Falling birth rates shift rotavirus epidemics

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Fewer births in states such as California may be delaying the annual onset of a common intestinal virus in the southwest, according to epidemiologists. The timing of infectious outbreaks in other locations such as the northeast remains more or less unchanged.

Rotavirus is a leading cause of diarrhea among children, both in the developed and developing world. In the United States, the virus causes about 60,000 hospitalizations each year and kills about 40 children below the age of five.

"It is an imperfectly immunizing infection," said Virginia Pitzer, postdoctoral researcher in the Center for Infectious Disease Dynamics and the department of biology, Penn State. "So you can get infected multiple times throughout your life."

Up until the late 1990s, annual rotavirus epidemics in the U.S. followed a predictable pattern. Infections appeared in the southwest and peaked in December or January, then spread to the northeast, where they peaked in March. In recent years epidemics in the southwest have begun later than usual.

Pitzer and her colleagues initially looked at environmental factors such as solar radiation, precipitation and temperature but these could not explain the shifts in outbreaks of new infections. Unlike other viruses that die out and are replenished each year with new strains from outside the United States, rotavirus infections tend to linger in the summer months.

"In general, the pattern of spread of rotavirus outbreaks from the southwest to the northeast is not consistent with any climatic factors," explained Pitzer, whose findings appear today (July 17) in *Science*. "For instance, temperature tends to be high in the southwest but it also tends to be high in places like Florida, where epidemics occur much later."

Instead, Pitzer and her colleagues looked at human birth rates and the potential link to the timing of rotavirus epidemics. While birth rates are typically high in the southwest and low in the northeast, census data indicates a recent decline in the southwest, particularly in California.

Statistical analysis suggested a negative correlation between birth rates and the timing of the epidemics between 1991 and 2006.

"Each time there was a decline in birth rate, whether from state to state or year to year, infections tended to happen later," explained Pitzer.

A mathematical model using information on the epidemiology of rotavirus and birth rates from states confirmed the statistical correlation and predicted that given the declining birth rate in California, rotavirus epidemics in the state would gradually shift from December to February.

"Since infants often have diarrhea and can be very infectious when they get rotavirus, they are the ones who tend to drive the epidemics," said Pitzer, who is also associated with Fogarty International Center at the National Institutes of Health through the Research and Policy for Infectious Disease Dynamics program. "Thus, you can get outbreaks of rotavirus happening a lot sooner when and where there are more infants being born."

Vaccines introduced in 2006 further confirm Pitzer's model. Since vaccination reduces the number of infants vulnerable to symptomatic infections, the effect is analogous to a decline in birth rate.

"With the effects of vaccination factored in, the model accurately predicted a small decrease in the incidence of severe diarrhea during the 2006-2007 season, and a larger decline and delay during 2007-2008, providing validation for our model," said Pitzer.

Researchers add that high levels of vaccination could further limit the intensity of new epidemics and lead to a period of years with very few cases of severe diarrhea caused by rotavirus.

"The important message here is that vaccination can have a big impact in controlling rotavirus infections," explained Pitzer. "Even those not vaccinated can benefit from those vaccinated because it lowers the overall prevalence of the infection in the population."

Source: Pennsylvania State University (news : web)