Estimate of HIV prevalence in pregnant women by means of spatial analysis in Southern Brazil

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ABSTRACT

Spatial analysis techniques were used to estimate the interurban differential HIV prevalence among pregnant women in the city of Porto Alegre, Southern Brazil. The estimates were produced through the spatial smoothing of residence pinpoints with live newborns and HIV infected pregnant women for the year of 2003. The overlay of high prevalence areas in city slums was identified. This finding confirms the intensification of AIDS epidemic among poor urban populations, and indicates areas where basic care and educational strategies should be reinforced.

KEYWORDS: HIV. Prevalence. Disease transmission, vertical, prevention & control. Residence characteristics.

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INTRODUCTION

Health policy in Brazil, implemented by the Ministry of Health, recommend the early detection of HIV during pregnancy to permit the use of prophylaxis, which effectively reduced mother to child transmission of HIV. One of the widely recognized actions is universal access to anti-retroviral therapy whose effectiveness requires the expansion to pre-natal health care to identify the populations vulnerable to HIV transmission.[3]

Porto Alegre, the capital of the state of Rio Grande do Sul (Southern Brazil), has a high prevalence rate among pregnant women, which has been monitored by the epidemiological vigilance of HIV positive pregnant women and exposed children since September of 2001.[2] According to health surveillance data in this city, in the years of 2002 and 2003, 3% of newborns were exposed to HIV during pregnancy or birth, of an average of 500 pregnant women researched per year.

In Brazil, there is no research regarding interurban differences of HIV prevalence among pregnant women. Nonetheless, the role of variables such as gender, race, color, education, and other socioeconomic conditions stands out as methodological approximations indicate the increased spread of the AIDS epidemic among the poor in Brazil and the world.[1]

METHODS

Spatial analysis techniques were used which permitted the transformation of data points (health information system records) in a continuous layer of risk. All of the records of live births registered in the National Live Births Information System (SINASC) and all of the live births exposed to HIV during pregnancy, registered in the the National Communicable Disease Information System (SINAN) in 2003 were analyzed, which generated one database of births whose mothers were infected with HIV. Three-hundred and ninety four cases of HIV positive pregnant women and exposed children were reported, yet seven cases of abortion and stillbirths were excluded in an effort to only analyze the birth of live newborns exposed to HIV, which totaled 387 cases. Of these, 358 were geocoded (92,5%). Of the total of 19,197 live births, 17,822 were geocoded (92,8%). These records were geocoded to a digital street map using Geographic Information Systems (GIS) constructed in the city of Porto Alegre. The coordinates of each record were calculated though the GIS algorithm and the database was exported to the program Crimestat[4] to calculate the smoothed layer of the prevalence rate. The Kernel Dual technique was used, using the list of HIV positive pregnant women as the primary reference file, and the list of the total number of live births as the comparative secondary file.

The smoothing method used by the Kernel Gaussian function is a non-parametric technique that promotes esthetic smoothing, which permits the variation between a group of data to be filtered while maintaining the local characteristics of the data. This permits a smoothed estimate of the local intensity of the events over a layer of risk of its occurrence to be obtained. This technique has been used for the detection of spatial clusters through the estimate of cases density.[5]

When using dichotomous variables with a value assigned to the points, as is the case for the serological status of HIV, the Kernel function is considered according to the variance of the values presented in each position in relation to the region studied. In this way, an estimate of the probability of finding a positive value in any point of this layer can be obtained. This generalized layer corresponds to the prevalence of HIV in pregnant women in the city. The expected result is the smoothing of the extreme values and the obtainment of values close to the average of prevalence in the city.

Two problems may be generated in the creation of this layer. The first is with respect to the statistic stability of the estimated values, which is a function of the smoothing level of the value of the points. The bandwidth defines the level of smoothness of the layer obtained. The small bands produce abrupt borders in the layers and small areas of high prevalence, with a number, at times, with insufficient data to affirm that the estimated prevalence differs from the rest of the city, with a small confidence interval. On the other hand, the large bandwidths can produce more stable estimates of prevalence, with a larger number of data in the interior of the areas created by the method. There is no consensus in the literature regarding how to choose a bandwidth. In general, this band should be proportional to the number of points (data) and the average distance between these points.[4] The average distance between points (315 m) and its standard deviation (543 m) was calculated, with the chosen bandwidth of 1,000m and 200 m of resolution (the size of the cell).

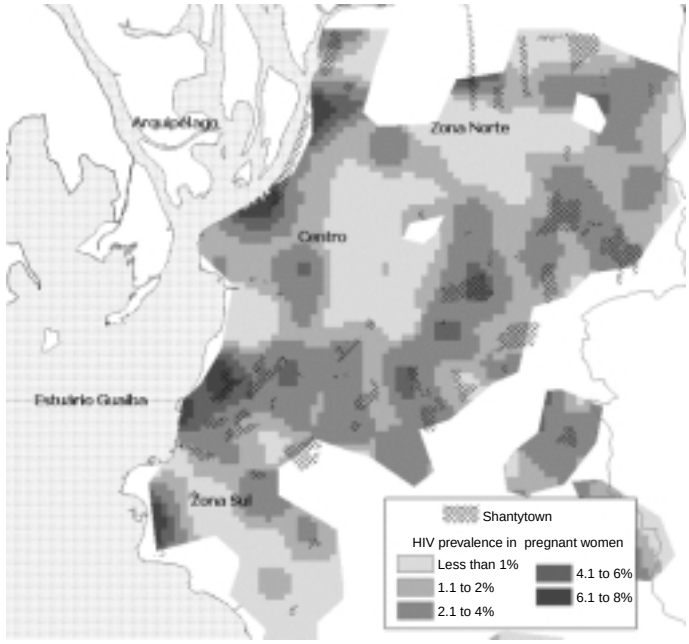
The second problem of the proposed smoothing method is the extrapolation of the results to an area beyond the data origin. In these areas, the Kernel method can produce values extrapolated to more than 100% or less than 0% seroprevalence, which should be avoided. To restrict the estimates, a mask was created and the results that fell in areas with low

population density and few live births were disregarded.

RESULTS AND DISCUSSION

The seroprevalence estimates of HIV pregnant women obtained varied between 0 and 8%. The map shows the spatial distribution of HIV prevalence among pregnant women.

The areas with higher HIV prevalence in pregnant women circle the center of the city and the central areas and the south of the city represent low values of prevalence among their population. In general, the areas with high prevalence of HIV positive pregnant women are near the city slums, according to the classification of the Brazilian Institute of Geography and Statistics (IBGE) for collecting census data, shown in the figure with a shading pattern. The estimates generated by the model confirm a tendency of the increased spread of the epidemic among the poor[1] influenced by the social and political determinants in the areas with the most social need.



Data source: National Communicable Disease Information System (SINAN) and National Live Births Information System (SINASC) from the Center of Health Surveillance, Porto Alegre City Health Department.

Figure - Layer of HIV seroprevalence among pregnant women in Porto Alegre, 2003.

The methodology proposed in this research has the primary advantage of producing maps of the interurban distribution of prevalence, without considering the administrative territorial divisions as units of analysis. In the present study, it was possible to estimate HIV prevalence in pregnant women through the use of data points which could be grouped in population areas with equal prevalence. As the city slums and other areas of need are generally formed by subdivisions inside neighborhoods and the previous aggregation of data in this type of spatial unit generally does not permit the evaluation of the risk concentration in these areas. The areas with the highest prevalence are those with the lowest income, level of education, and elevated fertility rates.[3] Politics of primary care and education should be focused on this new social and epidemiological landscape.

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