Chimpanzee Predation and the Ecology of Microbial Exchange

Richard Wrangham[1], Michael Wilson[1], Brian Hare[1] and Nathan D. Wolfe[2]

From the [1]Department of Anthropology, Harvard University, Cambridge, Massachusetts, USA [2]Department of International Health, Center for Immunization Research, Johns Hopkins School of Hygiene and Public Health, Baltimore, Maryland, USA

Correspondence to: Nathan D. Wolfe, Center for Immunization Research, Johns Hopkins University, 624 North Broadway Rm. 210, Baltimore, MD, 21202 USA; Fax: 410-502-6898; E-mail: nwolfe@jhsph.edu.

Microbial Ecology in Health and Disease 2000; 12: 186–188

Hunting provides one mechanism for the transmission of microbes across host species boundaries. It has generally been assumed that this mechanism leads to unidirectional transmission to humans. We report that wild chimpanzees occasionally prey on human children. This result and other evidence of chimpanzee hunting show the need for consideration of more complex predation-mediated host networks.
Key words: ecology, predation, *Pan troglodytes*, cross-species transmission, HIV, ebola, monkeypox, hunting, pathogen exchange.

The hunting, butchery, and consumption of primates provide one route for pathogens to enter into human populations. Human hunting of primates has been linked to epidemics of monkeypox (1) and Ebola (2) in Central Africa. The transmission of pathogens to hunters has long been viewed as unidirectional, with humans as the recipients of pathogens transmitted at this interface. This assumption has played a central role in the interpretation of data relevant to the origins of human pathogens, such as the recent assertion that chimpanzees are the ultimate source of HIV-1 origins (3). Nevertheless, humans are not only predators, they are sometimes prey. We report here a second potential route of cross-species disease transmission. Chimpanzee (*Pan troglodytes*) predation on humans provides an opportunity for disease transmission from humans to chimpanzees.

We have documented eight attacks in which a wild chimpanzee, or possibly more than one, caused severe bleeding and/or death to children. Attacks were verified by detailed interviews, observation of footprints, and calls. They occurred from August 1994 to September 1998 among rural villages west of Kibale National Park, Uganda. Victims were aged 6–60 months. The chimpanzee(s) attacked infants that were alone or accompanied only by women and children, and ate from all victims that could be carried to an undisturbed site. In three cases, children were eviscerated. Injuries to others included loss of an arm and removal of hands or feet (Table I). These injuries are similar to those seen in monkeys preyed on by chimpanzees (4). Such encounters would involve ample contact with human blood, feces, and other tissues and provide the opportunity for transmission of human patho-

Table I

Chimpanzee attacks on children around Kibale National Park, Uganda

Date	Victim's age (mo)	Also present (women/children)	Distance to forest (m)	Bleeding wounds	Evidence
Aug 1994	~36	0/0	18	Leg, foot	Witnesses
Aug 1995	~60	0/several	0	Hand	Witnesses
Nov 1995	6	1/0	32	Hand, foot, gut	Witnesses
Dec 1996	9	1/0	182	Face, foot, gut, liver	Witnesses, calls
May 1997	~30	1/1	56	Head, arm	Witnesses
Nov 1997	16	2/0	43	Head, hand, gut	Witnesses, footprints
May 1998	4–5	0/1	100–150	Foot, thigh, penis	Witnesses, footprints
Sept 1998	~18	0/2	150–200	Gut	Witnesses, corpse

 ISSN 0891-060X

Table II

Chimpanzee attacks on children in Africa.

Case	Site	Date	Victim's injuries	Circumstances	Source
1	Gombe, Tanzania	Before 1960	Injuries of infant unclear; face of older brother bitten	Male seized baby from 6-year-old brother; brother, mother and other women rescued infant	(4)
2	Gombe, Tanzania	Before 1960	Died, partially eaten	Male seized baby from mother's back	(6)
3	Gombe, Tanzania	1998	Survived	Male from study group twice attacked child	*
4	Kivu, Zaire	May 1982	Left foot bitten, left femur fractured. Infant later developed monkeypox	Chimpanzee seized 6-month-old infant from 5-year old sister and ran into forest; mother rescued infant	(7)
5	Byaga County, Uganda	1992	Died	Two children killed, separate occasions	~
6	Western Tanzania, Burundi border	Before 1995	Died	Two children killed, separate occasions	^

*Goodall, J. Personal communication.
~ Naughton-Treves, L. Personal communication from Uganda Game Department reports.
^Wallis, J. Personal communication.

gens to chimpanzees. The possibility of a successful transmission event may be further enhanced given that dental pathologies, including severe forms of periodontitis, are common in wild chimpanzees (5).

Seven attacks occurred within an area of 5.3 sq. km. They were apparently made by a single adult male chimpanzee who was killed in September 1998, within 12 hours of killing an 18-month-old girl. This male was observed intermittently during 1997–8, normally alone. On at least one occasion, however, he was accompanied by an adult female. His home range bordered other chimpanzee ranges to east and south. The eighth attack occurred 6.0 km from the nearest of the seven clustered attacks, and reportedly involved two chimpanzees.

Attacks occurred within a habitat composed of scattered villages, secondary forest, swamp forest, and fields of bananas and annual food-crops. The chimpanzee typically came from and returned to forest. The first kill occurred when a 6-month-old baby cried for several minutes 32 m from the forest edge. The cries of human babies resemble those of some forest antelope, and may therefore have elicited predatory behavior. Subsequent attacks included bolder behavior, such as journeys up to 182 m from the forest edge to remove babies from the doorway of houses (twice) or when being carried by elder siblings. The pattern suggests that following a chance encounter, a chimpanzee developed a prey specialization.

Within recent decades deforestation has reduced natural chimpanzee food sources in the attack areas, and human population has increased. Opportunities for chimpanzee-human contact have therefore risen. Such processes have presumably occurred for centuries at the fringes of chimpanzee habitats. As expected if chimpanzees readily learn to prey on children, similar attacks occur elsewhere (Table II). These reports involve 2 of the principal 6 field sites of chimpanzees (those lasting 1–4 decades), suggesting a 33% probability of attacks occurring per generation within each population.

Chimpanzees are efficient predators of monkeys, antelope and pigs up to about 10 kg^2. They should now be regarded as occasional hunters of humans. Hunting of humans provides the opportunity for transmission of human blood-borne pathogens into wild chimpanzee communities, an event of significance both for chimpanzee conservation and human disease reservoirs (8). Furthermore, chimpanzees may occasionally become superinfected with pathogens from humans and other prey species. Since superinfection can lead to viral recombination (9), chimpanzee predation patterns may play a role in the evolution and emergence of recombinant viruses. The relations among rapidly evolving or recombining pathogens, such as human and simian immuno-deficiency viruses, may therefore be considerably more complex than assumed by models limited to one-way transmission (3).

ACKNOWLEDGEMENT

Michael Wilson is supported by a Howard Hughes Predoctoral Fellowship. Nathan Wolfe is supported by an International Research Scientist Development Award from the National Institutes of Health (1 K01 TW003-01).

REFERENCES

1. Jezek Z, Arita I, Mutombo M, Dunn C, Nakano JH, Szczeniowski M. Four generations of probable person-to-person transmission of human monkeypox. Am. J. Epidemiol. 1986; 123: 1004–12.
2. World Health Organization. Outbreak of Ebola haemorrhagic fever in Gabon officially declared over. Wkly Epidemiol Rec 1996; 71: 125–6.

3. Gao F, Bailes E, Robertson DL, et al. Origin of HIV-1 in the chimpanzee *Pan troglodytes* troglodytes. Nature 1999; 397: 436–41.
4. Goodall J. The Chimpanzees of Gombe: Patterns of Behavior. Cambridge, (MA): Harvard University Press; 1986.
5. Kilgore L. Dental pathologies in 10 free-ranging chimpanzees from Gombe-National-Park, Tanzania. Am. J. Phys. Anthropol. 1989; 80: 219–27.
6. Thomas DK. The Gombe Stream Game Reserve. Tanganyika Notes and Records 1961; 56: 34–9.
7. Mutombo M, Arita I, Jezek Z. Human monkeypox transmitted by a chimpanzee in a tropical rainforest area of Zaire. Lancet 1983; 34: 735–7.
8. Wolfe ND, Escalante AA, Karesh WB, Kilbourn A, Spielman A, Lal AA. Wild Primate Populations in Emerging Infectious Disease Research: The Missing Link? EID 1998; 4: 149–58.
9. Burke DS. Recombination in HIV: An important viral evolutionary strategy. EID 1997; 3: 253–9.