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# Spatio-temporal distribution of Dengue, Zika and Chikungunya in Cali, Colombia: 2014-2016

Distribución espaciotemporal de dengue, Zika y Chikunguña en Cali, Colombia: 2014-2016

Distribuição espaço temporal de Dengue, Zika e Chikungunya em Cali, Colômbia: 2014-2016

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## Abstract

**Introduction**: Emerging and re-emerging arboviral infections have become a public health challenge in the Americas due to their epidemic potential. **Objective**: To determine the spatio-temporal distribution of the dengue, Zika, and chikungunya viruses during an epidemic period in Cali, Colombia. **Materials and methods**: Multi-method descriptive ecological and exploratory study of confirmed and suspected cases reported to the epidemiological surveillance system between 2014 and 2016. **Results**: 40,168 cases were analyzed, and it was found that dengue was the most frequent arboviral infection (59.2 %). The most affected individuals were women (65 %) and those with a mean age of 34.5 years. Although arboviral infections spread out throughout the city, the three diseases were concentrated in significant groups located at the center-east and northeast areas of Cali ($p$<0.01; z=-203.7). **Conclusions**: This study identified critical zones for the three arboviral infections, which are located in areas with low socioeconomic status. Likewise, the results suggest that in addition to eco-epidemiological and bio-psychosocial factors, temperature, precipitation, and the aedic index may play an important role in the spatio-temporal behavior of these diseases. A multidisciplinary and collaborative approach is necessary, which must involve communities and authorities to implement effective control strategies, especially during epidemic periods.

**Keywords:** Vector borne diseases; arbovirus infections; disease outbreaks; space-time clustering. (Source: DeCS, Bireme).

## Resumen

**Introducción:** Las arbovirosis emergentes y reemergentes representan un reto de salud pública en las Américas, debido a su potencial epidémico. **Objetivo:** Determinar la distribución espaciotemporal de los virus del dengue, el Zika y el chikunguña, en un periodo epidémico en Cali. **Materiales y métodos:** Estudio multimétodo descriptivo y ecológico exploratorio de casos confirmados y presuntos notificados al sistema de vigilancia epidemiológica, entre 2014 y 2016. **Resultados:** Se analizaron 40.168 casos, se encontró que el dengue fue la arbovirosis más frecuente (59,2 %). Los individuos más afectados tenían una edad media de 34,5 años y eran predominantemente mujeres (65 %). Las arbovirosis se distribuyeron en toda la ciudad, pero se identificaron agrupamientos significativos en el centro-este y noreste de Cali para las tres enfermedades ($p$<0,01; z=-203,7). **Conclusión:** Este estudio destaca la identificación de zonas críticas para las tres arbovirosis que se localizan en áreas con rezago socioeconómico. Además, los resultados sugieren que factores eco-epidemiológicos y biopsicosociales adicionales a la temperatura, las precipitaciones y el índice aédico pueden desempeñar un papel importante en el comportamiento espaciotemporal de estas enfermedades. Se recomienda una aproximación multidisciplinaria y colaborativa, involucrando a la comunidad y las autoridades, para implementar estrategias de control efectivas, especialmente durante periodos epidémicos.

**Palabras clave:** Enfermedades transmitidas por vectores; infecciones por arbovirus; brotes de enfermedades; agrupamiento espacio-temporal. (Fuente: DeCS, Bireme).

## Resumo

**Introdução:** Arbovírus emergentes e reemergentes representam um desafio de saúde pública nas Américas, devido ao seu potencial epidêmico. **Objetivo:** Determinar a distribuição espaço-temporal dos vírus dengue, Zika e chikungunya, em período epidêmico em Cali. **Materiais e métodos:** Estudo multimetodo, descritivo e ecológico exploratório de casos confirmados e suspeitos notificados ao sistema de vigilância epidemiológica, entre 2014 e 2016. **Resultados:** foram analisados 40.168 casos, constatou-se que a dengue foi a arbovirose mais frequente (59,2 %). Os indivíduos mais acometidos tinham idade média de 34,5 anos e eram predominantemente mulheres (65 %). Os arbovírus foram distribuídos por toda a cidade, mas foram identificados aglomerados significativos no centro-leste e nordeste de Cali para as três doenças ($p$<0,01; z=-203,7). **Conclusão:** Este estudo destaca a identificação de zonas críticas para as três arboviroses que estão localizadas em áreas com atraso socioeconômico. Além disso, os resultados sugerem que fatores eco-epidemiológicos e biopsicossociais adicionais à temperatura, à precipitação e ao índice aedico podem desempenhar um papel importante no comportamento espaço-temporal destas doenças. Recomenda-se uma abordagem multidisciplinar e colaborativa, envolvendo a comunidade e as autoridades, para implementar estratégias de controlo eficazes, especialmente durante períodos epidémicos.

**Palavras chave:** Doenças transmitidas por vetores; infecções por arbovirus; surtos de doenças; conglomerados espaço-temporais. (Fonte: DeCS, Bireme).

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used communication media and with evidence-based methodologies[33-35]; (iii) vector control, which should combine individual activities of the communities to eliminate breeding sites and other control strategies, especially in the highest risk areas[36]; and (iv) comprehensive approach of other HSDs[32] such as social and economic support, involvement of communities in their own care, reduction of violence in the city, infrastructure improvement, problems related to climate change, and access and safe storage of drinking water.

## Conclusions

This spatio-temporal study has identified critical areas from the center-east and northeast of Cali, which are at risk for dengue, Zika, and chikingunya viral infections during an epidemic period, due to its environmental and geographical conditions. The observed spatio-temporal behavior of these pathogens could not be explained only by factors such as the temperature, precipitation and aedic index during epidemic periods. Thus, further research that includes additional variables is needed. However, the evidence presented here suggests that the behavior of these arboviral infections could be affected by interactions of environmental, entomological, epidemiological, and psycho-behavioral factors. Therefore, an inter-institutional and multidisciplinary collaborative approach is suggested in order to control arbovirus epidemics in Cali. This proposed strategy must involve communities and cover aspects such as epidemiological surveillance, risk communication, vector control, and the comprehensive approach of other potential HSDs.

This study faced several limitations. First of all, only a few of multiple variables that could affect the arboviruses behavior were evaluated. Nevertheless, all available data were included in the study. Secondly, the sources of information had considerable under-recording issues, which is why ethnicity and employment of patients were excluded from this study. Thus, effective strategies to verify the quality of the information reported to Sivigila are needed. Finally, additional under-registration issues could be caused by economic, social, and multi-causal difficulties, which impeded proper access to health care. However, we were able to report findings that are consistent with previous studies regarding the spatio-temporal distribution of arboviral infections.

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**Conflict of interest:** the authors declare none.

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