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"AIDS" IN CHIMPANZEES

Published Findings Could Lead to Novel Treatments and Preventative Measures for Humans

BIRMINGHAM, Ala. – It has been known for some years that the AIDS virus, HIV-1, first entered the human population after transmission from chimpanzees. This knowledge prompted Beatrice Hahn, at the [University of Alabama at Birmingham](#) (UAB), to learn more about the natural history of the precursor virus, SIV, in naturally infected chimpanzees across central Africa. Until now, it has been thought that SIV infection is harmless to chimpanzees, but new findings from an international consortium led by Dr. Hahn indicate that chimpanzees with SIV can contract AIDS, and die as a result. These results are published in the July 23 edition of *Nature*.

There are many different forms of SIV, most of which infect various monkey species in Africa. While there are data for only a few of these species, all of the evidence so far has indicated monkey SIVs are not pathogenic in their natural hosts. “We all assumed that the same was true of SIV infection in chimpanzees, but that turns out not to be the case,” said Dr. Hahn. “But of course chimps are not monkeys. Chimpanzees and humans are very similar genetically, so perhaps we should not be surprised that these closely related viruses cause disease in both hosts.” Nevertheless, when Rebecca Rudicell, a graduate student working with Dr. Hahn, first reported these results at a major AIDS conference in February, they were described as one of the biggest surprises at the meeting.

The study focused on chimpanzees at [Gombe Stream National Park](#), on the shores of Lake Tanganyika in Tanzania. For nearly fifty years, [Jane Goodall](#) and her colleagues have studied the chimpanzee communities at Gombe, monitoring their biology and behavior. These chimpanzees are wild, but “habituated,” meaning that they have become accustomed to the presence of human observers. “This study would have not been possible without the many previous years spent studying chimps at Gombe,” said Brandon Keele who developed the non-invasive assays that identified SIVcpz in chimpanzee fecal samples and, together with Rudicell, did much of the virological work in Dr. Hahn’s laboratory.

For the last nine years, the team has been monitoring the SIV infection status of these chimpanzees. Using fecal samples, it was possible to determine which individuals were infected at the start of the study, and which have become infected since then. At any one time during this period, between 10 percent and 20 percent of chimpanzees were SIV-positive. Moreover, analyzing demographic data, the Gombe researchers noticed that a higher fraction of SIV-infected, rather than uninfected, chimpanzees died. Statistical

death hazard analyses, taking into account factors such as an individual's age and sex, indicated that those chimpanzees infected with SIV were 10-16 times more likely to die in any year than those who remained uninfected. According to Jamie Holland Jones, of [Stanford University](#), who performed these analyses, "at this point we cannot be too precise about the magnitude of the effect, because the number of chimpanzees surveyed is still limited. Nevertheless, the evidence is clear that infected apes have lower survival rates." The team also found that infected females were significantly less likely to give birth, and that any infants born to infected mothers had a low chance of survival.

Additional evidence came from examination of tissue samples from dead chimpanzees. A hallmark of HIV-1 infection in humans is the loss of CD4+ T-cells; these cells are a vital component of the immune system, and their depletion renders patients susceptible to many other infections – the classic symptoms of AIDS. A unique partnership between investigators from the [Tanzania National Parks](#), the [Lincoln Park Zoo](#) in Chicago and the [University of Illinois](#) provided the necessary infrastructure to enable post-mortem analyses of spleen and lymph node samples from chimpanzees who died during the course of the study. These revealed significantly lower CD4+ T-cell counts in SIV-infected individuals. "When I first looked at these samples I was taken aback," said Karen Terio, a veterinary pathologist from the University of Illinois. "Slides from one of the chimps showed extreme lymphatic tissue destruction, and looked just like a sample from a patient who has died of AIDS." To confirm her hunch, she sent these samples to Dr. Jacob Estes, of the [National Cancer Institute](#) in Frederick, Maryland, who examined them under code. "Only once the codes had been deciphered did we realize that there was a link between SIV infection and CD4+ T cell decline," said Jake Estes. "Two other infected chimpanzees who each died of trauma related causes, but not with overt AIDS symptoms, had less severely reduced T-cell counts."

Although this study was limited to chimpanzees at Gombe, Dr. Hahn's team has previously shown that SIV infection is widespread across two subspecies, central and eastern chimpanzees, which range from Cameroon in west central Africa to Tanzania in the east (two other subspecies, western and Nigerian chimpanzees, do not appear to have SIV infections). "It is certainly possible that SIV infection has similar pathogenic effects in all of these populations," said Michael Wilson, a primatologist at the [University of Minnesota](#), Minneapolis. "Chimpanzee numbers across Africa have been in decline, due to various factors including hunting and habitat loss. Death due to SIV infection may have also contributed to this decline."

"Obviously, we were a bit alarmed to discover that some of the chimpanzees at Gombe have probably died because of an AIDS-like illness," commented one of the leaders of the study, Anne Pusey, of the University of Minnesota, St. Paul. "It would not be practicable to attempt to treat the chimpanzees for their SIV infections. Fortunately, current data suggest that SIV in chimpanzees is not quite as pathogenic as HIV-1 in humans, and the main study community has so far maintained its size despite a certain level of mortality due to diseases."

The finding that SIV causes disease in chimpanzees opens up a number of new avenues of research. According to Titus Mlengeya, the Chief Veterinary Officer of the Tanzania National Parks, “This presents a unique opportunity to compare and contrast the disease-causing mechanisms of two closely related viruses in two closely related hosts.” “We hope that a better understanding of these mechanisms will benefit both humans and chimpanzees,” added Jane Goodall, who also emphasized that only non-invasive methods were used throughout the study.

Researchers involved in the study include Drs. Beatrice H. Hahn, Brandon F. Keele, Rebecca S. Rudicell, Yingying Li, Gerald H. Learn, T. Mark Beasley, George M. Shaw, all from UAB. Other researchers include Dr. James Holland Jones, Stanford University; Drs. Karen A. Terio, Michael J. Kinsel, University of Illinois; Dr. Jacob D. Estes, the National Cancer Institute in Frederick, Maryland; Drs. Michael L. Wilson, Joann Schumacher-Stankey, Emily Wroblewski, Anne E. Pusey, the Jane Goodall Institute Center for Primate Studies, University of Minnesota; Drs. Anna Mosser, Shadrack Kamenya, Jane Raphael, The Jane Goodall Institute, Tanzania; Drs. Elizabeth V. Lonsdorf, Dominic A. Travis, Lincoln Park Zoo in Chicago; Dr. Titus Mlengeya, Tanzania National Parks; Dr. James G. Else, Yerkes National Primate Research Center at Emory University in Atlanta; Dr. Guido Silvestri, University of Pennsylvania in Philadelphia; Dr. Jane Goodall, The Jane Goodall Institute, Arlington, Virginia; Dr. Paul M. Sharp, University of Edinburgh in the United Kingdom.

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