

Research Report

RISK FACTORS FOR INFANT ABUSE AND NEGLECT IN GROUP-LIVING RHESUS MONKEYS

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Abstract—This study investigated maternal abuse and neglect of offspring in a large population of rhesus monkeys over a period of 29 years. Abuse and neglect did not occur together and were associated with different risk factors. Infant abuse was concentrated in 8 of 57 families and among closely related females. Abuse was also repeated with successive offspring. In contrast, infant neglect was not affected by genealogical factors, was not repeated with successive offspring, and was displayed mostly by primiparous mothers. These results suggest that abuse and neglect may be different phenomena and that infant abuse in group-living monkeys could represent a good animal model for investigating the mechanisms underlying the intergenerational transmission of child maltreatment.

The recent discovery that maternal behavior in mice can be specifically impaired by genetic mutation (Brown, Ye, Bronson, Dikkes, & Greenberg, 1996) has brought about renewed interest in the possible biological determinants of child abuse and neglect (Krugman, 1997). The intergenerational transmission of child maltreatment might result from genetic influences on this phenomenon (Egeland, Jacobvitz, & Papatola, 1987; Widom, 1989). Constraints imposed by research with human subjects, however, have made it difficult to assess the potential role of genetic versus experiential determinants. Research with animal models could help overcome such constraints by making it possible to conduct multigenerational studies in a short period of time and to conduct experiments that would be ethically and practically impossible in humans.

Infant neglect and abuse in primates may be the closest approximation to child maltreatment provided by nonhuman animals. Some monkey mothers living in large social groups in captivity and in the wild abandon their infants after birth, and others physically abuse them by dragging them, stepping on them, or hitting or biting them (Maestriperi & Carroll, in press-b). Preliminary studies of infant abuse in group-living monkeys have revealed interesting similarities with child abuse in the general incidence of abuse in large populations (Maestriperi, Wallen, & Carroll, 1997a, 1997b), the intergenerational transmission of abuse (Maestriperi et al., 1997a, 1997b), and some psychological and social characteristics of abusive parents (Maestriperi, 1994, 1998; Maestriperi & Carroll, in press-a; Troisi & D'Amato, 1984, 1991). Recent studies of pigtail macaques (*Macaca nemestrina*) and sooty mangabeys (*Cercocebus atys*) have also provided preliminary evidence suggesting that abuse and neglect are predicted by different maternal and infant characteristics (Maestriperi et al., 1997a, 1997b).

The aim of this study was to confirm and extend previous results regarding genealogical and demographic influences on infant abuse and neglect using a different species of monkeys and a much larger data set. Here we report on the occurrence of infant abuse and neglect

among about 3,000 rhesus monkeys (*Macaca mulatta*) over a period of several generations. To assess whether infant abuse or neglect is transmitted across generations, we investigated the occurrence and distribution of these phenomena across and within families. To further investigate the possibility that abuse and neglect are associated with different risk factors, we compared the effects of maternal parity, infant's sex, and infant's age on abuse and neglect, as well as the probability of abuse and neglect being repeated with successive offspring.

METHOD

Infant abuse and neglect were studied in 57 families of group-living rhesus monkeys housed at the Field Station of the Yerkes Regional Primate Research Center of Emory University in Lawrenceville, Georgia. The data were obtained from the Yerkes Animal Records and span a period of 29 years, from 1967, when the first birth in one of these 57 families was recorded, to 1996. The 57 families were founded by 57 matriarchs that were genetically unrelated to each other and were part of several stocks of rhesus monkeys purchased by the Yerkes Center in the early 1960s and 1970s. In most cases, information on the identity of the males who sired offspring was not available; therefore, family trees were reconstructed on the basis of relatedness along the maternal line.

Over the course of 29 years, 3,116 births were recorded in the 57 families. The actual number of births is higher than 3,116, as some of the animal record files for the late 1960s were incomplete, and every year there has been a small number of newborns, whose origins remain unidentified, found dead. The total number of mothers was 671 (mean \pm SE per family = 11.77 ± 1.08). Family size ranged from 9 to 190 individuals (mean \pm SE = 54.67 ± 5.05), and the number of generations in each family varied between 3 and 7 (mean \pm SE = 5.08 ± 0.14).

The subjects of this study lived most of their lives in social groups numbering 50 to 90 individuals. Group size and composition approximate those found in natural conditions (Lindburg, 1991). All groups contain 2 to 6 adult males and 20 to 35 adult females with their subadult, juvenile, and infant offspring. Female offspring remain in their natal groups all of their lives, whereas male offspring are removed from their groups at puberty (4–5 years of age) to simulate the natural process of male migration and reduce the chances of inbreeding. Adult males are also rotated among groups every 3 to 4 years, and new males are periodically purchased and introduced into the breeding population. The monkeys have always been housed in outdoor compounds (about 30×30 m) with indoor living quarters, and individual housing in a cage was limited to short periods during acute medical treatment.

The Yerkes Animal Record files contain information on the clinical and reproductive history of all monkeys and the results of necropsies, performed by the Yerkes Pathology Division for all infant deaths. Data analysis focused on events that occurred in the infants' 1st year of life. When death or removal from the group for medical treatment was directly related to antecedent events observed by the Yerkes caretaker, veterinary, or scientific personnel, these events were reported in the animal's file. The cause of death or removal for medical treatment was

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classified into one of the following categories: (a) *stillbirth*, when the infant was found dead on the 1st day of life and was never observed alive; (b) *illness*, when a specific clinical condition was unequivocally diagnosed during medical examination of the infant or during necropsy; (c) *kidnapping*, when the infant died because of prolonged kidnapping by another group member, typically a nonlactating adult female; (d) *unknown*, when the cause of the infant's death or of the deterioration of its health condition was not unequivocally ascertained; (e) *neglect*, when the Yerkes caretaker, veterinary, or scientific personnel observed the mother actively rejecting and abandoning her infant prior to the infant's death or removal and the infant's subsequent medical examination or necropsy did not reveal any clinical condition other than starvation or dehydration; and (f) *abuse*, when the personnel observed that the mother physically abused her infant prior to the infant's death or removal and the infant's subsequent medical examination or necropsy did not reveal any clinical condition other than physical trauma. The following maternal behavior patterns were considered abuse: stepping, sitting, or jumping on the infant; pushing and dragging the infant on the ground; hitting; or causing lacerations of the infant's skin with mouth or fingers. Some healthy infants were permanently removed from their groups and sent to another facility for use in biomedical studies, and were therefore excluded from the analysis.

RESULTS

Forty-six infants were abused by their mothers (1.5% of the infant population), and 13 were neglected (0.4%). Other causes of infant mortality or removal for medication were distributed as follows: stillbirth,

197; illness, 87; kidnapping, 4; and unknown, 133. Infant abuse or neglect was suspected but not directly observed in many cases of stillbirth and infant death or removal for illness or unknown reasons. For example, in some cases of illness, death or removal was caused by physical trauma similar to that caused by maternal abuse.

In the study population, 17 of 671 mothers displayed abuse (2.53%) and 10 displayed neglect (1.49%). Abuse occurred in 8 families and neglect in 10 families, but only once in the same family (Table 1). In the 8 families in which abuse occurred, the number of abusive mothers ranged from 1 to 5 (mean ± SE = 2.12 ± 0.55), and the number of abused infants ranged from 1 to 12 (mean ± SE = 5.75 ± 1.51). There was never more than 1 neglectful mother per family, and the number of neglected infants in each family ranged from 1 to 3 (mean ± SE = 1.33 ± 0.23). In the only family in which both abuse and neglect were reported, they were displayed by different individuals. The number of abuse or neglect cases was not correlated with family size (Pearson product-moment coefficient of correlation: abuse— $r = .21, n = 57, n.s.$; neglect— $r = .16, n = 57, n.s.$).

In the two families with 2 abusive mothers, the abusive individuals were mother and daughter, and grandmother and granddaughter, respectively. In the two families with 5 and 4 abusive mothers, the coefficients of maternal relatedness (coefficients of relatedness calculated with the assumption that all infants were sired by the same male) were higher among abusive mothers than among all the other mothers (Table 2); for RQa's family, $\chi^2(5, N = 496) = 12.06, p < .05$, and for RSd's family, $\chi^2(4, N = 326) = 7.01, p = .1$. These results suggest that abuse was more likely to be displayed by closely related than by distantly related females.

Table 1. Families in which infant abuse or neglect occurred

Family identity	Family size	Number of mothers	Number of abused infants	Number of neglected infants	Number of abusive mothers	Number of neglectful mothers
Abuse						
OPE52	78	12	12	0	2	0
OPE2Z5	12	3	1	0	1	0
OPE2Z7	35	7	3	0	1	0
RQa	148	32	10	0	4	0
RSc	74	14	8	0	2	0
RSd	118	26	8	0	5	0
RTe	58	13	3	0	1	0
RYc ^a	65	16	1	1	1	1
Neglect						
OPE24P	43	9	0	1	0	1
OPE33Q	95	20	0	1	0	1
OPE4350	35	6	0	2	0	1
OPEA23	36	7	0	1	0	1
OPEO5J	24	7	0	1	0	1
ROa	44	11	0	1	0	1
ROd	109	22	0	1	0	1
RSb	115	21	0	3	0	1
RVc	74	15	0	1	0	1
RYc ^a	65	16	1	1	1	1

^aFamily in which both abuse and neglect occurred.

Table 2. Frequency distribution of coefficients of maternal relatedness (r) between abusive mothers and between other mothers in two families

r	RQa's family		RSd's family	
	Abusive mothers	Other mothers	Abusive mothers	Other mothers
.50	3	52	4	43
.25	2	87	4	75
.12	1	122	2	91
.06	0	131	1	71
.03	0	89	0	35
.01	0	9	—	—

In 8 of the 13 cases of infant neglect, neglectful mothers were primiparous when neglect occurred, whereas mothers were primiparous in only 9 of the 46 cases of infant abuse, $\chi^2(1, N = 59) = 8.70, p < .01$. Among multiparous mothers, 8 of 10 neglectful mothers did not repeat neglect with successive infants, whereas abuse was repeated with successive infants by 12 of 15 multiparous abusive mothers, $\chi^2(1, N = 25) = 7.21, p < .01$. Therefore, neglectful mothers were more likely to be primiparous than abusive mothers, and neglect was less likely to be repeated with successive infants than was abuse. Abused infants did not differ significantly from their nonabused siblings in terms of sex or birth order.

The sex ratio at birth in the population was female biased, and neither male nor female infants were abused or neglected significantly more than expected by chance: Twenty-four males and 22 females were abused, $\chi^2(1, N = 46) = 0.04, n.s.$; 8 males and 5 females were neglected, $\chi^2(1, N = 13) = 0.33, n.s.$ Both neglect and abuse mostly occurred within the first days of infant life (neglect: mean $\pm SE = 1.92 \pm 0.51$; abuse: mean $\pm SE = 5.62 \pm 1.61$), with a tendency for neglect to occur earlier than abuse (Mann-Whitney test: $z = -1.70, p = .08$).

DISCUSSION

In this population of rhesus monkeys, 1.5% of infants were at risk of maternal abuse and 0.4% of infants were at risk of neglect. The true prevalence of infant abuse and neglect in the population, however, is probably higher because data analysis focused only on severe cases of abuse and neglect, and some cases of abuse or neglect might have gone unnoticed. For example, it cannot be ruled out that all infants born to abusive mothers were abused, but mild cases of abuse were not reported in the animal record files (see Maestripieri, 1998, and Maestripieri & Carroll, in press-a, for recent studies of mild infant abuse).

Severe infant abuse was mostly concentrated in a few families, and within these families, it was most likely to be displayed by closely related females. Abuse was also repeated with successive offspring. Taken together, these findings are consistent with those reported in other monkey species in suggesting that genetic relatedness to other abusive or abused individuals is a significant risk factor for abuse (Maestripieri et al., 1997a, 1997b). Although this study does not provide information on the mechanisms by which infant abuse may be transmitted across generations, the relative role of experiential versus

genetic factors can be addressed by future studies in which female infants are cross-fostered at birth between abusive and nonabusive mothers and then studied when they give birth to their own offspring.

This study provides further evidence suggesting that infant abuse and neglect do not occur together and are associated with different risk factors. Unlike abuse, infant neglect did not appear to be affected by genealogical factors, was not repeated with successive offspring, and was displayed mostly by primiparous mothers. Neglect and abuse were associated with infants' age but not with their sex. Other studies have shown that infant neglect is common among young and inexperienced mothers, and among mothers of low body weight or in poor health conditions (Fairbanks & McGuire, 1995; Maestripieri et al., 1997a, 1997b). Therefore, infant neglect in monkeys may be an adaptive response to circumstances unfavorable to parental investment, whereas abuse is more likely to be a pathological phenomenon (Maestripieri, 1998; Maestripieri & Carroll, in press-b).

Although the similarities between infant maltreatment in primates and humans may be only superficial, further investigation of the primate phenomenon with longitudinal and experimental approaches could provide information useful for understanding the causes and consequences of child maltreatment (Maestripieri & Carroll, in press-b). The primate data also suggest that it may be profitable for future studies of child abuse and neglect to make more frequent distinctions between these two forms of maltreatment.

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