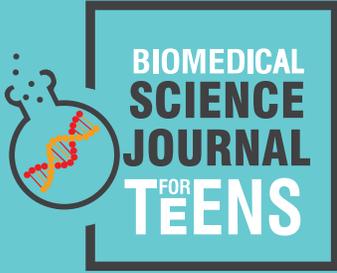


# What is the connection between Zika virus and microcephaly?



BIOMEDICAL  
SCIENCE  
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TEENS



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## Abstract

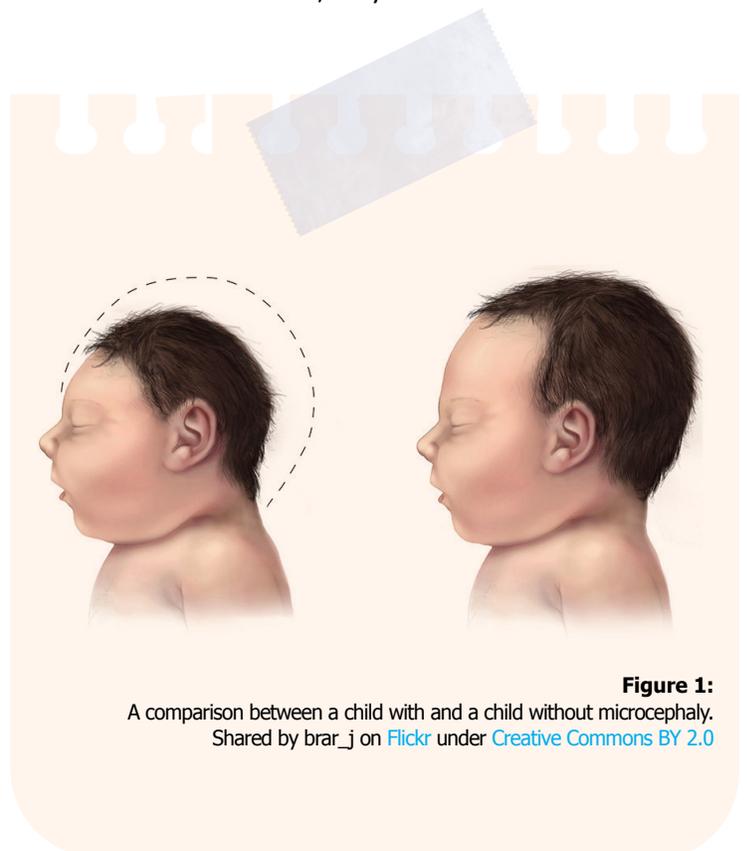
*Zika* is a *mosquito-borne* virus which usually causes no symptoms. Yet for some time now, scientists have believed Zika infection during pregnancy can lead to birth defects in the babies. One reason is that the Zika *outbreak* in Brazil coincided with a *microcephaly* outbreak. We wanted to see whether there really is a connection between the virus and this and other birth defects or whether there were other factors responsible for the microcephaly outbreak. That is

why we gathered information on every birth in Brazil since the beginning of the Zika outbreak. Using statistics we then tested different hypotheses about the cause of the increased rate of microcephaly cases. We found a strong connection between Zika infection early in the pregnancy and this birth defect. The risk is highest during the first two trimesters of the pregnancy. Although Zika virus turned out to cause other birth defects as well, they are a lot rarer as outcomes.

## Introduction

You have probably already heard of Zika virus. There was an outbreak in Brazil recently. But what is it and why was it in the news so much? Zika is a mosquito-borne disease which usually doesn't cause any symptoms. Sometimes it can cause a slight temperature increase, mild rash, and joint pain, but that doesn't sound very dangerous. What made people fear Zika is that during this outbreak in Northeast Brazil in 2015 a lot of babies with microcephaly (Fig. 1) were born – a lot more than usual. Many factors (such as genetic disorders, other infections during pregnancy like rubella, or some harmful chemicals) can cause this disorder, but the large increase in cases led to a growing concern that Zika infection during pregnancy can lead to microcephaly.

Nevertheless, as the virus spread throughout the country, rates of microcephaly remained low in other districts of Brazil. This led researchers to believe that other factors may have contributed to the elevated number of microcephaly cases in Northeast Brazil. These might include infection or coinfection with other viruses, such as the closely related dengue and chikungunya viruses; exposure to Zika after *yellow fever* virus vaccination; contaminated water and still other factors.



**Figure 1:**

A comparison between a child with and a child without microcephaly.  
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This is why we assembled information on different causes of microcephaly for every birth in Brazil since the beginning of the Zika outbreak. We wanted to answer the following questions:

- Were there other (non-Zika) factors which caused the microcephaly outbreak?

## Methods

We gathered as much information as possible for every birth (over 6.8 million births) in Brazil between January 2015 and May 2017. The data included:

- The presence or absence of any abnormalities in the babies
- The age and race of the mother
- The sex of the baby
- The pregnancy date
- The residence of the mother

- Or is Zika infection during pregnancy the main cause of microcephaly?
- Can Zika cause other malformations in babies?
- If Zika is indeed the cause, how much risk do pregnant women face and at what times in pregnancy?

To estimate the exposure to different viruses and other harmful factors we matched information on where and when each mother was pregnant to databases of the distribution of Zika, dengue, chikungunya and harmful chemicals. This helped us estimate who was infected and test different hypotheses about the cause of the 2015-2017 microcephaly outbreak.

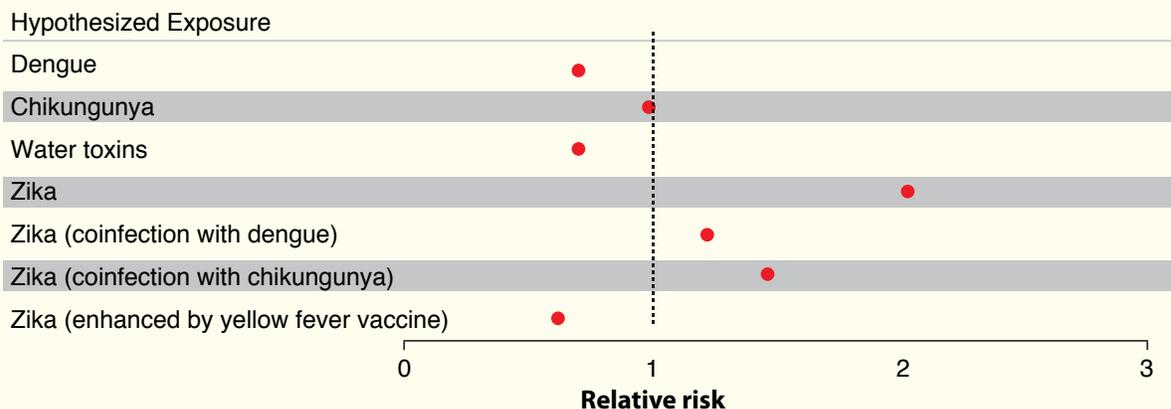
## Results

Our analysis of the data showed us that:

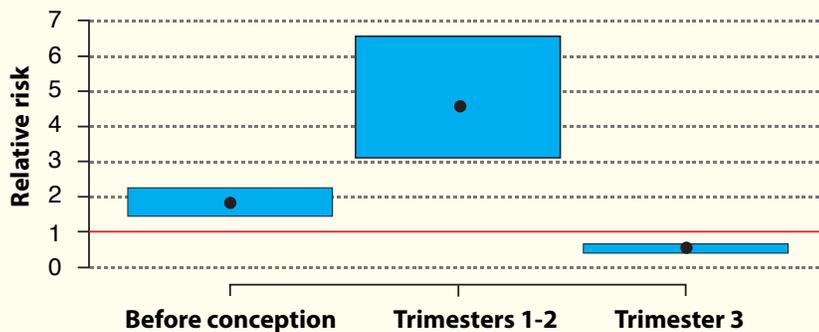
- 2791 of the 6.8 million babies were born with microcephaly.
- **Exposure to Zika virus alone is the most likely cause for microcephaly** (Fig. 2).
- Other factors had little or no role in causing the microcephaly outbreak.
- Coinfection with dengue and previous yellow fever vaccination did not increase the risk for microcephaly.

- Other birth defects due to Zika infection are very rare.
- Women infected with Zika virus early in the pregnancy were a lot more likely to give birth to a baby with microcephaly, and the risk is highest in the first two trimesters (Fig. 3).

**Please see  
Figure 3 Page 3**



**Figure 2:** Links between several hypothesized factors and microcephaly. *Relative risk* describes the risk a group exposed to any of the factors has, as compared with a group not exposed to that factor. Here we compare the risk of microcephaly for the babies of mothers who were or were not exposed to these different factors during pregnancy. A relative risk of 1 means there is no connection.



**Figure 3:** Relative risk of microcephaly given Zika exposure at different times in pregnancy. The black dots and blue bars represent the mean and 95% confidence intervals. The red line shows a relative risk of 1 (in this case, no risk of microcephaly).

At what time of pregnancy does exposure to Zika virus most increase the risk of microcephaly?

## Discussion

Our research shows that even though microcephaly was rare outside of Northeast Brazil, Zika infection is connected to this birth defect. Moreover, the risk is high: if a woman gets infected with Zika during the first two trimesters of her pregnancy, she might be up to 17 times more likely to give birth to a baby with microcephaly. This period is critical, because it includes the early *neurodevelopment* of the baby. The risk is significantly lower during the third trimester and before the baby's conception. We believe the reason that the microcephaly outbreak was concentrated in Northeast Brazil is because it was where the Zika epidemic began and because it took longer to control the epidemic there compared to other areas.

One limitation of the study is that there could have been other factors active in Northeast Brazil at the time that we didn't

have data for or were unable to measure. It is also possible that infection with dengue or chikungunya much earlier in the mother's life might change her risk of microcephaly if she is then infected with Zika in pregnancy, but we were unable to test this.

People have feared that microcephaly is only the most apparent birth defect, so this is why we searched for a connection between Zika infection and other birth defects, such as eye and foot defects. Our results showed that even though Zika virus can cause other abnormalities, they are a rare outcome. It's important to mention, however, that we couldn't account for possible abnormalities that only reveal themselves later in the lifetime of the child, such as abnormal sight or hearing development.

## Conclusion

Mosquitoes are responsible for transmitting Zika, other viruses and malaria. Even though only certain countries suffer from these diseases, it doesn't mean that they can't spread any further. Fast travel and global warming are among the factors which contribute to their expanding distribution. **It's important to protect yourself in order to protect everyone else!** Since there are no vaccines available yet, the best prevention is to avoid mosquito bites in areas where mosquito-borne diseases are present:

- Use insect *repellents* during the day, even indoors.
- Avoid going outside around sunrise and sunset, when most of the mosquitoes which transmit Zika are especially likely to bite.
- Wear clothing that covers your arms and legs.
- Use mosquito nets on your bed at night.

## REFERENCES

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## Glossary of Key Terms

**Coinfection** – simultaneous infection of a person by multiple viruses/bacteria. For example, many patients with HIV are also infected with Hepatitis C.

**Dengue and chikungunya** – mosquito-borne diseases which cause fever, rash, severe muscle and joint pain. Dengue is sometimes fatal.

**Microcephaly** – A condition in which a baby has an abnormally small head, often with an underdeveloped brain. Zika virus and Rubella virus can cause microcephaly in newborn babies.

**Mosquito-borne diseases** – diseases caused by viruses, parasites and bacteria, which mosquitoes transmit without being affected themselves. Some examples other than Zika include malaria, dengue, chikungunya, yellow fever, and West Nile fever.

**Neurodevelopment** – the development of the nervous system (including the brain) from the earliest stages of a baby's development to adulthood.

**Outbreak** – A sudden increase in the number of disease cases in a particular season and place.

**Relative risk** – A measurement that compares the risk of something (like microcephaly in our case) for a group (like pregnant women) exposed to a certain factor (like Zika virus) with the risk for a group that wasn't exposed.

**Repellent** – a chemical that is used to stop insects (and sometimes ticks) from biting you. The most common chemical is DEET (a brand of diethyltoluamide).

**Yellow fever** – yet another mosquito-borne disease, closely related to Zika. There is a vaccine against yellow fever that might react with Zika and other viruses.

**Zika** – a mosquito-borne disease in which the majority of infected people do not develop any symptoms. Sometimes the virus can cause a slight fever, a rash, and muscle and joint pain. Zika during pregnancy can cause birth defects.

## Check your understanding

1 What is a mosquito-borne disease? Give some examples.

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2 What harm does Zika virus cause to an adult? to an unborn baby?

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3 When during the pregnancy is the microcephaly risk highest due to Zika infection?

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4 How can you protect yourself against mosquito-borne diseases?

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