

# Low risk of dengue infection predicted for foreign visitors to Rio Olympics

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In 2014, before the FIFA World Cup opened in Brazil, there were fears that many of the 600,000 foreign visitors expected for the world's largest soccer tournament would acquire dengue fever. Their numbers could reach hundreds or even thousands, according to some predictions.

These fears were not unfounded, since two years ago infestations of the *Aedes aegypti* mosquito that transmits dengue were as widespread in Brazil as they are today. In May 2014, however, a month before the World Cup was due to open, an epidemiological study surprised the scientific community by contradicting all the gloom and doom: the number of dengue cases among foreign visitors would be negligible, it predicted. And the prediction proved correct.

According to the article "Risk of symptomatic dengue for foreign visitors to the 2014 FIFA World Cup in Brazil" by Professor Eduardo Massad and collaborators at the University of São Paulo's Medical School (FM-USP), sophisticated mathematical modeling techniques pointed to a likely minimum of three cases and a maximum of 59.

"Do you know how many cases there actually were?" Massad asks with a smile. "Just three: two visitors from the United States and one from Japan. That's the low end of our predicted range."

In 2016, three months before the opening of the Rio de Janeiro Summer Olympics, the same researchers used the same mathematical models to calculate the risk of dengue acquisition by the 400,000-odd foreign

visitors expected to attend, according to the Ministry of Tourism.

The epidemiologists used data from the Ministry of Health's Notifiable Diseases Information System (SINAN). Once again a very low number of dengue cases among foreign visitors to the Olympics is likely, said Raphael Ximenes, who is studying for a PhD with Massad as his supervisor.

Ximenes is the lead author of the article "The risk of dengue for non-immune foreign visitors to the 2016 Summer Olympic Games in Rio de Janeiro, Brazil" published by the journal *BMC Infectious Diseases*, and a FAPESP scholarship awardee for the related research project.

The mathematical model predicts a worst-case scenario of 23 symptomatic cases among the 400,000 foreigners expected to visit the Olympics, assuming the 2016 dengue epidemic displays the pattern observed in August 2007, when the number of reported cases was the highest ever for the month. Symptomatic cases are defined as those in which patients present with fever and other symptoms, whether or not they are hospitalized.

The model also predicts a maximum of 206 asymptomatic infections, in which visitors will be bitten by the mosquito and infected with [dengue virus](#) but will not develop symptoms or fall sick.

Annual dengue outbreaks in Brazil typically occur during the rainy season when the weather is warmer and the mosquito proliferates much faster. They usually peak in April and begin declining in May as the amount of rainfall decreases. When the cooler dry season begins, the mosquito basically stops breeding and the total number of dengue cases drops precipitously.

In 2007 the pattern was different. The temperature lows were unusually

high during the dry season (winter), and the mosquito continued to breed, albeit at lower levels. As a result, there was no interval between the dengue outbreak that began during the 2008 rainy season and the annual outbreak beginning in early 2007. Hence the relatively large number of cases reported in August 2007.

But 2007 was an exception to the rule. If [dry season](#) temperatures in 2016 are as low as they have been most years since 2002, the mosquito will stop breeding. Under these conditions, how many symptomatic cases of dengue are expected among foreign visitors to the Rio Olympics? None at all, at least according to the researchers' calculations. The number of asymptomatic infections may reach two at most.

"Dengue fever won't disappear and the outbreaks will continue until we have an effective vaccine," Massad said. Meanwhile, the only option is to try to exterminate the mosquito, which is a challenging task. "I've worked in Singapore, where there has been a dengue epidemic since 1974," he added. "Despite efforts by the government and society, the number of dengue cases increases year by year, in line with the number of mosquitoes, which correlates directly with population growth. Dengue is an urban problem. *A. aegypti* is like the rat and the cockroach. Wherever there are lots of people, there will be lots of mosquitoes and outbreaks of dengue."

Armed with their dengue research experience, the team at FM-USP now aim to try to estimate the risk of infection by Zika virus for foreign visitors to Brazil. This is a much more complex matter, with plenty of margin for error owing to the fact that notification of zika cases has only been mandatory since January 2016.

"You can't predict the risk of infection without knowing all about the past of the disease," Ximenes said. "Fortunately in the case of [dengue](#) the SINAN database is one of the most comprehensive in the world."

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