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Genealogical and Demographic Influences on Infant Abuse and Neglect in Group-Living Sooty Mangabeys (*Cercocebus atys*)

ABSTRACT: *This study investigated the occurrence of infant abuse and neglect in a large population of group-living mangabeys over a period of almost 3 decades. The prevalence of infant abuse and neglect did not differ significantly among the 9 families comprising the population, but within some families there was evidence of genealogical effects on infant abuse. Maternal inexperience and infant age were risk factors for neglect but not for abuse. Whereas neglecting mothers neglected only 1 of their offspring, usually their first-born infant, abusive mothers abused several of their offspring, and risk of severe abuse increased with later births. Infant sex was not a risk factor for neglect or abuse. These and other results concur with the findings of a previous investigation of infant abuse and neglect in a different primate species in indicating that neglect and abuse are different phenomena and in emphasizing genealogical influences on infant abuse in primates. The investigation of biological, experiential, and social determinants of the spontaneous occurrence of infant abuse and neglect in relatively undisturbed primate populations could significantly enhance our understanding of the etiology of child abuse and neglect in humans.* © 1997 John Wiley & Sons, Inc. Dev Psychobiol **31:** 175–180, 1997

Despite some early optimism concerning the value of nonhuman primates as an animal model for child maltreatment (e.g., Reite & Caine, 1983), in the last decade little research on primate infant abuse and neglect has been conducted. Although we know that early separation from the mother and rearing in conditions of social deprivation can result in maternal neglect and abuse of offspring during adulthood (Harlow & Seay, 1966; Nadler, 1980; Ruppenthal, Arling, Harlow, Sackett, & Suomi, 1976; Suomi & Ripp, 1983), we know very little concerning the spontaneous occurrence of infant abuse and neglect in undisturbed populations of nonhuman primates.

The information provided by a few well-docu-

mented cases of infant abuse in group-living macaques has emphasized some important similarities in the role of the parent's personality and stress from the social environment in the etiology of infant abuse in primates and humans (Maestripieri, 1994, in press; Troisi, Aureli, Piovesan, & D'Amato, 1989; Troisi & D'Amato, 1984; see Belsky, 1993, for humans). Moreover, a recent analysis of infant abuse and neglect in a large population of group-living pigtail macaques *(Macaca nemestrina leonina)* over 3 decades has identified similarities between the human and the primate phenomenon also in its occurrence at the population level (Maestripieri, Wallen, & Carroll, 1997; Widom, 1989). For example, in pigtail macaques, infant abuse was significantly more likely to occur in some families than in others, and among closely related females more than among distantly related females. Whereas maternal neglect was mostly limited to young mothers and their first infants, infant abuse was unrelated to the age and parity of the mother or to the sex and age of the infant, but was likely to be repeated with subsequent offspring (see also Maestripieri & Carroll, in press-a).

The present study investigated genealogical and demographic influences on maternal abuse and neglect of offspring in another primate species, the sooty mangabey *(Cercocebus atys).* Sooty mangabeys are African monkeys belonging to the same taxonomic family of macaques and baboons, the family *Cercopithecidae.* The goals of this study were to gather further information concerning the occurrence of infant abuse and neglect in a large primate population, to replicate and extend the findings obtained with the pigtail macaques, and to further investigate similarities and differences between the primate and human phenomenon.

METHOD

Subjects

Infant abuse and neglect were studied in 9 families of group-living sooty mangabeys housed at the Field Station of the Yerkes Regional Primate Research Center of Emory University in Lawrenceville, GA. The data were obtained from the Yerkes Animal Records and span a period of 26 years, from 1969, when the first birth in one of these 9 families was recorded, to 1995. The 9 families were founded by 9 matriarchs, genetically unrelated to each other, that were part of a stock of mangabeys purchased by the Yerkes Center in the early 1960s. Over the course of 26 years, the 9 families comprised 103 reproductively active females that pro-

duced a total of 535 infants (Table 1). Births ranged from 15 in the smallest family to 167 in the largest family. However, 535 is an underestimate of the actual number of births, as some of the animal record files for the early 1970s were incomplete, and every year a small number of newborns have been found dead whose origins remain unidentified.

All the mangabeys initially lived in one multimale multifemale social group, and as the population increased, the group was split ultimately giving rise to four different groups. The mangabeys have always been housed in outdoor compounds with indoor living quarters, and individual housing in a cage was limited to short periods during acute medical treatment. Although the mangabeys have been housed in several different compounds over the course of 26 years, most monkey compounds at the Field Station of the Yerkes Center have similar size (25 × 25 m) and structure. The size and composition of the mangabey groups have been maintained to approximate those found in natural conditions, and group size has ranged from 20 to 100 individuals including the infants.

Females were first bred with independently purchased males and, in subsequent years, with males born at the Center and rotated among groups. However, because no new males were ever introduced into the population, some degree of inbreeding is probably present. In the last 3–4 years, the birth rate has been reduced by vasectomization of some males.

Data Analysis

The Yerkes Animal Record files contain information on the clinical and reproductive history of all monkeys and the results of necropsies of all infant deaths performed by the Yerkes Pathology Division. In most cases, the identity of the males who sired infants was not known. Data analysis focused on events that occurred in the 1st year of infant life. When infant 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 causes of infant death or removal for medical treatment were 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) *neglect,* when the Yerkes caretaker, veterinary, or scientific personnel observed the mother actively rejecting and abandoning her infant prior to infant death or removal, and the

Table 1. Demographic Information Concerning the Occurrence of Infant Abuse and Neglect in the 9 Families of Mangabeys

Matriarch's code	D	G	H	I	K	Md	P	U	V
Number of generations	5	4	4	5	4	4	6	6	5
Number of births	121	17	22	52	15	21	167	81	39
Cases of neglect	1	0	1	0	0	0	4	0	1
Cases of abuse	3	2	2	0	0	0	13	4	7
Number of mothers	21	3	4	11	4	4	37	14	5
Number of neglecting mothers	1*	0	1*	0	0	0	3*	0	1*
Number of abusive mothers	2*	1	1*	0	0	0	5*	2	1*

* Asterisks indicate that one mother displayed both abuse and neglect, though with different infants.

infant's subsequent medical examination or necropsy did not reveal any clinical condition other than starvation and/or dehydration. This criterion allows the distinction between infant death caused by neglect and abandonment following infant death, because monkey mothers usually do not abandon their dead infants for several hours or days; (d) *abuse,* when the personnel observed that the mother physically abused her infant prior to infant 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, dragging and crushing the infant on the ground, hitting or biting, dangling the infant and then dropping it, causing lacerations of the infant's skin with mouth or fingers. Since hitting and biting may also occur during weaning-related, mother–infant conflicts, these behaviors were not classified as abuse unless they were associated with some of the other behavior patterns; (e) *kidnapping,* when the infant died because of prolonged kidnapping by another group member, typically a nonlactating adult female; (f) *infanticide,* when the cause of death was aggression from an adult male; (g) *unknown,* when the cause of infant death or of the deterioration of its health condition was not unequivocally ascertained. Some healthy infants were permanently removed from their group and sent to another facility for use in biomedical studies, and were therefore excluded from the analysis. The strict and conservative criteria for assessment of neglect and abuse differentiate the present study from previous analyses of primate medical records, in which maternal abuse was only inferred from injuries suffered by infants in unknown circumstances (Caine & Reite, 1983; Schapiro & Mitchell, 1983). Because of the nature of our criteria, however, our dataset is skewed toward severe cases of abuse and neglect.

The characteristics of infant abuse and neglect were compared among and within families with the chi-square test, the Mann-Whitney U test, and one-way factorial analyses of variance (ANOVA). Because the data were not normally distributed, they were log-transformed prior to ANOVA to meet assumptions of normality of distribution and homogeneity of variance required by parametric statistics. Bonferroni/Dunn tests were used as post-hocs. Tests were two-tailed unless a specific prediction was tested, and a one-tailed test was used.

RESULTS

Occurrence of Infant Abuse and Neglect in the 9 Families

Seven cases of infant neglect and 31 cases of infant abuse were reported. The other cases of infant death or removal were distributed as follows: 37 stillbirth, 28 illness, 65 unknown, 1 kidnapping, and 7 infanticide. Infant abuse and neglect occurred in 3 families, abuse without neglect occurred in other 3 families, and in 3 families there was neither abuse nor neglect (Table 1). Two mothers displayed neglect only, 8 mothers displayed abuse only, and 4 mothers displayed both neglect and abuse, though with different infants.

Overall, the 9 families did not differ significantly in the proportion of infants that were neglected, $\chi^2 = 6.47$, $df = 8$, n.s., or abused, $\chi^2 = 12.21$, $df = 8$, n.s., and in the proportion of mothers who displayed neglect, $\chi^2 = 7.13$, $df = 8$, n.s., or abuse, $\chi^2 = 5.22$, $df = 8$, n.s. The 9 families did not differ significantly in the infant sex ratio at birth, $\chi^2 = 8.21$, $df = 8$, n.s., or in the sex ratio of neglected, $\chi^2 = 0.60$, $df = 2$, n.s.; (1 male, 7 females) and abused infants, $\chi^2 = 0.52$, $df = 5$, n.s.; (16 males, 15 females). The families did not differ significantly in the birth order (firstborn vs. later-born) of neglected and abused infants, neglect: $\chi^2 = 2.62$, $df = 2$, n.s.; abuse: $\chi^2 = 3.06$, $df = 5$, n.s., or in their age at death or removal,

abuse: $F(5, 25) = 1.02$, n.s.; all neglected infants were 1 day old.

Characteristics of the Mother–Infant Pairs in Which Abuse or Neglect Occurred

First-born infants were significantly at risk for neglect but not for abuse, as 4 of 7 neglected infants were firstborn, compared to only 3 of 31 abused infants, $\chi^2 = 8.56$, $df = 1$, $p < .01$. Neglected infants were also more likely to be firstborn than ill infants, $\chi^2 = 4.52$, $df = 1$, $p < .05$, and than infants that survived the 1st year without complications, $\chi^2 = 5.97$, $df = 1$, $p = .01$. In contrast, birth order was not significantly different among abused, ill, and surviving infants, $\chi^2 = 1.08$, $df = 2$, n.s. At death or removal, neglected infants were significantly younger than abused and ill infants, and abused infants were younger than ill infants, mean age in days $\pm SE$, neglect: 1.00 ± 0.00; abuse: 11.51 ± 4.01; illness: 115.14 ± 21.48; $F(2, 63) = 3.22$, $p < .0001$; post-hocs: neglect–abuse, $p = .05$, neglect–illness, $p < .0001$; abuse–illness, $p < .0001$. Only 1 of the 6 neglecting mothers neglected more than 1 infant, whereas 9 of the 12 abusive mothers abused multiple offspring, $\chi^2 = 5.51$, $df = 1$, $p = .01$. Altogether, these results indicate that infant neglect primarily occurred among reproductively inexperienced mothers dealing with their first newborn. Infant abuse, on the other hand, was more common among multiparous mothers.

Influence of Parity and Kinship on Infant Abuse

The 12 abusive mothers had a total of 91 live offspring. Of these 91 infants, 30 were abused to death, or with sufficient severity to require medical treatment. Thirty infants survived without external intervention, and the others died or were removed for illness or unknown reasons. The sex of the infants that were severely abused was not significantly different from that of infants that survived without external intervention, $\chi^2 = 0.02$, $df = 1$, n.s. However, the birth order of severely abused infants was significantly higher than that of surviving infants, abused: 6.17 ± 0.56; surviving: 3.90 ± 0.43; Mann-Whitney U test, $U = 258$, $z = -2.85$, $p < .005$. Therefore, among abusive mothers, the probability of severe infant abuse increased with increasing parity. Although it cannot be ruled out that health-related problems associated with aging may be responsible for the effect of parity on infant abuse, in general, maternal infirmity was not a risk factor for

infant abuse. The prevalence of chronic illness or a permanent physical handicap due to injury during the years of reproductive activity did not differ significantly between abusive (1 of 12) and nonabusive mothers, 7 of 91; $\chi^2 = 0.02$, $df = 1$, n.s.

In the 3 families in which there was more than 1 abusive mother, it was investigated whether abusive females were more likely to be mother–daughter pairs than any other pairs of relatives. In P's family, in which there were 5 abusive females, 2 of 36 mother–daughter pairs were abusive, whereas only 10 of 666 other possible pairs of related females were abusive, $\chi^2 = 3.34$, $df = 1$, $p < .05$, one-tailed. In U's family, 1 of 13 mother–daughter pairs was abusive, whereas none of all the other 91 possible pairs was abusive, $\chi^2 = 7.07$, $df = 1$, $p < .01$, one-tailed. In D's family, none of 20 mother–daughter pairs were abusive, whereas 1 of 208 other pairs was abusive, $\chi^2 = 0.09$, $df = 1$, n.s. Therefore, in 2 of the 3 families with more than 1 abusive mother, abusive behavior was more likely to be displayed by mothers and daughters than by other individuals. The overall difference is significant when data from the 3 families are pooled together, $\chi^2 = 4.92$, $df = 1$, $p < .02$, one-tailed. In none of the abusive mother–daughter pairs was there evidence that daughters had been severely abused as infants. In fact, in the whole population, only 2 adult females were abused as infants and neither of them abused or neglected her own infants.

DISCUSSION

In 9 families of group-living sooty mangabeys, 1.3% of the infants born over a period of 27 years were neglected by their mothers and 5.8% were physically abused. These figures probably represent an underestimate of the prevalence of infant abuse and neglect in this population of primates for two reasons: First, our analysis focused exclusively on severe cases of abuse and neglect; second, some of the 37 reported stillbirths could have been cases of maternal neglect or early abuse, and some of the 65 cases of infant death or removal for unknown reasons were due to severe physical trauma, suggesting maternal abuse as a possible cause. Overall, the prevalence of infant abuse and neglect among sooty mangabeys is slightly lower than that recently reported for a population of pigtail macaques (about 10%; Maestripieri et al., 1997) and that of child abuse and neglect in the United States (about 10% in the most recently reported year, 1993; U.S. Department of Health and Human Services, 1995).

This study did not find evidence that mangabey in-

fant abuse runs in families, as reported for pigtail macaques (Maestripieri et al., 1997), perhaps owing to the presence of inbreeding of this population. However, genealogical effects on infant abuse were found in 2 families of mangabeys. In these families, abusive behavior was displayed by pairs of mothers and daughters significantly more than expected by chance. As in the previous study of pigtail macaques, there was no evidence that daughters who became abusive mothers had themselves been severely abused during infancy. We cannot rule out, however, that abusive mothers had experienced mild abuse as infants. Therefore the role of biological, experiential, and/or environmental factors in mediating intergenerational transmission of infant abuse remains unclear.

This study confirms previous findings obtained with pigtail macaques in indicating that infant neglect primarily occurs among first-time mothers, in the first few days of infant life, and is not repeated with subsequent offspring. Therefore, infants born to a mother who has neglected her first offspring are not at risk for neglect more than infants born to nonneglecting mothers. In contrast, as in the pigtail macaques, infant abuse was often common among multiparous mothers and was likely to be repeated with subsequent offspring. Therefore, infants whose older siblings have been previously abused are themselves especially at risk of abuse. Moreover, among abusive mothers, the probability of infant abuse increased with increasing parity.

Infant abuse and neglect in group-living monkeys share some similarities as well as differences with infant abuse and neglect by female monkeys who are separated from their mothers early in life and raised in social isolation (Harlow & Seay, 1966). Similar to the findings of this study, Ruppenthal et al. (1976) reported different effects of parity on infant neglect and abuse. The proportion of mothers who displayed neglect decreased significantly with successive infants, whereas this was not the case for abuse. Ruppenthal et al. (1976) reported that male infants were more likely to be abused than female infants, but this finding was not replicated in a subsequent study (Suomi & Ripp, 1983).

Infant abuse and neglect by rhesus motherless mothers was initially attributed to their failure to learn mothering skills from adult models (Harlow & Seay, 1966). The fact that most group-living, abusive mothers successfully raise some of their infants seems to argue against the hypothesis that they lack competent mothering skills. In fact, even mothers who fatally abuse all of their infants alternate long periods of appropriate caregiving behavior with brief, but intense episodes of physical abuse (Maestripieri, in press; Troisi & D'Amato, 1984). Moreover, unlike motherless

mothers, abusive females living in social groups are socially competent individuals with no other obvious behavioral abnormalities (e.g., Maestripieri, 1994; Troisi & D'Amato, 1984). Based on these similarities and differences, it may be argued that infant abuse and neglect displayed by individually housed, motherless mothers and by group-living, mother-reared mothers share some causal factors but not others.

The identification of individuals and genealogies within a large population of monkeys that have a higher-than-average probability of displaying infant abuse offers the opportunity to investigate the etiology of abuse in ways not possible in humans. For example, it may be possible to cross-foster infants to abusive females to assess the relative contribution of genetic and experiential factors in the etiology of abuse, and families with abusive individuals can be screened for the presence of genetic markers or abnormal endocrine or neurochemical functioning under carefully monitored conditions. The parenting style and personality traits of abusive females could also be characterized to identify commonalities and differences among abusive individuals. Finally, the early behavior of infants born to potentially abusive mothers should be carefully investigated and compared to identify predictors of vulnerability to abuse. These and other studies of infant abuse and neglect in group-living monkeys could provide important insights into the etiology of child abuse and neglect in humans (Maestripieri & Carroll, in press-b).

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