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Source: Environmental Health Insights, 10(1)

Published By: SAGE Publishing

URL: https://doi.org/10.1177/EHI.S40953

Insights into Zika Virus History, Human Health Effects, and Control Measures

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CITATION: Kelley and Richards. Insights into Zika Virus History, Human Health Effects, and Control Measures. *Environmental Health Insights* 2016:10 173–174
doi: 10.4137/EHI.S40953.

TYPE: Editorial

FUNDING: Authors disclose no external funding sources.

COMPETING INTERESTS: Authors disclose no potential conflicts of interest.

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Zika virus is named for the Zika Forest in Uganda and was first discovered in 1947 in primates. The first human cases of Zika virus infection were detected in 1952. From about 1960–1980, human infections occurred across Asia and Africa, although infections were typically mild with limited symptoms. The first major human outbreak occurred in Micronesia in 2007. Zika was linked to a neurological disorder (Guillain-Barré syndrome, or GBS) during a 2013–2014 outbreak in French Polynesia. In May 2015, the first human cases were reported in Brazil and a link to GBS was also reported. Other symptoms of Zika infection include rash, fever, conjunctivitis and joint pain. Only approximately 20% of infected individuals experience clinical symptoms (http://www.cdc.gov/zika/symptoms/symptoms.html). Brazil reported an association between Zika viral infections and microcephaly in October 2015. Microcephaly is a disorder in which the head of a newborn child is disproportionally small relative to the body. It may result from a variety of chromosomal and environmental causes, including drug, alcohol, or radiation exposure and prenatal infections (rubella, herpes simplex, and likely Zika virus) (Merck Manual, 2016). As of August 3, 2016, evidence of mosquito-borne Zika virus transmission has been reported in 68 countries and territories and 14 countries or territories have reported microcephaly and other central nervous system (CNS) malformations associated with Zika virus.

As of August 3, 2016, evidence of mosquito-borne Zika virus transmission has been reported in 68 countries and territories and 14 countries or territories have reported microcephaly and other central nervous system (CNS) malformations associated with Zika virus. From January 1, 2015 through September 7, 2016, there have been 2,920 U.S. travel-associated cases reported, 43 locally-acquired mosquito-borne cases reported and one laboratory acquired case reported for a total of 2,964 cases (24 sexually transmitted and seven with GBS association) (http://www.cdc.gov/zika/about/overview.html and http://www.who.int/emergencies/zika-virus/timeline/en/). At the time of this report, all U.S. states except for Wyoming had confirmed traveler-related Zika virus cases.

The first U.S. case of locally-transmitted (victim did not travel) mosquito-borne Zika virus was reported in Miami, Florida on July 29, 2016 and all local U.S. cases (as of September 7, 2016) have been restricted to the state of Florida. The U.S Territories of Puerto Rico, American Samoa and the U.S. Virgin Islands have reported (as of September 7, 2016) 15,809 local and 60 travel-associated cases of Zika virus infection.

Zika virus is primarily spread through the bite of an infected mosquito of the species *Aedes aegypti* (the yellow fever mosquito) or *Ae. albopictus* (the Asian tiger mosquito). Maps showing the approximate distribution of these species in the U.S. show that *Ae. albopictus* is more widespread than *Ae. aegypti*, although caution is advised in interpretation, since mosquito surveillance may be inadequate in some areas (Hahn, et al. 2016). These species of mosquitoes lay eggs primarily in artificial containers holding standing water. *Aedes aegypti* females prefer to blood feed on humans, while *Ae. albopictus* females are opportunistic feeders, blood feeding on a variety of hosts, including humans. Both *Ae. aegypti* and *Ae. albopictus* are primarily active and blood feed in the daytime. When mosquitoes bite a person infected with the virus, they may become infected; however, not all mosquitoes can become infected with and transmit viruses. Mosquitoes that are competent vectors (ie, able to transmit Zika virus) can pass the virus to humans through their subsequent blood meals. A pregnant woman who is bitten by a Zika virus-infected mosquito may pass the virus to her fetus, which may result in microcephaly and/or other complications in the developing fetus and newborn child. Zika virus may also be passed through sexual contact, even if the infected person shows no symptoms. Zika virus may also be transmitted through transfusion of infected blood and laboratory exposure, although the exact mechanism of the laboratory transmission is unclear (http://www.who.int/topics/zika/en/, http://www.cdc.gov/zika/transmission/index.

html). There is some evidence (in mice) that Zika virus impacts adult brain cells and these effects may be present in immunocompromised or healthy individuals (Li et al. 2016). More research is needed to further investigate these effects on the human brain.

There is currently no vaccine for Zika virus, although work is currently underway to develop an emergency vaccine target product profile for dengue, chikungunya and Zika viruses. Dengue and chikungunya viruses are also mosquito borne pathogens of public health concern that use the same species of mosquito vectors as Zika virus. The current primary means of preventing Zika virus infections is protection against mosquito bites using insect repellants (DEET, Picaridin [LBR 3023], Bayrepel, Incaridin, oil of lemon eucalyptus [OLE], para-menthane-diol [PMD] or IR3535), wearing of long-sleeved shirts and long pants (which may be professionally treated with permethrin to increase protection), and use of effective screens on windows and doors, air conditioning when available, and control of oviposition (egg-laying) areas (emptying and scrubbing of any outdoor items that may hold water such as tires, buckets, toys, pools, birdbaths, flowerpot water receptacles, trash containers, etc.). Sexual transmission of Zika virus can be limited by using safe sexual practices (eg, condoms or other barrier protection). Individuals planning to travel should pay attention to travel advisories provided by the U.S. Centers for Disease Control and Prevention (http://wwwnc.cdc.gov/travel/page/zika-travel-information) and the World Health Organization (http://www.who.int/csr/disease/zika/information-for-travelers/en/). Mosquito control and protection from mosquito bites may have the added benefit of protecting against other mosquito-borne viruses such as dengue and chikungunya.

As reported in a previous *Environmental Health Insights* editorial entitled "Insights into Ebola and Other Emerging and Re-emerging Infectious Disease Risks" (Kelley, 2014), it is important to recognize that the risks associated with emerging infectious diseases such as Zika may be covered more frequently by global media; however, widespread global issues with other mosquito-borne pathogens such as dengue and chikungunya viruses are also of continued concern, especially as global travel continues to increase the incidence of imported cases. Of course, the effects of Zika virus on pregnant women and their children is a serious concern with long-lasting implications. It is important that a vaccine is developed as quickly as possible to limit further congenital abnormalities and mosquito surveillance and control is brought to the forefront of priorities for public health protection.

Author Contributions

Conceived the concepts: TK, SR. Analyzed the data: TK, SR. Wrote the first draft of the manuscript: TK, SR. Contributed to the writing of the manuscript: TK, SR. Agree with manuscript results and conclusions: TK, SR. Jointly developed the structure and arguments for the paper: TK, SR. Made critical revisions and approved final version: TK, SR. Both authors reviewed and approved of the final manuscript.

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