

Chimpanzees die from primate version of HIV Study shows AIDS-like health effects in a wild population

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A primate version of the virus that causes AIDS was long thought to be harmless in its African hosts, but chimpanzees have not been spared after all.

A long-term study of a wild population has found that chimpanzees naturally infected with simian immunodeficiency virus, or SIV, die early and their babies die within a year of birth. In one instance, a female died with all the hallmarks of end-stage AIDS. The work, reported in the July 23 *Nature*, could help researchers understand the pathogenicity and species-to-species transmission of immunodeficiency viruses that, up until now, have appeared to pose serious health hazards primarily to humans.



Previously, Asian macaques, a type of monkey, were the only nonhuman primates known to regularly develop full-blown AIDS when infected with SIV.

“Great apes have so many disease threats — Ebola, anthrax, respiratory diseases spread from people — the last thing they need is something resembling AIDS,” comments Craig Stanford, codirector of the Jane Goodall Research Center at the University of Southern California in Los Angeles.

As well as boding ill for chimps, the research also emphasizes how the fate of those infected with the viruses depends not only on characteristics of the virus itself, but also those of the host, including genetic makeup and immune response, says Robin Weiss of the University College London, a coauthor of a *Nature* commentary on the new research published in the same issue.

The sick chimps are from a population of the chimp subspecies *Pan troglodytes schweinfurthii* that live in Gombe National Park in Tanzania. Of the four subspecies of chimpanzees, only two are known to harbor the chimp version of SIV, dubbed SIVcpz. The other subspecies that carries the virus, *Pan troglodytes troglodytes* lives west of this region. It is from this second subspecies that SIV is believed to have jumped to humans on three separate occasions, yielding three subtypes of HIV-1. One of these subtypes is responsible for a majority of cases of AIDS in humans.



says.

An AIDS-like illness has not been observed in the western chimps despite the presence of SIVcpz in their population. Perhaps SIVcpz is not that virulent in the western chimps but becomes more so in a different host such as the eastern chimps or humans, Weiss speculates. The amount of time that a host species has interacted with a virus may also affect pathogenicity. The sick eastern chimps may have acquired SIVcpz from their western relatives fairly recently and thus had naïve, weaker immune responses to the virus, Weiss

“It might be quite a new virus in that population,” Weiss says. A relatively recent transmission might explain the chimps’ progression to the AIDS-like illness, he says.

Similarly, HIV-1 may be particularly devastating in people because of the virus’s relatively recent move to humans. Since the AIDS pandemic began, research has shown a broad range of susceptibility, resistance

and disease progression from individual to individual. Past work has already identified primate genes that hinder infection, and the new findings could elaborate on what underlies differences in pathogenicity.

The sick chimpanzees were part of a population that has been under study by Jane Goodall and her colleagues since the 1960s. Without extensive knowledge of the chimps' relationships and behaviors, and the animals' familiarity with researchers, the work would not have been possible, says study coauthor Beatrice Hahn, a virologist specializing in AIDS at the University of Alabama at Birmingham.

For nine years, the researchers followed 94 chimps from two communities in Gombe National Park. The scientists tested for virus antibodies in 1,153 chimp poop samples and 226 urine samples. Animals that tested positive for antibodies — immune system proteins that the host produces in response to the virus — were then tested for direct evidence of the virus.

Seventeen chimpanzees tested positive for antibodies against SIVcpz and 14 of these animals had viral RNA in their feces. Two of the antibody-positive chimps were babies of infected moms. Oddly, one of these moms was SIVcpz-negative when her baby was born but became infected 10 to 15 months after giving birth, raising the possibility of breast milk transmission. Seven of the 17 infected chimps died or went missing (and were presumed dead) in the course of the study.

Comparing survival rates revealed that infected chimps had a 10-to-16-fold greater death rate than noninfected chimps. The odds of an infected female giving birth were three times lower than a noninfected female, the researchers report. All four infants born to infected mothers died before their first birthday. Analyses of the spleens and some lymph nodes of some of the chimps showed that in infected individuals, much of the infection-fighting white blood cells were depleted, akin to the changes seen in people with AIDS. One female who died within three years of becoming SIVcpz positive also had several abscesses in her abdomen from nematode infection and her skeletal muscle had wasted away, findings consistent with end-stage AIDS.

While troubling, the findings suggest that SIVcpz in this subspecies isn't as serious a threat as HIV is in humans, Hahn says. Yet the discovery of the sick chimps offers what could be a better model for studying pathogenic lentiviruses, a group of viruses, including SIV and HIV, characterized by a very long incubation period.

There are more than 40 different simian immunodeficiency viruses, each with a specific, nonhuman primate host. In most cases, illness is rare. Previous research on the SIVcpz strain suggests that it evolved in a chimp from a chimeric mix of lentiviruses from the red-capped mangabey, the greater spot-nosed monkey and perhaps other closely related species. How the viruses are passed along depends on the host — biting and wounds may be the primary route among nonhuman primates, although eating infected meat may also play a role.

Now that they are aware of SIV's pathogenicity in the wild, researchers should screen sanctuary chimps for the virus, Hahn says. If carriers, these chimps could provide additional information on the virus and its relationship with its host.

The new findings underscore how long-term studies can reveal what might be right under researchers' noses, she adds. Typically, "the only time you know something is up is if you have a lot of dead bodies."