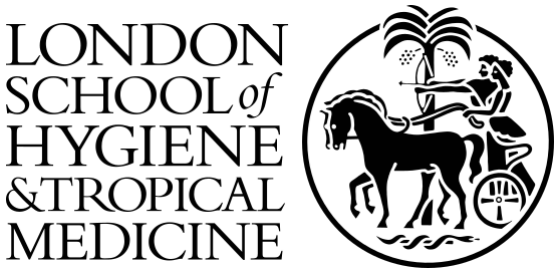

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Short Communication

Low chikungunya virus seroprevalence two years after emergence in Fiji

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ABSTRACT

Objectives: In Fiji, autochthonous chikungunya virus (CHIKV) infection was first detected in March 2015. In a previous serosurvey conducted during October–November 2015, we reported a prevalence of anti-CHIKV IgG antibodies of 0.9%. In the present study, we investigated the seroprevalence of CHIKV two years after its emergence in Fiji.

Methods: Sera from 320 residents of Fiji recruited in June 2017, from the same cohort of individuals that participated in the serosurvey in 2015, were tested for the presence of IgG antibodies against CHIKV using a recombinant antigen-based microsphere immunoassay.

Results: Between 2015 and 2017, CHIKV seroprevalence among residents increased from 0.9% (3/333) to 12.8% (41/320). Of the participants with available serum samples collected in both 2015 and 2017 (n = 200), 31 (15.5%) who were seronegative in 2015 had seroconverted to CHIKV in 2017.

Conclusions: Our findings suggest that low-level transmission of CHIKV occurred during the two years following the emergence of the virus in Fiji. No CHIKV infection has been reported in Fiji since 2017, but due to the presumed low herd immunity of the population, the risk of CHIKV re-emergence is high. Consequently, chikungunya should be considered in the differential diagnosis of acute febrile diseases in Fiji.

Introduction

Chikungunya virus (CHIKV, *Alphavirus* genus, *Togaviridae* family) is transmitted to humans by *Aedes* mosquitoes. CHIKV infection causes an acute febrile illness commonly with polyarthralgia which can become chronic, maculopapular rash, headache, fatigue and myalgia (Ministry of Health and Medical Services, 2015). In Fiji (884,887 inhabitants in 2017), the first reported CHIKV infection was detected in March 2015 (Ministry of Health and Medical Services, 2015). Four autochthonous CHIKV infections were subsequently detected the same year, followed by 86 in 2016, and 2 in 2017 (Kama et al., 2019). During this period, CHIKV infection was also reported in travelers returning from Fiji to Australia and New Zealand (The Australian Government Department of Health, 2019; Institute of Environmental Science and Research Limited, 2018). A serosurvey conducted during October-November 2015 in the Central Division, where 43% of the Fiji population is living, showed a prevalence of anti-CHIKV immunoglobulin class G (IgG) antibodies of 0.9% (Kama et al., 2019). In the present study, we investigated the seroprevalence of CHIKV in the same population two years after emergence in Fiji.

Methods

Our study was conducted in 320 volunteers with no significant acute illness recruited in the Central Division in June 2017, from the

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Table 1
Prevalence of anti-chikungunya virus and anti-Ross River virus antibodies in a representative subset of the Fijian population sampled in the Central Division during October-November 2015 (N = 333) and June 2017 (N = 320).

Sampling period	Age range (median), y	N	No. positive (% [95% CI])	
			CHIKV	RRV
October–November, 2015	4–80 (29)	333	3 (0.9 [0.2–2.6])	124 (37.2 [32.4–42.7])
June, 2017	6–84 (29)	320	41 (12.8 [9.4–17])	125 (39.1 [33.7–44.7])

CHIKV, chikungunya virus; RRV, Ross River virus.

same cohort previously tested in 2015 (Kama et al., 2019). All blood samples were tested for the presence of IgG against CHIKV using the same recombinant antigen-based microsphere immunoassay (MIA) as in the serosurvey conducted in 2015 (Kama et al., 2019), with 100% sensitivity and specificity. Samples were also tested by MIA for IgG against Ross River virus (RRV), a related a*lphavirus* that caused a large outbreak in Fiji in 1979 and has since established endemic circulation, as suggested by recent evidence (Aubry et al., 2019). A subset of paired serum samples collected in 2015 and 2017 was also tested for the presence of neutralizing antibodies against CHIKV as previously described (Aubry et al., 2018). Data were analyzed with GraphPad Prism 6.03 using the Fisher's exact test.

Results

The prevalence of anti-CHIKV IgG in the participants from the Central Division increased from 0.9% (95%CI 0.2%–2.6%) in 2015 to 12.8% (95%CI 9.4%–17%) in 2017 ($p < 0.0001$) (Table 1). The prevalence of anti-RRV IgG was stable over the same period, with 37.2% (95%CI 32.4%–42.7%) in 2015 and 39.1% (95%CI 33.7%–44.7%) in 2017 ($p = 0.687$). Among the 200 participants with available serum samples collected in both 2015 and 2017, 31 (15.5%; 95%CI 10.8%–21.3%) participants who had no detectable anti-CHIKV IgG and 16 (8%; 95%CI 4.6%–12.7%) with no anti-RRV IgG in 2015 had seroconverted to these respective viruses by 2017 (Table 2). Among the 31 participants with anti-CHIKV IgG in 2017, 5 (16.1%; 95%CI 5.5%–33.7%) had anti-RRV IgG in 2015. Moreover, for all 31 participants that were found seronegative in 2015 and subsequently tested seropositive in 2017 against CHIKV by MIA, paired serum samples were also tested by neutralization assay and results were 100% concordant between the two assays.

Discussion

Although CHIKV was introduced to an immunologically naïve population in Fiji, as demonstrated by a CHIKV seroprevalence <1% in 2015 (Kama et al., 2019), our serological findings show the transmission rate in the following two years was relatively low, with seroprevalence of 12.8% in 2017. This result contrasts with the explosive CHIKV outbreak that occurred in 2014–2015 in French Polynesia (Aubry et al., 2015), another Pacific island country, where a seroprevalence of 76% was found one year after the emergence of the virus (Aubry et al., 2018). A possible explanation for the large difference in transmission between the two countries is that recent exposure to RRV may provide cross-protection against CHIKV infection. Indeed, higher RRV seroprevalence was detected in the general population from Fiji (37.2% in 2015 and 39.1% in 2017) compared to French Polynesia (18% in 2015) (Aubry et al., 2019; Aubry et al., 2017). Moreover, the finding that 8% of Fiji residents who were initially seronegative to RRV had seroconverted between 2015 and 2017 suggests recent circulation of the virus in Fiji, whereas in French Polynesia the low RRV seroprevalence (1%) in children aged less than 16 years in 2014 (Aubry et al., 2017) suggests limited transmission during the past two decades. This hypothesis is further supported by experiments showing that mice infected with RRV and challenged with CHIKV 4.5 months later had significantly reduced CHIKV viremia and were protected against the disease (Gardner et al., 2010). Another factor that may have limited circulation of CHIKV in Fiji is possible competition for transmission by the mosquito host (Vogels et al., 2019), as CHIKV circulated concurrently with other arboviruses (Zika virus, dengue viruses and RRV) that share the same mosquito vectors (Kama et al., 2019; Aubry et al., 2019) Additional studies are therefore needed to identify the factors modulating concurrent transmission of multiple mosquito-borne viruses in Fiji.

In our study, participants were recruited in the Central Division, where 74.2% (69/93) of the confirmed cases of CHIKV infection in Fiji were detected between 2015–2017. Serological evidence together with surveillance data (Kama et al., 2019) strongly suggest low CHIKV transmission in Fiji between 2015–2017. Since most residents in Fiji are still susceptible to CHIKV, there is a high risk of reemergence in the coming years. Consequently, active surveillance is crucial for early detection of new cases of CHIKV infection, and chikungunya should be considered in the differential diagnosis of acute febrile illness in Fiji, particularly in the presence of polyarthralgia and/or rash.

Table 2
Positivity for anti-chikungunya virus and anti-Ross River virus antibodies in paired serum samples serially collected from the same participants (N = 200) during October-November 2015 and June 2017.

2015	2017			
	CHIKV+	CHIKV−	RRV+	RRV−
CHIKV+	0	2	–	–
CHIKV−	31	167	–	–
RRV+	–	–	56	12
RRV−	–	–	16	116

CHIKV, chikungunya virus; RRV, Ross River virus.

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Ethical approval statement

This study was approved by the Fiji National Health Research Ethics Review Committee (ref 2017.20.MC) and the London School of Hygiene and Tropical Medicine Observational Research Ethics Committee (ref 12037).

Conflict of interest statement

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

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