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ORIGINAL ARTICLE

Poverty, Urban Environmental Factors and Spatial Distribution of Visceral Leishmaniasis in an Area of Recent Emergence in Inner Brazil

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Abstract

In an urban area of recent emergence of visceral leishmaniasis (VL) in Brazil, the spatial distribution of both VL and VL-HIV coinfection was negatively associated with per capita income, population density, paving of streets, existence of sidewalks and drains for rainfall. Poverty and urban infrastructure deficits may influence VL emergence.

Keywords

Visceral leishmaniasis, Leishmania-HIV coinfection, Spatialepidemiology

Introduction

In the past three decades, visceral leishmaniasis (VL) in Brazil changed from rural endemics of Northeastern States into an emergent disease of great urban centers [1].

The area affected spread southwards affecting São Paulo, the most populous state in the country. In this setting, the epidemics of VL and AIDS intertwined [2].

In urban areas of recent emergence, the spatial distribution of VL cases is not homogeneous [3]. Socio-economic and environmental factors may contribute to the occurrence of LV in specific areas [4].

Therefore, the study of those factors is likely to provide clues to determinants of the emergence of VL.

The Study

We studied the spatial distribution of overall VL and VL-HIV coinfection in the city of Bauru (340,000 inhabitants), inner São Paulo State, Brazil. The first notifications of VL in that city date from 2003. The cumulative incidence rates of of VL and VL-HIV (per 100,000 inhabitants) in the period 2003-2016 were 131.1 and 19.7, respectively.

The addresses of cases were georeferenced in QGIS 2.18 (QGIS Development Team [2016]. QGIS Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.osgeo.org"), using UFT-8 codifications and MMQGIS geocodification algorithm. After georeferencing,cases were assigned to census sectors of the city of Bauru, Brazil, according to Brazilian Institute of Geography and Statistics (IBGE). Kernel density maps were generated in ArcGis 10.1 (ESRI, Redlands, CA) using the following algorithms: “integrate”, “collect events” and “hotspot analysis”.

Census sectors were the units for analysis of predictors of VL and VL-HIV incidence. Variables included in the analysis were collected in the 2010 Brazilian Census Data (IBGE) and included and per capita

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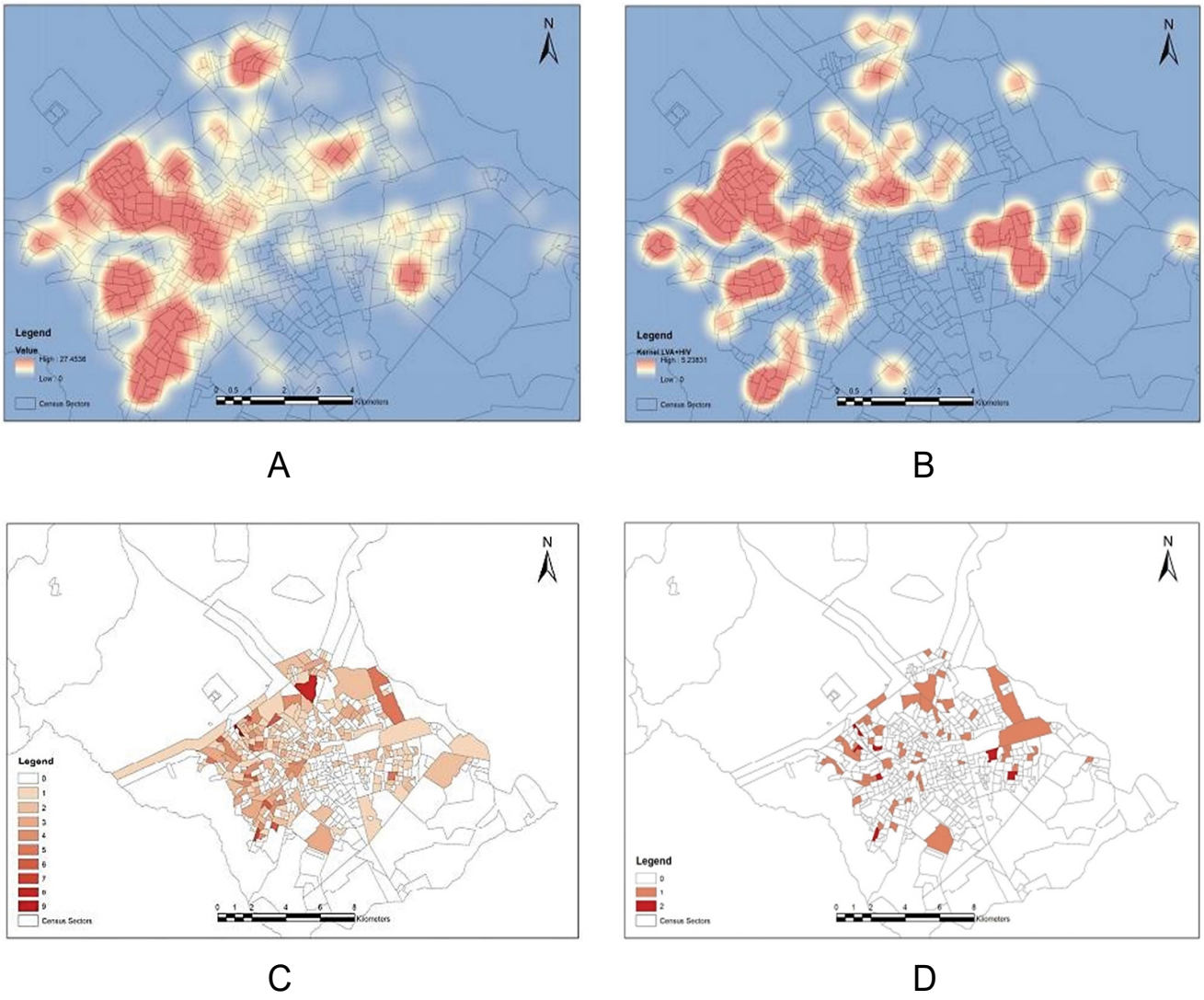

Figure 1A: Kernel density map for overall VL. Spatial distribution of Visceral Leishmaniasis (VL) and VL-HIV coinfection in the city of Bauru, inner Brazil.

Figure 1B: Absolute incidence of general VL in the census tracts. Spatial distribution of Visceral Leishmniasis (VL) and VL-HIV co-infection in the city of Bauru, Brazil.

Figure 1C: Kernel density map for VL-HIV co-infection. Spatial distribution of coinfection by Visceral Leishmaniasis (VL) and VL-HIV in the city of Bauru, Brazil.

Figure 1D: Absolute incidence of VL-HIV co-infection in census tracts. Spatial distribution of Visceral Leishmaniasis (VL) and VL-HIV co-infection in the city of Bauru, Brazil.

income andpopulation density. Other data collected from the same source includedpercentage of houses in places with sidewalks, paving of streets, drains forrainfall, trees, sewage and garbage in the open. Data were analyzed in Stata 14 (College Station, TX), using univariate and multivariable (single-step) models of Zero-inflated Poisson Regression.

Figure 1 presents spatial distribution of cases, in crude incidence percensus sectors and Kernel densities. Predictors of geographic incidence arepresented in Table 1. Briefly, overall VL incidence was negatively associatedwith population density and per capita income, while there was negativeassociation of the incidence of VL-HIV coinfection with per capita income andpresence of drains for rainfall.

Our results provide clues to the routes of urbanization of VL and intersection of VL and AIDS epidemics. In univariable analysis, several aspects linked to poverty (e.g., absence of sidewalks and paving of streets, presence of garbage in the open) were associated with the outcomes. Those environmental factors may be proxies for both the presence of vectors (Lutzomyia longipalpis) breeding sites (usually sites with decaying organic matter) and of reservoirs (domiciled or stray dogs) [5,6].

Similarly to our results, proxy indicators of poverty such as (illiteracy and income) have been described both in areas of early [7] and recent emergence [8]. Urban VL has been associated with living in the periphery of cities, which are sites where favelas and poor neighborhoods are located. Not surprisingly, those are areas of greater prevalence of HIV infection [9].

Table 1: Factors associated with the incidence of Visceral Leishmaniasis (VL) and VL-HIV coinfection among census sectors in the city of Bauru, inner Brazil.

Factors	Univariada		Multivariada	
	IRR (95%CI)	*P*	IRR (95%CI)	*P*
Overall VL				
Population density	**0.95 (0.92-0.99)**	**0.006**	**0.94 (0.90-0.97)**	**< 0.001**
Per capita income (BRL 100)	**0.90 (0.87-0.92)**	**< 0.001**	**0.89 (0.86-0.92)**	**< 0.001**
Street paving (x10%)	**0.93 (0.90-0.96)**	**< 0.001**	1.01 (0.92-1.10)	0.87
Sidewalks (10%)	**0.92 (0.90-0.95)**	**< 0.001**	0.99 (0.91-1.09)	0.91
Rain drains (10%)	**0.94 (0.90-0.98)**	**0.002**	0.96 (0.92-1.00)	0.08
Trees (x10%)	1.03 (0.92-1.10)	0.57	0.92 (0.80-1.05)	0.21
Open sewer (10%)	1.08 (0.93-1.27)	0.33	1.09 (0.91-1.31)	0.36
Open-air garbage (x10%)	**1.06 (1.02-1.12)**	**0.004**	1.00 (0.95-1.06)	0.96
Coinfecção LV-HIV				
Population density	0.97 (0.90-1.05)	0.48	0.94 (0.86-1.03)	0.18
Per capita income (R$ 100))	**0.85 (0.78-0.93)**	**< 0.001**	**0.80 (0.71-0.91)**	**< 0.001**
Street paving (x10%)	**0.92 (0.85-0.98)**	**0.02**	0.95 (0.90-1.19)	0.67
Sidewalks (10%)	**0.92 (0.86-0.99)**	**0.03**	1.09 (0.87-1.37)	0.44
Rain drains (10%)	**0.86 (0.77-0.95)**	**0.004**	**0.87 (0.78-0.98)**	**0.02**
Trees (x10%)	1.04 (0.81-1.32)	0.76	0.94 (0.73-1.19)	0.60
Open sewer (10%)	11.08 (0.66-1.78)	0.76	1.27 (0.76-2.13)	0.36
Open sewer (10%)	0.99 (0.87-1.13)	0.89	0.86 (0.74-1.01)	0.07

VL: visceral leishmaniasis; HIV: Human Immunodeficiency Virus; BRL: Brazilian currency (Real, approximately US$0.25); IRR: incidence rate; CI: confidence interval.

Conclusions

Taken together, all those findings reinforce the social and economic determination in the distribution of VL and VL-coinfection. Since a recent systematic review failed to identify effective measures to prevent VL in Latin America [10], interventions aimed at improving income and housing conditions may be pathways for controlling this disease.

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