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Chikungunya in Ecuador, 2014–2017: Maps and more

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Dear Editor,

Chikungunya virus (CHIKV) infection can be a cause of significant morbidity in different countries in Latin America and the Caribbean after its arrival in December 2013 [1,2]. Although that there is still a lack of studies assessing its occurrence in certain countries, such as in the case of Ecuador [3,4]. Travelers to endemic areas in the region should be aware of the risk of infective biting exposure when visiting for different purposes those areas [1,2,5]. In order to advise them, epidemiological information is of utmost importance, including the availability of detailed maps in order to assess the risk when visiting specific destinations [5,6]. For those reasons, we have developed amongst the first national published epidemiological maps for CHIKV in Ecuador using geographical information systems (GIS).

Surveillance cases data (2014–2017) (officially reported by the Ministry of Public Health) were used to estimate the cumulative incidence rates using reference population data (2014–2017), on CHIKV infections (cases/100,000 pop) and to develop the first maps for Ecuador. GIS used was Kosmo® 3.1.

From 2014 till 2017, Ecuador reported 35,714 cases of CHIKV, for a cumulative rate of 218.24 cases/100,000 pop (Table 1). Rates ranged from 3.29 to 1,785.84 cases/100,000 pop (Esmeraldas province, 30.22% of the country cases), followed by Manabi (706.45 cases/100,000 pop; 29.73%), and Santo Domingo de Los Tsachilas (403.14 cases/100,000 pop; 4.77%) (Fig. 1). All the provinces of Ecuador (even Galapagos islands) had CHIKV cases during at least one year (Table 1). Although cases reporting begun in 2014 (0.11% of the period 2014–2017), most of them occurred in 2015 (94.13%) (Table 1).

Geographical epidemiology is a recent scientific discipline concerned with conditions and habits on human settlement taking into account their geographical features, useful for environmental health, disease ecology and mapping, especially for emerging diseases [7]. In the case of CHIKV, in other countries, GIS has been extensively used for mapping the disease occurrence [5], however, in Ecuador, there is a lack of studies about it [3,4]. Previous studies in the country have not mapped CHIKV at the national scale[6] as it is shown herein [3,4]. Use of GIS-based epidemiological maps allows integrating preventive and control strategies, as well as public health policies, for joint control of this vector-borne disease, as probably also for Zika, which has not been mapped nationally either. As these arboviral diseases are transmitted primarily by *Aedes aegypti*, maps of these infections as well for coinfections will also be needed [5]. Simultaneous or subsequent arboviral infections occur and should be also assessed. Curiously, but expected, ongoing transmission of CHIKV in countries of the Americas, such as Ecuador, two or more years after the 2015 peak of the epidemic (Fig. 1), suggests current endemicity [8]. In this setting, GIS-based mapping should include in the future new perspectives such as the analyses of temporal dependency of disease evolution in conjunction with exposure and outbreak latency, since risk factors depend on both spatial and temporal dimensions [4,6,7]. Furthermore, the potential contribution of using remote sensing data demands new GIS software to handle the vast amounts of variables with many multivariate approaches proposed for spatial and temporal disease mapping using satellite information [6].

In this study we found coastal and highly touristic areas, such as the provinces of Esmeraldas, Manabi, Guayas, El Oro and Galapagos islands, were significantly affected by the CHIKV epidemics, particularly in 2015, maybe playing a role in the arbovirus spreading to other areas and countries by travelers (Fig. 1). Provinces located at highlands were less affected, but even with cases. Although the number of cases reported in eastern Amazonic provinces bordering with Colombia and Brazil was low, given the small population magnitude, resulted in significant incidence rates (> 20 cases/100,000 pop) (Fig. 1).

Finally, also providing relevant information in order to assess the risk of travelers with a specific destination in high transmission areas with the idea of giving prevention advice, even more, because they also play an essential role in the virus spread, as occurs in Ecuador, is of utmost importance [5,8].

Conflicts of interest

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Table 1
CHIKV incidence rates (cases/100,000 pop) by provinces, Ecuador, 2014–2017. Source: Ministry of Public Health (www.salud.gob.ec).

Province	2014		2015		2016		2017		2014–2017	
	Cases	Rates[a]	Cases	Rates[a]	Cases	Rates[a]	Cases	Rates[a]	Total	Cumulated rates[a]
Esmeraldas	0	0.00	10,477	1,746.82	301	49.43	13	2.10	10,791	1,785.84
Manabi	29	1.96	10,229	683.59	339	22.44	22	1.44	10,619	706.45
Santo Domingo de los Tsachilas	0	0.00	1,569	374.50	124	29.05	12	2.76	1,705	403.14
Guayas	3	0.07	8,376	204.99	307	7.40	100	2.38	8,786	213.44
El Oro	0	0.00	780	116.10	420	61.69	8	1.16	1,208	178.63
Santa Elena	0	0.00	347	96.69	95	25.87	4	1.06	446	122.83
Orellana	0	0.00	92	60.94	50	32.62	4	2.57	146	96.01
Galapagos	0	0.00	26	88.28	0	0.00	0	0.00	26	87.22
Los Rios	0	0.00	501	57.90	26	2.96	3	0.34	530	60.85
Sucumbios	0	0.00	44	21.40	13	6.17	0	0.00	57	27.39
Pichincha	5	0.17	711	24.12	85	2.83	11	0.36	812	27.29
Pastaza	0	0.00	25	25.04	1	0.97	0	0.00	26	25.67
Bolivar	0	0.00	48	23.82	3	1.48	0	0.00	51	25.20
Azuay	0	0.00	167	20.61	13	1.58	3	0.36	183	22.38
Cañar	0	0.00	26	10.06	30	11.40	1	0.37	57	21.86
Imbabura	0	0.00	54	12.13	1	0.22	0	0.00	55	12.27
Carchi	0	0.00	20	11.13	1	0.55	1	0.55	22	12.19
Loja	1	0.20	42	8.48	8	1.60	9	1.78	60	12.05
Chimborazo	0	0.00	28	5.58	24	4.74	0	0.00	52	10.32
Zamora	0	0.00	9	8.35	0	0.00	0	0.00	9	8.26
Cotopaxi	0	0.00	23	5.03	7	1.51	2	0.43	32	6.95
Morona Santiago	0	0.00	1	0.57	7	3.90	1	0.54	9	5.08
Tungurahua	1	0.18	23	4.13	4	0.71	0	0.00	28	4.99
Napo	0	0.00	1	0.83	1	0.81	2	1.59	4	3.29
Total	39	0.24	33,619	207.00	1,860	11.28	196	1.17	35,714	218.24

[a] Cases per 1000,000 pop.

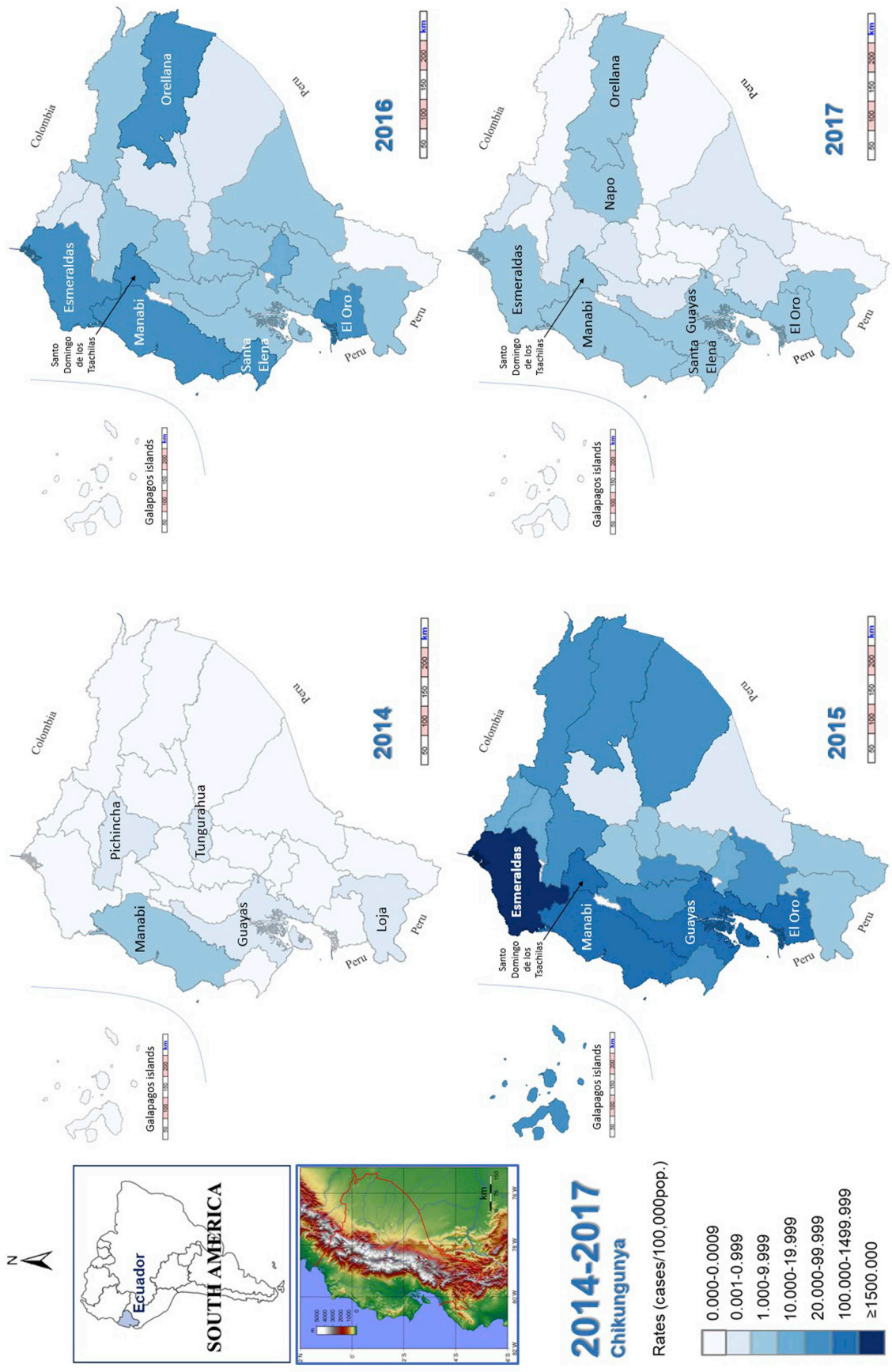

Fig. 1. Spatial distribution of CHIKV incidence rates (cases/100,000 pop) by provinces, Ecuador, 2014–2017, including altitude reference map for the country.

CRediT authorship contribution statement

Maritza Cabrera: Conceptualization, Formal analysis, Methodology, Writing - review & editing. **Fernando Córdova-Lepe:** Writing - review & editing. **Nereida Valero-Cedeño:** Data curation, Writing - review & editing. **Javier Reyes-Baque:** Data curation, Writing - review & editing. **Alfonso J. Rodríguez-Morales:** Conceptualization, Formal analysis, Methodology, Writing - original draft, Writing - review & editing.

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