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Short Communication

Seroprevalence of arboviruses among blood donors in French Polynesia, 2011–2013

Maite Aubry [a,*], Jérôme Finke [b], Anita Teissier [a], Claudine Roche [a], Julien Broult [c], Sylvie Paulous [d], Philippe Desprès [d,e], Van-Mai Cao-Lormeau [a], Didier Musso [a]

[a] Unit of Emerging Infectious Diseases, Institut Louis Malardé, PO Box 30, 98713 Papeete, Tahiti, French Polynesia
[b] Hochschule Emden/Leer, Emden, Germany
[c] Centre de Transfusion Sanguine de la Polynésie Française, Hôpital du Taaone, Papeete, Tahiti, French Polynesia
[d] Unité Hépacivirus et Immunité Innée, Institut Pasteur, Paris, France
[e] UMR PIMIT (12T) Université de La Réunion, Sainte-Clotilde, France

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SUMMARY

Objectives: French Polynesia is a high epidemic/endemic area for arthropod-borne viruses (arboviruses). We recently reported the silent circulation of Ross River virus and absence of active transmission of chikungunya virus (CHIKV) among blood donors sampled before the emergence of Zika virus (ZIKV) and CHIKV in French Polynesia. In this study, the prevalence of the four serotypes of dengue virus (DENV) and the occurrence of circulation of other arboviruses were investigated in blood donors in French Polynesia.
Methods: Serum samples from 593 blood donors collected between July 2011 and October 2013 were tested by ELISA for the presence of immunoglobulin G antibodies against each of the four DENV serotypes, ZIKV, Japanese encephalitis virus (JEV), and West Nile virus (WNV).
Results: It was found that 80.3%, 0.8%, 1.3%, and 1.5% of blood donors were seropositive for at least one DENV serotype, ZIKV, JEV, and WNV, respectively.
Conclusions: These results corroborate the expected high transmission of DENV and conversely suggest that no active circulation of ZIKV, JEV, and WNV occurred in French Polynesia before 2011. Information provided by this study may be useful for public health authorities to improve surveillance and implement strategies to prevent the transmission of arboviruses.

1. Introduction

French Polynesia, a French overseas territory in the South Pacific, is a high epidemic/endemic area for arthropod-borne viruses (arboviruses). The four serotypes of dengue virus (DENV) have caused several outbreaks since the 1940s.[1] Zika virus (ZIKV) and chikungunya virus (CHIKV) emerged in October 2013[2] and October 2014,[3] respectively.

Different arbovirus infections can have similar clinical presentations, and their circulation may be underreported if specific diagnostic tools have not been implemented. We recently described the silent circulation of Ross River virus (RRV) and the absence of active CHIKV transmission before the CHIKV outbreak in French Polynesia.[4] In the present study, the seroprevalence of each DENV serotype and the possible circulation of other undetected arboviruses were investigated among the same population of blood donors.

2. Methods

Serum samples were collected from the 593 blood donors between July 2011 and October 2013, as reported previously.[4] Serum samples were tested for the presence of immunoglobulin G class antibodies (IgG) against each of the four DENV serotypes, ZIKV, Japanese encephalitis virus (JEV), and West Nile virus (WNV) by indirect ELISA,[4] using recombinant antigens comprising domain III of the envelope glycoprotein of each of the DENV-1, DENV-2, DENV-3, DENV-4, ZIKV, JEV, and WNV strains[5] (respective GenBank accession numbers **AF226686.1**, **FM986654**, **FJ44740.1**, **FM986672.1**, **KJ776791**, **FJ979830**, and **AY033389**).

* Corresponding author. Tel./Fax: +689 40 416 460/+689 40 431 590.
E-mail address: maubry@ilm.pf (M. Aubry).

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Table 1
Seropositivity for DENV, ZIKV, JEV, and WNV among blood donors in French Polynesia (July 2011 to October 2013)

	Blood donors[a]			
	Group 1	Group 2	Group 3	Total
Number	132	290	171	593
Age, years				
Range	18–59	18–69	19–75	18–75
Median	32	33	42	36
Time of residence in FP, years				
Range	18–59	12–69	0–50	0–69
Median	32	32	12	27
Seropositivity for				
At least one DENV serotype	119 (90.2%)	260 (89.7%)	97 (56.7%)	476 (80.3%)
DENV-1	102 (77.3%)	219 (75.5%)	65 (38.0%)	386 (65.1%)
DENV-2	81 (61.4%)	158 (54.5%)	51 (29.8%)	290 (48.9%)
DENV-3	99 (75.0%)	205 (70.7%)	53 (31.0%)	357 (60.2%)
DENV-4	96 (72.7%)	195 (67.2%)	62 (36.3%)	353 (59.5%)
ZIKV	0 (0.0%)	5 (1.7%)	0 (0.0%)	5 (0.8%)
JEV	3 (2.3%)	5 (1.7%)	0 (0.0%)	8 (1.3%)
WNV	2 (1.5%)	6 (2.1%)	1 (0.6%)	9 (1.5%)

DENV, dengue virus; ZIKV, Zika virus; JEV, Japanese encephalitis virus; WNV, West Nile virus; FP, French Polynesia.
[a] Group 1: residents who were born in French Polynesia and had never travelled abroad; group 2: residents who were born in French Polynesia and had travelled abroad at least once; group 3: immigrants.

3. Results

Among the 593 blood donors, 132 were born in French Polynesia and had never travelled abroad (group 1), 290 were born in French Polynesia and had travelled abroad at least once (group 2), and 171 were immigrants (group 3). The age of these blood donors ranged from 18 to 75 years (median 36 years) and the duration of residence in French Polynesia ranged from 0 to 69 years (median 27 years) (Table 1).

The overall seropositivity rates were 80.3% for at least one DENV serotype, 0.8% for ZIKV, 1.3% for JEV, and 1.5% for WNV.

For DENV, the seropositivity rates were significantly higher for blood donors born in French Polynesia (90.2% in group 1 and 89.7% in group 2) than for immigrants (56.7%) (median time of residence in French Polynesia 32 and 12 years, respectively) (Fisher's test, $p < 0.0001$). Whatever the blood donor group, the highest seropositivity rate was found for DENV-1 and the lowest for DENV-2.

4. Discussion

In French Polynesia, with the exception of RRV and CHIKV,[4] only old data on the prevalence of arboviruses have been available and these have exclusively concerned DENV. A serosurvey conducted in 1987 showed that seropositivity rates for at least one DENV serotype ranged from 7.4% in children aged less than 5 years to 83.1% in those aged 15–19 years, and increased with age.[6] In the present study, 80.3% of blood donors were found to be seropositive for at least one DENV serotype. The successive outbreaks due to the four DENV serotypes recorded in French Polynesia since the mid-twentieth century[1,7] may have contributed to the high seroprevalence found among blood donors aged 18 to 75 years. Not surprisingly, a lower DENV seropositivity rate was found among immigrants compared to blood donors born in French Polynesia, with respective median durations of residence in French Polynesia of 12 and 32 years, confirming that DENV seroprevalence increases with time spent in French Polynesia. The finding of the highest seropositivity rate for DENV-1 and the lowest for DENV-2 is consistent with epidemiological data recorded in French Polynesia. DENV-1 had been circulating for several years (2001–2009) and re-emerged during the sampling period in March 2013,[1,7] which may explain the high proportion of blood donors seropositive for this serotype. In contrast, the last circulation of DENV-2 was reported 12 years before the beginning of the study.[1] The low level of herd immunity against DENV-2 is associated with the risk of a large outbreak if this serotype is introduced into French Polynesia.

Blood samples tested in this study were collected before the emergence of ZIKV and CHIKV in French Polynesia.[2,3] A small proportion of blood donors had IgG against ZIKV (0.8%) and CHIKV (3.0%).[4] The large magnitude of both ZIKV and CHIKV epidemics in French Polynesia in 2013 and 2014 could be explained by the low levels of pre-existing immunity against these pathogens in the population. Moreover, the low seroprevalence rates ($\leq$1.5%) against JEV and WNV suggest the absence of past active circulation of these viruses in French Polynesia.

The herd immunity of a population is one of the factors to take into account when evaluating the potential emergence of arboviruses.[8] Some prevention measures, such as mosquito bite prevention and integrated vector management, are common for all arboviruses. For other arboviruses such as JEV, specific measures including vaccination are available.[8] For DENV, future tetravalent vaccines may have different efficacy against the four serotypes.[9]

In the context of active circulation and new emergences of arboviruses in the Pacific,[7] and the presence of several potential mosquito vectors,[10] information provided by this study may be useful for public health authorities to improve surveillance and implement strategies to prevent the transmission of arboviruses in French Polynesia.

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Ethical approval: This study was approved by the Ethics Committee of French Polynesia under reference number 61/CEPF (08/27/2013).

Conflict of interest: None of the authors have any conflict of interest (financial or personal) in this study.

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