. The population data for the women aged 12-49 years were obtained from the Brazilian Institute of Geography and Statistics [*Instituto Brasileiro de Geografia e Estatística (IBGE)*].

We established a new epidemiological index - the detection coefficient for the association between leprosy and pregnancy (DCLP). The DCLP was based on a study by Palacios et al<sup>6</sup> and is depicted below:

$$\text{DCLP} = \frac{\text{Number of pregnant leprosy women}}{\text{Total number of women aged 12-49 years}} \times 10,000$$

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Depending on the population quantum, a reference of 100,000 inhabitants can also be used for analysis adequacy. Since this study was performed in the municipalities of Pará and by year, the 10,000 inhabitant constant was maintained during the study period.

To estimate the endemicity patterns of the association between leprosy and pregnancy, the DCs were first calculated for all counties (143 counties in 3 years, totaling 429 coefficients) and sorted in increasing order (using the 'sort and filter' and then the 'sort smallest to largest' functions) in a single column using Microsoft Office Excel 2007. Subsequently, the column containing the DCs was selected, the 'sort and filter' and 'filter' functions were applied, and repeated zero values were excluded to avoid interference in the calculation of percentiles. A total of 84 significant values (positive numbers) was found. Then, the DCs corresponding to the  $P_{20}$ ,  $P_{40}$ ,  $P_{60}$ , and  $P_{80}$  percentiles (four percentiles dividing the ordered series of coefficients into five equal parts) were calculated. One advantage of using percentiles is that they can be applied to any set of continuous data, even if it does not show any statistical distribution<sup>7</sup>.

Each of the five parts corresponds to a track featuring an endemic pattern of the disease according to the percentiles formula: low, medium, high, very high, and hyperendemic (Figure 1). The calculated values were:  $P_{20} = 17$  (or the 17<sup>th</sup> term of the increasing sequence of coefficients),  $P_{40} = 34$  (34<sup>th</sup> term),  $P_{60} = 51$  (51<sup>st</sup> term), and  $P_{80} = 68$  (68<sup>th</sup> term). In the 2007 Excel software, the 'insert' ( $f\chi$ ) followed by the 'percentile' function were selected. In the opened frame, the field matrix was automatically filled when all rows of the DC column were selected, while the field K (referring to the k<sup>th</sup> percentile of the values in the range) corresponded to each of the values found for the calculation of the  $P_{20}$ ,  $P_{40}$ ,  $P_{60}$ , and  $P_{80}$  percentiles (17, 34, 51, and 68, respectively). K represents the percentile values within the range of 0-1 (0.17, 0.34, 0.51, and

0.68, respectively). This ultimately resulted in the values defining the endemicity parameters for the DCLP (Figure 1).

The percentiles we identified were:  $P_{20} = 17^\circ$  or 0.36,  $P_{40} = 34^\circ$  or 0.70,  $P_{60} = 51^\circ$  or 1.10, and  $P_{80} = 68^\circ$  or 1.50. Considering these values, the scale of the parameters for the DC of the association between leprosy and pregnancy is depicted in Table 1.

The methodology chosen in our study allowed for the creation of a new index, summarized in Figure 2, providing a tool that can be used to establish a more precise epidemiological profile of the association between leprosy and pregnancy. According to the few existing reports, an outbreak or worsening of leprosy results from the physiological changes associated with pregnancy<sup>6,8-10</sup>. Thus, the creation of an indicator allowing a more accurate epidemiological assessment of the association between illness and the physiological state in question is imperative. We show that the methodology adopted in this study was adequate for this purpose, and we suggest that the DCLP a new and useful tool for the evaluation of the biological interaction of leprosy with pregnancy. However, although our study is based

**TABLE 1 - Endemicity parameter scale of the detection coefficient for the association between leprosy and pregnancy (DCLP).**

Range of the coefficient	Interpretation
Above 1.50	hyperendemic
From 1.10 to 1.50	very high
From 0.70 to 1.09	high
From 0.36 to 0.69	medium
Below 0.36	low

**Formula**

$$P_i = i \cdot \left(\frac{N+1}{100}\right), \text{ where: } P_i = \text{Percentile value (20, 40, 60, 80);}$$

$i = 20, 40, 60, 80;$   
 $N = \text{Number of observations in the dataset (DCLP positives)} = 84$

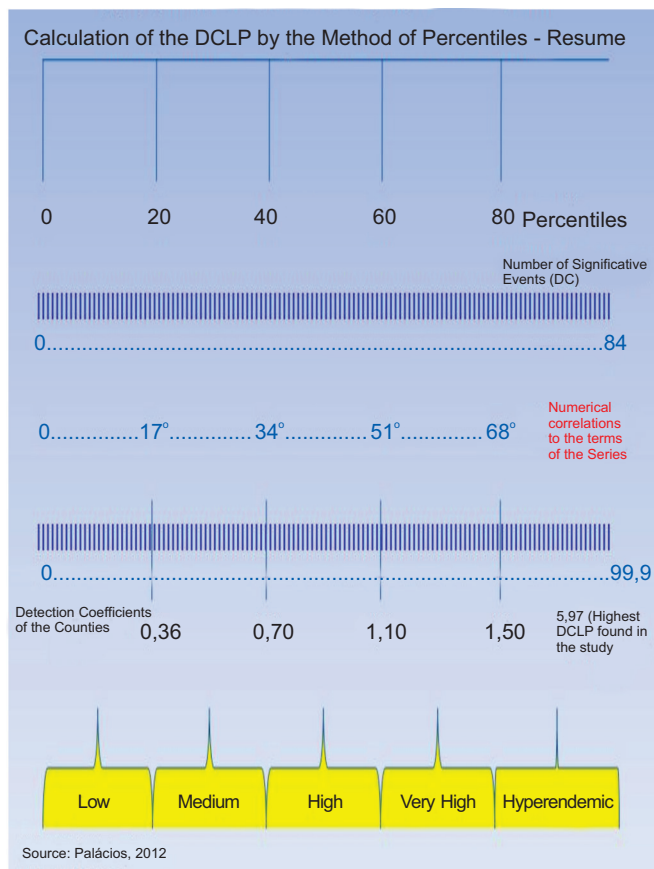
$$P_{20} = 20 \cdot \frac{84 + 1}{100} = 17^\circ$$

$P_{20} = 17^\circ$  term of series coefficients ordered from low to high so that worked in Excel, we have:  $P_{20} = 0,36$

**Resume: Thus, the following percentiles were obtained:**

$P_{20} = 17^\circ$  .....in Excel.....0,36  
 $P_{40} = 34^\circ$  .....0,70  
 $P_{60} = 51^\circ$  .....1,10  
 $P_{80} = 68^\circ$  .....1,50

**FIGURE 1 - Summary of the calculation of the percentiles that correspond to the endemicity patterns of leprosy associated with pregnancy.**  $P_i$ : percentile value;  $i = 1, 2, 3, \dots, 99$  (or a percentile estimate of 20, 40, 60, and 80 in this study);  $N$ : number of observations ( $N = 84$  in this survey); **DCLP**: detection coefficient for the association between leprosy and pregnancy.



**FIGURE 2 - Summary of the calculation for the endemicity parameters for the association of leprosy with pregnancy. DLCP:** detection coefficient for the association between leprosy and pregnancy.

on data from one of the regions with the highest prevalence of leprosy worldwide (the State of Pará in the Brazilian Amazon)<sup>11</sup>, the values for the adoption of new parameters for evaluating endemicity should be adjusted when used for global data. New surveys studying the association between leprosy and pregnancy should be performed using the parameters defined in this study to arrive at a more comprehensive and updated epidemiological understanding of the subject. Such a survey with data covering all of will be the scope of a study by this research group that is already underway and will be released soon.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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