We investigated dengue and chikungunya virus antibody seroprevalence in French Polynesia during 2014–2015.

Dengue virus seroprevalence was ≈60% among schoolchildren and >83% among the general population; chikungunya virus seroprevalence was <3% before and 76% after Zika virus emergence (2013). Dengue virus herd immunity may affect Zika virus infection and pathogenesis.

In French Polynesia, the only recognized actively circulating arboviruses were the 4 dengue viruses (DENV; family Flaviviridae, genus Flavivirus) (1,2) until Zika virus (family Flaviviridae, genus Flavivirus) emerged there in 2013 (3), followed by chikungunya virus (family Togaviridae, genus Alphavirus) in 2014 (4). Serosurveys conducted among blood donors in French Polynesia during 2011–2013, before these outbreaks, confirmed the absence of Zika and chikungunya virus circulation and assessed DENV antibody seroprevalence at ≈80% at that time (5,6).

Another study conducted after the emergence of Zika virus showed Zika virus antibody seroprevalence rates ±95% CIs to be 49% ±7% among the general population and 66% ±5% among schoolchildren in 2014 and 22% ±6% among the general population in 2015 (7). We report seroprevalence of antibodies against the 4 DENVs and chikungunya virus in French Polynesia in 2014–2015 and discuss the possible role of anti-DENV herd immunity on Zika virus infection and pathogenesis.

The Study

To assess antibody seroprevalence against DENV types 1–4 and chikungunya virus in the population of French Polynesia, we conducted 3 cluster samplings (7). During February–March 2014, we sampled 196 participants from the general population of the 8 most inhabited islands of the 5 French Polynesia archipelagos: Tahiti and Moorea (Society), Rangiroa and Makemo (Tuamotu), Nuku Hiva and Hiva Oa (Marquesas), Rurutu (Australs), and Rikitea (Gambier). To better estimate seroprevalence of antibodies against these viruses among children, during May–June 2014, we recruited 476 schoolchildren from primary and high schools on the most populous island (Tahiti). To increase accuracy of seroprevalence data for DENVs and assess postoutbreak chikungunya virus seroprevalence, during September–November 2015, we sampled 700 members of the general population from the most inhabited archipelago (Society).

We report seroprevalence of antibodies against the 4 DENVs and chikungunya virus in French Polynesia in 2014–2015 and discuss the possible role of anti-DENV herd immunity on Zika virus infection and pathogenesis.
immunoassay (MIA) (8) using the same recombinant antigens as for the ELISA. Among the samples collected in 2015, we selected 20 to be a representative panel of the different antibody profiles found by MIA and tested them for neutralizing antibodies against each dengue, chikungunya, and Zika virus (8). We analyzed data by using GraphPad Prism version 6.03 software (https://www.graphpad.com/) and the Fisher exact test. We set significance at p<0.05.

Overall seropositivity rates for antibodies against ≥1 DENV were 96% ± 3% among the general population and 60% ± 5% among schoolchildren in 2014 and 83% ± 3% among the general population in 2015 (Table 1). Seroprevalence of DENV antibodies did not differ significantly between archipelagos, except for DENV-3, which differed between Society (76% ± 18%) and Austral-Gambier (53% ± 15%) Islands (p = 0.034). In all 3 groups of participants, we found the highest seropositivity rates for DENV-1 antibodies and the lowest for DENV-2. Seropositivity rates in 2014 and 2015 for all DENV antibodies were significantly lower for schoolchildren (median age 11 years) than for the general population (median age 41 years in 2014 and 43 years in 2015) (all p<0.0001). Seroprevalence of chikungunya virus antibodies was 3% ± 3% among the general population and 1% ± 1% among schoolchildren in 2014 and 76% ± 5% among the general population in 2015 after the outbreak.

According to information provided by a questionnaire, the percentages of asymptomatic DENV infections were 65% ± 7% among the general population and 81% ± 5% among schoolchildren in 2014 and 51% ± 4% among the general population in 2015. The percentage of asymptomatic chikungunya virus infections in participants recruited in 2015 was 13% ± 2%. Among the 20 samples positive by MIA for IgG against DENV-1–4 and chikungunya virus in this study and against Zika virus in the previous serosurvey (7), the proportions showing neutralizing activity were 8/9 (89%) for DENV-1, 5/5 (100%) for DENV-2, 6/6 (100%) for DENV-3, 6/6 (100%) for DENV-4, and 7/8 (88%) each for chikungunya and Zika viruses (Table 2).

**Conclusions**

The finding of DENV IgG in >80% of the general population sampled in 2014 and 2015 corroborates past high transmission rates for these viruses in French Polynesia (1,2,6,9). The lower seropositivity rates for antibodies against DENVs among children is consistent with seroprevalence rates for antibodies against viruses endemic to the region, which are expected to increase with duration of exposure (6). Finding the highest seroprevalence rate against DENV-1 in the general population and schoolchildren is consistent with the long-term circulation of this virus in French Polynesia during 2001–2009 and since 2013 (1,9). DENV-2 has not circulated in French Polynesia since 2000 (9), which is consistent with the lowest seroprevalence rate against this virus. The reduced population immunity against DENV-2 coupled with the circulation of this virus in neighboring Pacific Islands and detection of imported infections in travelers entering French Polynesia from Vanuatu in February 2017 (9) indicates that French Polynesia is at risk for a new epidemic. Although seroprevalence rates for antibodies against DENVs are consistent with epidemiologic data, bias associated with the presence of cross-reactive antibodies produced during a previous flavivirus infection could have resulted in detection of antibodies against viruses to which the persons were never exposed. The proportion of asymptomatic DENV infections assessed in this study seems to be consistent with reported rates (10). However, because the questionnaire asked about clinical manifestations suggestive of past DENV infection over a lifetime or during time spent in French Polynesia, the estimates may be strongly limited by recall bias.

The low seroprevalence rates for chikungunya virus antibodies for the general population (3% ± 3%) and

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**Table 1. Seropositivity for antibodies against dengue and chikungunya viruses among participants randomly recruited, French Polynesia, 2014–2015**

<table>
<thead>
<tr>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Society, n = 49</td>
<td>Tuamotu, n = 49</td>
<td>Marquesas, n = 49</td>
</tr>
<tr>
<td>Dengue</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥1 type</td>
<td>46 (94 ± 8)</td>
<td>49 (100 ± 0)</td>
<td>46 (94 ± 8)</td>
</tr>
<tr>
<td>Type 1</td>
<td>42 (86 ± 16)</td>
<td>47 (95 ± 5)</td>
<td>41 (84 ± 13)</td>
</tr>
<tr>
<td>Type 2</td>
<td>23 (47 ± 17)</td>
<td>22 (45 ± 13)</td>
<td>26 (53 ± 12)</td>
</tr>
<tr>
<td>Type 3</td>
<td>37 (76 ± 18)</td>
<td>33 (67 ± 21)</td>
<td>35 (71 ± 14)</td>
</tr>
<tr>
<td>Type 4</td>
<td>31 (63 ± 8)</td>
<td>32 (65 ± 21)</td>
<td>29 (59 ± 15)</td>
</tr>
<tr>
<td>Asymptomatic</td>
<td>36/46 (78 ± 12)</td>
<td>29/49 (59 ± 14)</td>
<td>24/46 (52 ± 14)</td>
</tr>
<tr>
<td>Chikungunya</td>
<td>3/6 (50 ± 8)</td>
<td>1 (2 ± 4)</td>
<td>1 (2 ± 4)</td>
</tr>
<tr>
<td>Asymptomatic</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>

*95% CIs were calculated by taking into account the cluster sampling design and using the Fisher exact test. Median ages of participants among the general population, 38–47 y; of schoolchildren, 11 y. ND, not determined.*

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Virus immunopathogenesis is enhanced in the setting of genital abnormalities (Barré syndrome and Zika virus infection–associated congenital abnormalities (8,14) might also suggest that Zika virus immunopathogenesis is enhanced in the setting of high seroprevalence of DENV antibodies (15).

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About the Author
Dr. Aubry is a research scientist at the Institut Louis Malardé, Tahiti, French Polynesia. Her research focuses on the epidemiology in the Pacific region and genetic evolution of various arboviruses, including dengue, Zika, chikungunya, and Ross River viruses.

References


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