Relaxed precautions, not climate, the biggest factor driving wintertime COVID-19 outbreaks

February 9 2021, by Morgan Kelly

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Wintertime outbreaks of COVID-19 have been largely driven by whether people adhere to control measures such as mask wearing and

social distancing, according to a study published Feb. 8 in *Nature Communications* by Princeton University researchers. Climate and population immunity are playing smaller roles during the current pandemic phase of the virus, the researchers found.

The researchers—working in summer 2020—ran simulations of a wintertime coronavirus outbreak in New York City to identify key factors that would allow the virus to proliferate. They found that relaxing control measures in the summer months led to an outbreak in the winter regardless of climate factors.

"Our results implied that lax control measures—and likely fatigue with complying with control measures—would fuel wintertime outbreaks," said first author Rachel Baker, an associate research scholar in Princeton's High Meadows Environmental Institute (HMEI). Baker and her co-authors are all affiliated with the HMEI Climate Change and Infectious Disease initiative.

"Although we have witnessed a substantial number of COVID-19 cases, population-level immunity remains low in many locations," Baker said. "This means that if you roll back enforcement or adherence to control measures, you can still expect a large outbreak. Climate factors including winter weather play a secondary role and certainly don't help."

The researchers found that even maintaining rigid control measures through the summer can lead to a wintertime outbreak if climate factors provided enough of a boost to viral transmission. "If summertime controls are holding the transmissibility of coronavirus at a level that only just mitigates an outbreak, then winter climate conditions can push you over the edge," Baker said. "Nonetheless, having effective control measures in place last summer could have limited the winter outbreaks we're now experiencing."

Cases have climbed in many northern hemisphere locations since November. In the United States, spikes in COVID-19 cases are thought to be tied to increased travel and gatherings for Thanksgiving and Christmas. Notably, outbreaks were recorded in temperate locations such as Los Angeles in addition to regions with much colder conditions, Baker said. At the same time, large outbreaks were observed in South Africa from November to January, which are that country's summer months.

"The greater incidence of COVID-19 in various environs really speaks to the climate's limited role at this stage," Baker said.

In May, the same authors published a paper in the journal *Science* suggesting that local climate variations would be unlikely to affect the coronavirus pandemic. The paper suggested that hopes that the warmer conditions of summer would slow the transmission of the novel coronavirus, SARS-CoV-2, in the northern hemisphere were unrealistic.

Gabriel Vecchi, a professor of geosciences and the High Meadows Environmental Institute and co-author of both studies, said that the virus currently spreads too quickly and that people are too susceptible for climate to be a determining factor.

"The influence of climate and weather on infection rates should become more evident—and thus a potentially useful source of information for disease prediction—as growing immunity moves the disease into endemic phases from the present epidemic stage," Vecchi said.

The most recent study provides insight on how scientists can determine the impact of various factors on the virus at various times, said co-author C. Jessica Metcalf, associate professor of ecology and evolutionary biology and public affairs and an HMEI associated faculty member.

"An important challenge that we tackle here is balancing the role of many potential factors on the trajectory of the epidemic," Metcalf said. "As the pandemic progresses, both natural and vaccinal immunity will play an increasing role, underscoring the importance of developing a handle on the landscape of immunity."

Critical factors to consider when projecting the future of COVID-19 are emerging variants of the virus, as well as how efforts to contain coronavirus have changed other diseases, said co-author Bryan Grenfell, the Kathryn Briger and Sarah Fenton Professor of Ecology and Evolutionary Biology and Public Affairs and associated faculty in HMEI.

In November, Grenfell and his co-authors in the Climate Change and Infectious Disease initiative published a paper in the *Proceedings of the National Academy of Sciences* that non-pharmaceutical interventions (NPIs) such as mask wearing and social distancing could result in large, delayed outbreaks of endemic diseases such as influenza and respiratory syncytial virus (RSV).

"The interaction between NPIs and immunity will become even more complex as a variety of vaccines are deployed and new viral variants arise," Grenfell said. "Understanding the impact of these variables underlines the importance of immune surveillance and greatly expanded viral sequencing."

Additional authors of the current paper include Wenchang Yang, an associate research scholar in geosciences at Princeton.

The paper, "Assessing the influence of climate on wintertime SARS-CoV-2 outbreaks" was published online Feb. 8 by *Nature Communications*.

More information: Rachel E. Baker et al, Assessing the influence of climate on wintertime SARS-CoV-2 outbreaks, *Nature Communications* (2021). DOI: 10.1038/s41467-021-20991-1