



AIDS diagnosis and depression in the Multicenter AIDS Cohort Study: the ameliorating impact of pet ownership

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Abstract *The impact of pet ownership on depression was tested among a sample of gay and bisexual men (n = 1,872). Multivariate analyses, controlling for demographics and baseline depressive symptomatology, showed that neither pet ownership nor the presence of HIV infection was associated with depression. Depression was influenced by the presence of AIDS and by having relatively few confidants. Analyses among HIV-infected men only showed that persons with AIDS who owned pets reported less depression than persons with AIDS who did not own pets. This beneficial effect of pet ownership occurred principally among persons who reported fewer confidants. These results suggest that by enhancing companionship for some HIV-infected persons, pets may buffer the stressful impact of AIDS.*

Introduction

An obituary appeared in the *Los Angeles Times* for a 40-year-old man who died of complications of AIDS. Named as survivors were his parents, his two brothers and 'his beloved dog, Shmuel'. Later that month, an obituary for an AIDS-related death requested that memorial contributions be made to PAWS-LA (Pets Are Wonderful Support, Los Angeles), an organization facilitating pet ownership among persons infected with the human immunodeficiency virus (HIV)—the virus which causes AIDS. These obituaries attest to the central role that companion animals played in the lives of two young men who died of AIDS. Our research is an attempt to systematically examine the impact of companion animals on the psychological status of men at risk for AIDS. We use data from a longitudinal study of the natural history of AIDS, in which all participants are gay or bisexual men.

There are an estimated one million persons infected with HIV in the USA (COC (Centers for Disease Control and Prevention), 1992a). Household surveys among the general population in the USA indicate that between 56 and 60% of households include companion animals (American Veterinary Medical Association, 1992; Beck & Meyers, 1996; Wise & Yang, 1992), a proportion that is similar across developed countries (Beck & Meyers, 1996). According to the American Veterinary Medical Association (1992), pet ownership is most

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common among young couples and parents of all ages, and relatively lower among single persons, with ownership estimated at 43% for the 35 to 65 year age group of interest in this study. A Florida survey of 408 adults with AIDS reported that 46% were living with a pet, or had lived with a pet within the past five years (Conti *et al.*, 1995). These data suggest that a significant number of HIV-infected adults own companion animals.

Our interest in the psychological status of HIV-infected individuals is twofold. First, it is well documented that the presence of HIV infection, and AIDS especially, has a profound psychological impact (Chuang *et al.*, 1989; Faulstich, 1987; Tross & Hirsch, 1988). Depressive symptoms appear to rise in HIV-infected persons prior to AIDS development (Lyketsos *et al.*, 1996), are commonly reported among persons with AIDS, and adjustment disorder with depressed mood is the most frequent diagnosis for HIV-infected persons with psychiatric disorders (Joseph *et al.*, 1990; O'Dowd, 1988). Thus, factors that might mitigate depression among HIV-infected individuals are of interest from both a research and clinical perspective. Second, depression may have a direct effect on immune function, a finding of particular significance for HIV-infected persons. A meta-analysis showed a linear decline in immune function with increasing severity of depressive affect (Herbert & Cohen, 1993), although studies of medical outcomes among persons with HIV disease have produced mixed results regarding the impact of depressive symptoms (Burack *et al.*, 1993; Lyketsos *et al.*, 1993).

The notion that pets may provide psychological benefits for HIV-infected persons is supported by an interview study of gay men with AIDS (Carmack, 1991). Pets were reported to combat feelings of isolation and alienation. Predominant themes that emerged from these interviews were that pets provide affection and nurturing, pets reduce stress, pets allow owners to feel valued and needed, and pets are a constant presence—emotionally and physically.

A limited number of methodologically rigorous studies have investigated the relationship of pet ownership to health, none of which were among HIV-infected persons (Marx, 1984). Some found no benefit of ownership (Stallones *et al.*, 1990), while others noted marked effects, including greater longevity for heart attack survivors who owned pets than those who did not (Friedmann *et al.*, 1980). The latter finding was replicated in the Cardiac Arrhythmia Suppression Trial, with the greatest benefit conferred by dog ownership, an effect independent of physiologic status and other psychosocial factors, including social support (Friedmann & Thomas, 1995). In a study of the physician utilization patterns of elderly persons, pets buffered the effect of stressful life events, resulting in fewer doctor contacts during times of stress for pet owners compared to non-owners (Siegel, 1990). This moderating effect was most evident among dog owners who, in turn, reported a higher level of attachment to their pets than did owners of other types of pet. An experimental study, in which service dogs were provided to persons with ambulatory disabilities, demonstrated improvements in both psychological status (e.g. wellbeing, self-esteem) and functional status (school attendance, number of paid and unpaid assistance hours). The participants who received dogs were compared with matched waiting list controls (Allen & Blascovich, 1996). Other research has indicated that pet attachment is associated with lower levels of depressive symptoms (Garrity *et al.*, 1989), particularly among persons reporting inadequate human social support. The conclusion offered in a recent literature review on companion animals and health was that the benefits of animal companionship are especially apparent for children, the elderly, socially isolated and handicapped (Beck & Meyers, 1996). In short, the impact is greatest among vulnerable populations.

Appropriately, human companionship has received much more research attention than animal companionship, with studies mostly showing a positive impact of social support on physical and mental health. Furthermore, social support appears to have an ameliorative

effect on depression among persons who are ill. For example, outpatients with a variety of chronic diseases were less likely to develop depressive symptoms (Schulz & Decker, 1985; Siegel *et al.*, 1987; Turner & Noh, 1988) if they received or perceived support from others. Other research has shown that perceived support, particularly the presence of a confidant, is the measure most strongly associated with mental health outcomes (Eisemann, 1984; George *et al.*, 1989). Social support is thought to influence depression both directly and indirectly, via its stress-reducing capabilities (Alloway & Bebbington, 1987; Broadhead *et al.*, 1983; Cohen & Wills, 1985).

Our study examines the impact of animal companionship on depressive symptoms among individuals at risk for AIDS. In particular, we were interested in whether pet ownership and level of attachment to one's pet would be associated with a decreased prevalence of depressive symptoms. We hypothesized that the effect of pet ownership would be strongest among HIV-infected persons who are most ill and who have lower levels of human social support—that is, those with AIDS, and among those with fewer confidants. A secondary goal of our research was to determine if concerns about animal-associated opportunistic infections influences pet ownership. Many HIV-infected persons report being told that they can reduce risk of exposure to certain opportunistic infections by not having pets (Burton, 1989), but the extent to which these recommendations influence behaviour has not been studied systematically (Glaser *et al.*, 1994).

Methods

Subjects

The present study was conducted among participants of the Multicenter AIDS Cohort Study (MACS) between April 1 and September 30 1991. The MACS, established to study the natural history of AIDS, enrolled 4,954 homosexual and bisexual men in Baltimore, Chicago, Los Angeles and Pittsburgh between April 1984 and March 1985 (Chmiel *et al.*, 1987; Detels *et al.*, 1992; Kaslow *et al.*, 1987). Inclusion criteria were 18 years of age or older, no diagnosis of AIDS or cancer (except skin cancer) and no radiation therapy. MACS participants returned semi-annually for physical examinations, laboratory tests, questionnaires and interviews. When the MACS began, 1,809 (36%) of the participants were HIV infected. In 1991, when the study reported here began, 403 additional participants had become HIV infected and 703 men had died of AIDS.

The 2,187 participants who visited the Baltimore, Chicago or Los Angeles study sites between April and September 1991 were eligible for the study on pet ownership. Sixty-five per cent of the surviving MACS participants visited a MACS site during this six-month period, a rate similar to previous six-month intervals (Kass *et al.*, 1994). According to information collected at study enrolment, participants who visited a site between April and September 1991 and those who did not were comparable in regard to their demographic and health profiles, except that those visiting a site were more likely to be non-Hispanic white, $\chi^2(2) = 20.04$, $p < 0.001$, and have at least some college education, $\chi^2(2) = 54.11$, $p < 0.001$. All MACS participants gave informed consent, and each study undertaken as part of the MACS was approved by the appropriate institutional review boards.

Measures

Blood samples were collected during each of the semi-annual visits. When the blood was drawn, participants were asked if they wished to be informed of their serological results. Sera

were tested for antibodies to HIV using the enzyme-linked immunosorbent assay (ELISA). Individuals were considered antibody positive if they had two positive ELISA tests and two of three bands from *gag*, *pol* and *env* regions were positive; HIV-seropositive persons were considered to be HIV infected. Absolute CD4 lymphocyte counts, which are frequently used to monitor the severity of immunologic damage in HIV-infected persons (Jewett & Hecht, 1993), were determined using whole blood lysis and flow cytometry (Giorgi *et al.*, 1990). Although having a CD4 count < 200 cells/microliter was not included as an AIDS-defining condition until the AIDS surveillance definition was expanded in 1993 (CDC, 1992b), persons with CD4 counts < 200 (or a clinical diagnosis of AIDS, or both) were classified as having AIDS in this analysis.

A structured interview, approximately 30 minutes in length, was conducted as part of the semi-annual visits. Participants were asked if they had ever received a physician diagnosis of AIDS or of any of the conditions listed as an AIDS-defining illness in the 1987 revised Centers for Disease Control and Prevention AIDS case definition (CDC, 1987). Reports of a clinical diagnosis of AIDS were confirmed by contacting the patient's physician and reviewing the patient's medical records. As a component of the interview, participants were asked to categorize their current individual gross annual income into one of six categories, each representing a ten thousand dollar increment, with the highest being \$60,000 or more. The men were also asked if they knew the results of their previous serological test for HIV antibodies; those who did not know the results were excluded from the analysis.

Participants completed the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977) at the time of their enrolment in the MACS and during subsequent semi-annual visits. The CES-D Scale is a 20-item self-report scale designed to measure the frequency of depressive symptomatology during the previous seven days. Responses for each item range from rarely or none of the time (scored as 0) to most or all of the time (scored as 3). A total score is generated by summing across the 20 items. The CES-D Scale has adequate intraobserver reliability, internal consistency and criterion validity (Weissman *et al.*, 1977). A score of 16 or greater is considered suggestive of a depressive disorder (Myers & Weissman, 1980).

Social support was assessed at the semi-annual visits by a single, self-report item. Participants were asked to indicate the number of people they could 'talk to about things that are important' or 'count on for understanding and support'. Response options were no one, one person, two to three persons, four to five persons, and six or more persons.

MACS participants who visited the study sites between April 1 and September 30 1991, were given a self-report questionnaire that asked if the participant was a current pet owner or if he had owned a pet in the previous five years. Pet owners were further queried about the number of pets, type of pet and year of adoption of the pet or pets. Participants who had lost a pet during the previous five years reported on the year of the loss and the reason for the loss (open-ended question). Pet owners completed the eight-item Poresky Companion Animal Bonding Scale (CABS; Poresky *et al.*, 1987) in regard to their favourite pet. The CABS is designed to measure the interaction between pet owners and their pets (i.e. how frequently the owner handles the pet, where the pet sleeps, etc.). Each item is scaled from one to five, with five indicating the highest degree of attachment. An attachment score is generated by summing across the eight items. A psychometric evaluation of the CABS among MACS participants demonstrated adequate reliability, both internal consistency (Cronbach's $\alpha = 0.79$) and intraobserver consistency (test-retest-retest correlation coefficient = 0.81) (Angulo *et al.*, 1996). Last, each participant was asked if he had ever heard or read that HIV-infected individuals should either get rid of their pets or not

have pets. Those who answered affirmatively were asked to indicate the source of this information and the type of pets to avoid.

Results

Sample characteristics

The questionnaire about pets was completed by 1,992 (91%) of the 2,187 eligible MACS participants. There were 718 respondents in Baltimore, 555 in Chicago and 914 in Los Angeles. There were no differences among the response rates in the three sites. The 195 persons who declined to complete the pet questionnaire were comparable to respondents in age, income, ethnicity and education. Non-respondents, however, were more likely than respondents to be HIV-infected, $\chi^2(1) = 19.43$, $p < 0.001$, and to score in the range suggestive of a depressive disorder on the CES-D, $\chi^2(1) = 5.39$, $p < 0.05$. There was a trend for non-respondents to have fewer confidants than respondents ($p = 0.09$).

All respondents who were HIV-seronegative during their previous MACS visits were again seronegative during the visit in which pet information was collected (approximately six months later), reflecting the decline in incidence of new cases that was seen as the MACS progressed. The 120 respondents who did not know the results of their previous HIV antibody test were excluded from the analyses reported here, resulting in a final sample of 1,872 participants, 708 of whom were HIV infected (38%), of whom 214 (30%) had AIDS. Expressed as a proportion of the sample for this study, 11% had AIDS.

According to information collected at study enrolment (1984 to 1995), the sample was predominantly non-Hispanic white (96%), reported a median age of 38 years and had at least some college education (81%). Level of employment was high (85%), with over half of the sample employed in professional or managerial positions (54%). Among persons with AIDS, 38% were employed. Data collected for the pet ownership study (in 1991) indicated that the median annual income was \$30 to \$40 thousand dollars. The characteristics of the sample are presented in Table 1.

The mean CES-D Scale scores at study enrolment (mean = 9.76, SD = 8.96) and during the pet ownership study period (mean = 9.68, SD = 9.18) were comparable. There were no missing data for the CES-D Scale completed at study enrolment. For the CES-D Scale completed during the study period, missing data for two or fewer items were replaced by the mean score for the respondent's other responses. Scale scores were not calculated if three or more of the 20 questions were left unanswered. After replacing one missing CES-D Scale item for 41 persons and two missing items for one person, all but 27 participants completed a CES-D Scale. During the study period, 28% of participants scored in the range suggestive of a depressive disorder (16 or above). Number of confidants was reported by all but 18 participants; the median response for number of confidants was 'two to three' persons.

A pet was currently owned by 48% of the participants; an additional 11% did not currently own a pet but had owned one in the previous five years. Compared to uninfected persons, the HIV-infected persons were slightly more likely to currently own a pet, $\chi^2(1) = 2.93$, $p = 0.09$. The 214 participants with AIDS were comparable to the other 494 HIV-infected participants in regard to the proportion who currently owned a pet (52 and 51%, respectively). Pet ownership characteristics are reported in Table 2.

The mean scores on the Companion Animal Bonding Scale were comparable for current (mean = 21.63, SD = 5.76) and former (last five years) pet owners (mean = 20.99, SD = 6.47). Missing data on one item on the CABS were replaced by the mean score of the other responses. If more than one response on the CABS was missing, an attachment score

Table 1. *Sample characteristics of 1,872 men in the Multicenter AIDS Cohort Study who participated in research on pet ownership, April 1 to September 30 1991*

	%	Number
Age in years		
35 or younger	27	507
35 to 44	51	955
45 or older	22	410
Racial/ethnic group		
White, non-Hispanic	96	1794
Other	4	78
Site		
Baltimore	26	485
Chicago	28	522
Los Angeles	46	865
Education		
High school graduate or less	12	220
Some college	29	541
College degree or more	59	1111
Income (annual)		
Less than \$20,000	20	374
\$20,000-\$50,000	54	1011
More than \$50,000	26	487
CES-D score		
15 or less	71	1328
16 or greater	28	517
Missing	1	27
Number of confidants		
One or fewer	12	227
2 to 3 persons	41	769
4 to 5 persons	25	463
5 persons or more	21	395
Missing	1	18
HIV status		
Uninfected	62	1164
HIV infected, without AIDS	26	494
HIV + infected, with AIDS	11	214

was not calculated. Scores were computed for seven individuals who were missing a single item; scores were not available for one bird owner, three cat owners and one dog owner. Among current owners of one type of pet, the mean attachment scores for the 326 dog owners (mean = 22.87, SD = 5.29) and 408 cat owners (mean = 21.48, SD = 5.42) were comparable. There were no differences in the level of attachment to one's pet between HIV-infected and uninfected persons, or between persons with and without AIDS. Based on the bi-modal distribution, persons scoring greater than or equal to 15 were considered attached pet owners and those scoring less than 15 were considered unattached.

Having heard that HIV-infected persons should not own pets was more frequently acknowledged by HIV-infected than uninfected participants (60% compared to 39%), $\chi^2(1) = 78.09$, $p < 0.001$. The media (60%) and/or friends (41%) were commonly cited as sources for this information, with relatively fewer participants mentioning a physician (11%), veterinarian (1%) and/or other health care provider (8%). Cats (87%) and birds (50%) and,

Table 2. Pet ownership, by type of pet, among HIV-infected and uninfected participants in the Multicenter AIDS Cohort Study, April 1 to September 30 1991

	HIV infected <i>n</i> = 708		Uninfected <i>n</i> = 1,164	
	%	Number	%	Number
Currently own pet	51	361	47	546
Currently own bird	4	26	4	54
Currently own cat	27	194	26	308
Currently own dog	24	172	21	250
Currently own other pet	5	37	4	47
Do not own pet, but owned pet in past 5 years*	13	90	10	113
Previously owned bird	2	18	2	29
Previously owned cat	12	86	6	75
Previously owned dog	9	61	8	84
Previously owned other	2	14	1	13

¹ Participants may own more than one type of pet.

*HIV infected and uninfected differ at $p < 0.05$.

to a lesser extent, dogs (21%) or fish (16%), were named as the pets posing a health risk to HIV-infected persons.

Despite the widespread awareness about potential hazards of pet ownership, only four of the 468 former pet owners (<1%) cited health concerns of owning the pet as a reason for no longer having a pet that they had owned in the previous five years. The most common explanations for no longer having a pet were 'moving' (45%) and 'death of the pet' (35%). There were no differences between HIV-infected and uninfected participants, or between persons with and without AIDS, regarding either the reasons they offered for no longer owning a pet or the likelihood of being a former pet owner. HIV-infected persons did differ from uninfected persons in that they were less likely to adopt a new pet after having lost a pet, $\chi^2(1) = 4.11$, $p < 0.05$, especially after losing a cat, $\chi^2(1) = 18.01$, $p < 0.001$. There were no differences in this regard between persons with AIDS and other HIV-infected persons.

Associations with depressive symptomatology

The CES-D Scale score was treated as a dichotomous variable, with persons considered to be depressed if they scored greater than or equal to 16 during the pet ownership study period (Myers & Weissman, 1980). Among the demographic characteristics, only having an income below the median was associated with depression, $\chi^2(1) = 26.06$, $p < 0.001$. Participants 45 years or older and participants at the Los Angeles study site were slightly more likely to be depressed than younger participants and participants in Baltimore or Chicago, $\chi^2(2) = 5.46$, $p = 0.06$, and $\chi^2(1) = 3.7$, $p = 0.05$, respectively.

In regard to health status, HIV infection was unrelated to depression, however presence of AIDS was strongly associated with depression, $\chi^2(1) = 20.66$, $p < 0.001$. For the total sample, 41% of persons with AIDS scored 16 or above on the CES-D compared to 26% of those without AIDS. When considering HIV-infected persons only, presence of AIDS was still associated with depression, $\chi^2(1) = 26.31$, $p < 0.001$.

Four pet ownership variables were explored in our analysis: current pet owner, current attached pet owner, previous pet owner (was a pet owner in the last five years but is no longer

a current pet owner) and previous attached pet owner. In each instance, participants with these characteristics were compared with all other participants. None of these pet ownership variables was associated with depression in univariate analyses. Human companionship, however, was related to depression in that men having three or fewer confidants were more likely to be depressed than men with a greater number of confidants, $\chi^2(1) = 29.36$, $p < 0.001$.

To test these associations in a multivariate model, unconditional logistic regressions were computed, using depression during the pet ownership study period as the dichotomous outcome variable. Persons scoring greater than or equal to 16 on the CES-D were considered to be depressed. Predictors in the model included the pet ownership variables, social support, HIV infection, AIDS, and the pet ownership by HIV interaction terms. CES-D score at study enrolment, age, income and study site were included as covariates in each logistic model. The latter three were associated with depression in the univariate analyses.

Consistent with the univariate analyses, neither HIV infection nor any of the pet ownership variables (tested individually) were associated with depression in the multivariate model. Controlling for covariates, having fewer confidants, $\beta = 0.96$, $p < 0.001$, and the presence of AIDS, $\beta = 0.98$, $p < 0.001$, were associated with depression. None of the interaction terms contributed to the logistic model when the main effects (HIV infection and the respective pet ownership variables) and covariates (age, income, study site, CES-D Scale score at study enrolment) were included in the model.

To assess whether pet ownership might modify the association between AIDS and depression among HIV-infected persons, we repeated the multivariate analyses among the 708 HIV-infected participants only. Controlling for the covariates, having fewer confidants, $\beta = 0.93$; $p < 0.001$, and the presence of AIDS, $\beta = 1.08$, $p < 0.001$, again were associated with depression. The current pet owner by AIDS interaction term contributed to the model, suggesting that owning a pet modified the association between AIDS and depression among HIV-infected persons, $\beta = 0.78$, $p < 0.05$.

The contribution of the pet by AIDS interaction term is evident by comparing the odds ratio for each level of pet ownership. The odds ratio is the estimate provided by the logistic model of the change in the risk of the outcome (in this case, a score of 16 or above on the CES-D) associated with a specific exposure (in this case, the presence of AIDS). Looking at these odds ratios, persons with AIDS were 2.9 times more likely to be depressed than persons without AIDS, among those who did not own a pet. Among pet owners, however, persons with AIDS were only 1.4 times more likely to be depressed than persons without AIDS. These data are presented in Table 3. In other words, the presence of AIDS was associated with a more than twofold increase in the likelihood of depression for participants who did not own a pet, $\beta = 1.39$, $p < 0.001$, but among pet owners, persons with AIDS were only moderately more likely to be depressed than persons without AIDS, $\beta = 0.65$, $p = 0.05$.

The same pattern of findings emerged when the attached pet owner by AIDS interaction term was tested, $\beta = 0.80$, $p < 0.05$. Again, having AIDS was associated with a modestly increased probability of depression for HIV-infected participants who were attached to their pets ($\beta = 0.85$, $p < 0.05$), whereas AIDS was associated with a more than twofold increase in the likelihood of depression among participants who did not own a pet or were not attached to their pet ($\beta = 1.49$, $p < 0.001$). Taking type of pet into account yielded a weak trend for dogs to influence the association between AIDS and depression to a greater extent than cats (the only pets with sufficient numbers for analyses), ($\beta = 0.66$, $p = 0.17$ for dog owners and $\beta = 0.19$, $p = 0.67$ for cat owners. Similar findings emerged when looking at attached dog or cat owners.

Our final analysis evaluated whether the presence of confidants influenced the effect

Table 3. Odds ratios of depression associated with AIDS diagnosis among HIV-infected men ($n = 708$) in the Multicenter AIDS Cohort Study, April 1 to September 30 1991

Effect modifier	With effect modifier			Without effect modifier		
	<i>n</i>	OR ^{1,2}	95% CI ³	<i>n</i>	OR	95% CI
Pet owner*	366	1.4	1.1-1.6	328	2.9	2.6-3.2
Cat owner	203	1.8	1.5-2.2	491	2.1	1.9-4.0
Dog owner	179	1.0	0.6-1.5	515	2.3	2.1-2.5
Attached pet owner*	294	1.4	1.1-1.6	395	3.1	2.8-3.4
Attached cat owner	177	1.7	1.3-2.1	514	2.1	1.9-2.4
Attached dog owner	169	0.9	0.5-1.4	524	2.3	2.1-2.5
Among persons with fewer than 3 confidants:						
Pet. owner	212	1.3	0.9-1.7	176	2.5	2.2-2.9
Attached pet owner*	160	1.0	0.7-1.4	224	3.4	3.1-3.7
Among persons with 4 or more confidants:						
Pet owner	154	1.8	1.3-2.3	152	3.7	3.3-4.2
Attached pet owner	134	2.9	2.4-3.4	171	2.5	2.0-3.0

¹ Odds ratio.² Controlling for study site, age, income and depression at baseline; analyses include only men who knew their HIV serostatus.³ Confidence interval.* Odds ratios differ at $p < 0.05$.

of pet ownership on the association of AIDS and depression. Using the median number of confidants as the cut-off, we added social support to the two multivariate models which contained the covariates, the main effect terms (either pet ownership or attached pet ownership, presence of AIDS, and social support), the two-way interaction term (either current pet ownership by presence of AIDS, or attached pet ownership by AIDS), and the three-way interaction term (social support by current or attached pet ownership by presence of AIDS). Social support contributed to each model, $\beta = 0.72$, $p < 0.05$ for pet ownership and $\beta = 0.84$, $p < 0.01$ for attached pet ownership, leaving the two-way interaction terms unchanged. Additionally, the three-way interaction term also contributed to the multivariate models, $\beta = 0.77$, $p < 0.05$ for pet ownership, and $\beta = 0.81$, $p < 0.05$ for attached pet ownership. Retaining social support as an ordinal, rather than dichotomous, variable did not change these results.

To clarify how effect modification varied by social support, the logistic regressions were then rerun within the groups of participants with high or low confidant support. For the 325 participants with fewer than three reported confidants, the pet ownership by AIDS and the attached pet ownership by AIDS interaction terms each significantly contributed to the models, $\beta = 0.85$, $p < 0.01$ and $\beta = 0.97$, $p < 0.01$, respectively. Among persons who did not own a pet, those with AIDS were 2.5 times more likely to be depressed than those without AIDS ($\beta = 0.72$, $p < 0.05$). Among persons who owned a pet, however, those with AIDS were only slightly more likely to be depressed than persons without AIDS ($p = 0.57$). Similarly, among persons who did not own a pet or had low levels of attachment to their pets, those with AIDS were 3.4 times more likely to be depressed than those without AIDS, $\beta = 0.80$, $p < 0.05$. Among persons who were attached to a pet, however, those with AIDS were no more likely to be depressed than persons without AIDS ($\beta = 0.09$, $p = 0.89$). In contrast, among the 383 persons with four or more

confidants, the impact of AIDS on depression was not modified by pet ownership ($p = 0.28$) or by attached pet ownership ($p = 0.83$). These odds ratios are reported in Table 3.

Discussion

This survey, one of the largest examining pet ownership and health, provides the first methodologically rigorous investigation of the psychological benefits of pet ownership for HIV-infected persons. Confidence in the research outcomes is enhanced by the large sample size, excellent participation rates, detailed information on each study participant, valid measurement of attachment between pet owners and their pets, and assessment of both direct and indirect effects of pet ownership on depressive symptomatology. Findings from our research should not be generalized, however, to HIV-infected women or persons other than non-Hispanic whites.

A direct effect of pet ownership on depression was not supported by our analyses. Pet owners, whether attached to their pet or not, were as likely to be depressed as persons without pets, corroborating research on pet ownership among the elderly (Siegel, 1990). The presence of HIV infection also was unrelated to depression, a finding observed among all MACS participants at baseline (Ostrow *et al.*, 1989). As a result, pet ownership could not modify an association between HIV infection and depression. A low level of human companionship, however, was associated with depression, in both univariate analyses and when controlling for other correlates of depression.

Although being HIV infected did not influence psychological status, having AIDS had a profound impact on depression. The likelihood of depression was one-and-a-half times greater among persons with AIDS, and almost two times greater when considering HIV-infected participants only. The latter association was diminished significantly among pet owners, and attached pet owners in particular. That is, among HIV-infected persons, the presence of AIDS was associated with depression only for those who did not own (or, in other analyses, did not have an attachment) to their pet, a finding compatible with the buffering model of support (Alloway & Bebbington, 1987; Broadhead *et al.*, 1983; Cohen & Wills, 1985). These results do not appear to be due to sicker persons or more depressed persons having lost or given away a pet. Neither AIDS diagnosis nor depression was associated with the likelihood of being a former (past five years) pet owner, nor were the reasons for no longer having a pet differentiated by HIV status.

Pet ownership was common among MACS participants—48% for the total sample and 51% among HIV-infected participants. These levels of ownership were slightly lower than the estimated 60% of all US households, and somewhat higher than both a national estimate for middle-aged single persons (American Veterinary Medical Association, 1992) and the proportion in another study of an AIDS population (Conti *et al.*, 1995). The benefit of pet ownership is most likely achieved through the companionship pets offer. In research with elderly persons (Siegel, 1990), companionship or company (cited by 75%), feelings of security (25%) and feeling loved (21%) were mentioned most frequently in response to an open-ended question on the benefits of pet ownership. Both older persons and HIV-infected persons may have particularly pronounced companionship needs because loss of a loved one, a potent precursor to depression, is common in these cohorts. In our sample, social isolation or stigmatization may be present as well, either on the basis of sexual orientation or illness, and these experiences, in turn, can exacerbate depressed affect. Our data on confidant support are consistent with this line of reasoning, in that pet ownership was most influential in reducing AIDS-associated depression among persons with low levels of confidant support. Moreover, the most significant impact of pet ownership was among men with high levels of

attachment to their pets and low levels of confidant support. Other research converges in demonstrating an association between pet attachment and health among respondents with low levels of human support, but not among those with adequate human support (Garrity *et al.*, 1989). Thus, pets may fulfil important companionship needs for men with AIDS and also promote psychological wellbeing.

In contrast to other research indicating that dog ownership is more influential for health status than the presence of other companion animals (Friedmann & Thomas, 1995; Siegel & 1990), our analyses yielded only a weak trend in this direction, and none of the pet-specific interaction terms was statistically significant. More important than type of pet was the strength of the affective bond between owner and companion animal—in all analyses, the effect of pet ownership was magnified among attached pet owners. If pets are beneficial to their owners because of the companionship needs they fulfil, it follows that owners with stronger bonds to their pets would benefit the most from having pets.

Given the potential benefit of pet ownership for persons with AIDS, it is important to consider possible deterrents to owning a pet. The majority of the HIV-infected pet owners had heard, through the media or from friends, that there were health concerns associated with owning a pet. Some of the information they reported receiving was either incorrect (i.e. that birds pose a great risk) or overly cautious, such as giving up pets altogether. Only a small proportion of participants cited physicians, veterinarians and other health care providers as the source for information about health hazards associated with pet ownership. This is consistent with surveys of health care providers indicating that few offer HIV-infected persons advice regarding safe practices for pet ownership (Angulo *et al.*, 1995; Gorzyca *et al.*, 1989). Responding to the documented need for increased participation by health care providers in informing HIV-infected persons about safe pet practices (Angulo & Swerdlow, 1995; Angulo *et al.*, 1994; Glaser *et al.*, 1994), the Centers for Disease Control and Prevention have developed opportunistic infection prevention recommendations for HIV-infected pet owners (Kaplan *et al.*, 1995). Our findings indicate that health care providers should discuss the potential psychological benefits of pet ownership with HIV-infected persons, as well as the possible health risks.

We did not randomly assign MACS participants to be pet owners or non-owners. Therefore, we cannot conclude that persons with AIDS should become pet owners. Most likely, there are other differences that determine who becomes a pet owner, such as personality or social stability, and these factors may have influenced our results. We can extrapolate from these data to suggest that routine advice to HIV-infected persons to give away their pets is unwarranted, particularly if information is provided on safe pet practices. Although less than 1% of our respondents gave away their pets because of health concerns, HIV-infected participants were more likely than uninfected participants to be former pet owners. Possibly health concerns were a factor in the decision to not replace a pet, although we did not inquire about reasons for not replacing a pet. The explanation given most often for no longer having a pet was change in residence, one of the many possible adjustments made in response to HIV infection and its sequelae. Thus, we would also suggest that HIV-infected persons who wish to own pets, especially those persons with relatively few confidants, make special efforts to acquire housing where pets are permitted.

Federal legislation prohibits discrimination against pet ownership in public assisted housing and some states are considering similar legislation for state-regulated housing, such as mobile home parks. Additionally, community and voluntary organizations sometimes play a constructive role in facilitating pet ownership and, in certain cases, care for pets if the owner is temporarily or permanently unable to fulfil certain duties. Our data indicate that pets have a salutary effect on the mental health of men with AIDS. Other reports suggest that reducing

depression may bolster the immune response capability. Furthermore, our findings are compatible with the observation that preserving the bond between people and their pets is in the best interest of public health (Beck & Meyers, 1996).

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