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A Propensity-Score-Weighted Population-Based Study of the Health Benefits of Dogs and Cats for Children

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ABSTRACT There is a widely held belief that children's general and psychological health benefits from owning and/or interacting with pets. In our study, we aimed to determine whether children who live with a dog or cat in their home have better mental and physical health outcomes compared with children without such a pet. Our study design consisted of a secondary analysis of household survey data from the 2003 California Health Interview Survey. Children in pet-owning households (n = 2,236 households with a dog or cat) were compared with children in non-pet owning households (n = 2,955 households) using a weighted propensity score regression approach. Double robust regression analyses were used to examine the association between living with a dog or cat and health outcomes, while accounting for confounding factors. Our results demonstrated strong confounding effects. Unadjusted analyses found that children in pet-owning households were significantly healthier than children in non-owning households in terms of, for example, better general health, higher activity level, and less concern from parents regarding mood, behavior, and learning ability. However, when estimates were adjusted using the double robust approach, the effects were smaller and no longer statistically significant. The results indicate that the benefits of owning pets observed in this study were largely explained by confounding factors.

Keywords: confounding, double robust, observational studies, propensity score

There is a widely held belief that children's general and psychological health benefits from owning and/or interacting with pets. Both the academic literature and popular books include unequivocal statements such as "Companion animals are a vital part of

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the healthy emotional development of children" (Robin & ten Benzel, 1985), "Companion animals can promote healthy child development"(Endenburg & van Lith, 2011), and "Nothing less than alchemy is involved when animals and children get together, and the resulting magic has healing properties that work well" (Anderson, 2008).

The majority of work on the health benefits of interacting with pets considers the use of animal-assisted therapy/interventions (AAT/AAI) (Kamioka et al., 2014), although this research is not without criticism. In this paper, we focus on the potential benefits of pet dogs and cats in non-clinical populations. Pet dogs and cats are thought to provide benefits to children through two mechanisms. The first is psychological—an animal can provide social support, distraction, or comfort. Children have been found to be less anxious during a routine physical examination (Nagengast, Baun, Megel, & Leibowitz, 1997) or while reading out loud (Friedmann, Katcher, Thomas, Lynch, & Messent, 1983) in the presence of a dog. The second is through exercise; dogs in particular often provide an energetic play companion, and encourage owners to exercise. Children who live in a household with a dog have been found to be more physically active and less likely to be overweight (Timperio, Salmon, Chu, & Andrianapoulos, 2008) than those living in non-dog owning households.

The research on the benefits of pets to children suffers from two methodological flaws, which lead us to believe that the types of statements with which we began this section are, at best, premature. First is the issue of selection bias or confounding—it is not feasible to randomly assign individuals to pet ownership conditions, and we are aware of only one study which attempted to adjust for confounding using propensity scores (Headey & Grabka, 2007). Propensity score analyses refers to a statistical approach whereby a propensity score is calculated as the probability that an individual is treated based on observed characteristics such as age and gender. These propensity scores are then used to either weight, match, or sub-classify treated and untreated individuals so that comparisons between treated and untreated groups identify differences that should only be a result of treatment. The study that used this analysis, carried out in Germany, found a statistically significant reduction in the number of doctor visits in adult pet owners (Headey & Grabka, 2007). Second, much is made of experimental evidence (such as that cited earlier), showing the short-term effects of the *presence* of pets in potentially stressful situations. A recent study found that the presence of a dog, a fish, or a plant were all associated with a statistically significant reduction in anxiety, but they did not differ significantly from each other (Buttelmann & Römpke, 2014). It is possible, however, that this is merely a novelty effect, and would not generalize to long-term reductions in anxiety (or other negative emotions).

Pet ownership has also been associated with small but important risks to health. It has been estimated that 4.5 million individuals are bitten by dogs each year in the US, and that approximately 19% of these require medical attention (Gilchrist, Sacks, White, & Kresnow, 2008), and approximately 30 people are killed by dogs every year (Patronek, Sacks, Delise, Cleary, & Marder, 2013). Pets are also responsible for spreading infections, which are often dangerous to both children and adults.

In our study, we assessed the impact of cat and dog ownership on children's health using the California Health Interview Survey (CHIS), a large, population-based survey of families in California. We used a propensity score analysis to remove confounding and thereby obtain unbiased estimates of the effects of pet cats and dogs on children's health. The primary outcome was child's parent-reported general health, with secondary outcomes including child's parent-reported weight, ADD/ADHD diagnosis, and physical activity, and parent's expression of concerns about the feelings, behavior, learning, or obedience of the child.

Methods

Sample

This study used survey response data from the 2003 California Health Interview Survey (CHIS 2003), a population-based, random-digit dial telephone survey of California households. CHIS collected extensive information on health status, health conditions, health-related behaviors, health insurance coverage and access to health-care services, as well as demographic and socioeconomic information. Within each household, separate interviews were conducted with a randomly selected adult (ages 18 years and over), adolescents (ages 12–17), and parents of children (ages 0–11). CHIS 2003 was conducted between August 2003 and February 2004. Detailed information about the CHIS methodology, sample design, and construction of the sample design weights (used throughout our analyses) is available elsewhere (California Health Interview Survey, 2005). We restricted our analysis to households with at least one child aged 5 to 11 years. Though this survey has been conducted more recently, the 2003 survey is the only instrument that included a question about dog and cat ownership; this information was not collected in any other year. The research was approved by the Institutional Review Board of the RAND Corporation (approval number 2014-0490-CR04).

Outcomes Assessed

Within each applicable household, an adult respondent was asked a series of questions related to several health conditions and health-related and psychological behaviors pertaining to themselves and to their child. In this analysis, we focused on outcomes derived from responses to such questions including: general health condition of the child (5 = excellent, 4 = very good, 3 = good, 2 = fair, 1= poor), whether a doctor had ever told the adult that the child had attention deficit (hyperactivity) disorder (ADD/ADHD), child's weight, whether the adult was concerned about the child's feelings and mood (a lot/a little vs. not at all; only applicable for children less than 7 years of age), whether the adult was concerned about the child's behavior (a lot/a little vs. not at all; only applicable for children less than 7 years of age), whether the adult was concerned about the child's ability to learn how to do things for themselves (a lot/a little vs. not at all; only applicable for children less than 7 years of age), whether the child was generally obedient (not true/somewhat true vs. certainly true; only applicable for children 6 years of age or older), and the number of days the child played actively enough to breath hard in the previous week (less than 3 days vs. 3 days or more).

Statistical Analysis

To examine the association between pet ownership and health/psychological outcomes, we used survey-weighted linear and logistic regression analyses, where pet ownership (dog ownership, cat ownership, and dog or cat ownership) was the main independent variable of interest in the model. While one could include all or a subset of available control variables in an attempt to adjust for possible confounding, inclusion of such control variables as independent variables in a regression analysis is (a) often not enough to control for imbalances between the two groups being examined, that is, among those who own a pet compared with those who do not, and (b) relies on correct model specification (Rosenbaum & Rubin, 1983; Rubin, 1979). Therefore, we instead used a double robust regression estimation approach (Lee, Lessler, & Stuart, 2010; Lunceford & Davidian, 2004). Specifically, we used propensity scores to weight our regression models such that those with a pet were comparable with those without a pet on all available confounding factors in the data. We then fitted a weighted regression model which weights by these propensity scores and includes all variables used in the propensity score model as control variables in the regression model. This estimation procedure has been shown to be robust to either mis-specification of the propensity score model or mis-specification of the regression model.

We estimated the propensity score using a Generalized Boosted Model (GBM) to predict pet ownership using the twang package (Ridgeway, McCaffrey, Morral, Griffin, & Burgette, 2011) within the R statistical environment (R Development Core Team 2014). The propensity score model included all available control variables that may potentially be related to the likelihood of owning a pet and related to the outcomes of interest. GBM is a flexible, non-parametric estimation technique that can account for a large number of covariates and that adaptively captures the functional form of the relationship between the covariates and an outcome, with less bias than traditional approaches (Harder, Stuart, & Anthony, 2010; Lee et al., 2010; McCaffrey, Ridgeway, & Morral, 2004). We considered using over 100 control variables in our GBM model, selected from hundreds of available variables, based on substantive knowledge concerning which variables would be expected to be associated with both pet ownership and the outcomes of interest. However, to be parsimonious, only those variables that explained at least 1% of the variation in at least one of the pet ownership variables were included in our GBM fit. Twenty control variables met this criterion for inclusion in the final propensity score model; these variables are shown in Table 1. Cat ownership was used as a control variable when predicting dog ownership, whereas dog ownership was used as a control variable when predicting cat ownership.

While propensity score weighting has been shown to reduce bias in effect estimation when confounding is present, weighting can perform poorly if the estimated propensity score weights are highly variable (Golinelli, Ridgeway, Rhoades, Tucker, & Wenzel, 2012). In this paper, we guarded against this by selecting an optimal iteration of GBM, defined as the iteration which minimizes variance as much as possible while still obtaining unbiased estimates of the exposure effect, thereby directly addressing the bias-variance trade-off inherent in all statistical inference problems (Golinelli et al., 2012; Kang & Schafer, 2007; McCaffrey, Morral, Ridgeway, & Griffin, 2007).

Using either propensity score weighting or regression adjustment alone can lead to limitations in terms of increased standard errors (if propensity score weights are highly variable) or remaining bias (if the regression model is not correctly specified). Our use of the double robust approach has the potential to reduce the risk of bias attributable to differences in covariates between the two groups that may remain even after propensity score weighting (Bang & Robins, 2005). We obtained a double robust estimate of exposure effect by adjusting for all covariates used in the propensity score model in our regression model, weighted by the propensity score weights (in addition, where child's weight was the outcome, we adjusted for age and height).

Results

Individual characteristics for children and adults were available from 5,191 households. Of these, 25% reported having a dog that was allowed in the house, and 19% reported having a cat that was allowed in the house. Table 1 shows the distribution of covariates included in the propensity score model (which are also the covariates included in the double robust models) overall and by pet ownership, weighted appropriately to account for sampling design. Overall, 42% of the sample were White, 37% were Hispanic or Latino, 9% were Asian, 7% were African American, 40% of the sample indicated that their child received free or reduced lunch at school, 69% lived in a house (as opposed to a duplex, apartment, or mobile home), 64% worked full-time, 56% were born in the US, and 10% indicated that their child had asthma. On average, the sample reported good to very good general health, had a monthly housing cost of less than $1,200, worked less than 30 hours a week, and reported that their child saw a doctor within the last year. The distribution of the covariates differed greatly between the ownership groups for almost all covariates. Compared with non-owners, adult dog and/or cat owners were significantly less likely to be Hispanic or Latino, Asian, or African American, less likely to have a child who received free or reduced lunch at school, and more likely to have better English language skills, have higher monthly housing costs, worked more hours per week, lived in a house (as opposed to a duplex, apartment, or mobile home), had lived in the US for a larger percentage of their life, and had better general health.

Table 2 shows the distribution of outcomes overall and by pet ownership, weighted appropriately to account for sampling design. For all three ownership types, unadjusted descriptive statistics show that among those who owned pets, the general health of the child was better, the percentage of children diagnosed with ADHD tended to be higher, child's weight tended to be slightly higher, parents tended to be less concerned about the child's feelings, mood, behavior, and learning ability, parents tended to report children as more obedient, and children tended to be more active.

Table 3 shows the coefficient estimates for dog ownership, cat ownership, and dog or cat ownership for all examined outcomes. This table shows (a) the unadjusted effects of pet ownership (i.e., regression model only includes the pet ownership indicators, and the model is only weighted with population weights to reflect sample design) and (b) double robust weighted estimates using propensity scores. The coefficient estimates from the unadjusted regression models reflect the same results as are shown in Table 2. That is, for almost all outcomes examined, the unadjusted analysis shows significant associations between pet ownership and outcomes. Children with pets tended to have better general health, have higher weight (dog only), be more likely to have ADD/ADHD, were less likely to have their parents concerned about their feelings, mood, behavior, and learning ability (dog or cat only), be more likely to be obedient, and more likely to be active/play hard compared with children without pets. When we estimated the models controlling for selection effects using the double robust method, we found that the estimates of the effect of pet ownership were dramatically reduced and that there was no longer any evidence of significant effects of pet ownership.

Table 1. Distribution of covariates included in the propensity score model by ownership (weighted to account for sample design).

	Covariates in Propensity Score Model									
	Overall	Dog Ownership			Cat Ownership			Dog or Cat Ownership		
	n = 5,191	Do not have a dog (n = 3,601)	Have a dog (n = 1,590)	p	Do not have a cat (n = 3,942)	Have a cat (n = 1,249)	p	Do not have a dog or cat (n = 2,955)	Have a dog or cat (n = 2,236)	p
	Mean (*SD*) or %	Mean (*SD*) or %	Mean (*SD*) or %		Mean (*SD*) or %	Mean (*SD*) or %		Mean (*SD*) or %	Mean (*SD*) or %	
English language skill of the adult respondent (5 = speak English only, 4 = speak English very well, …, 1= do not speak English at all)	3.79 (0.03)	3.52 (0.04)	4.57 (0.04)	< 0.001	3.57 (0.03)	4.72 (0.03)	< 0.001	3.34 (0.04)	4.59 (0.03)	< 0.001
Child receives free or reduced lunch at school (1 = yes, 0 = no)	40%	46%	22%	< 0.001	44%	21%	< 0.001	50%	21%	< 0.001
General health condition of the adult respondent (5 = excellent, 1 = poor)	3.49 (0.02)	3.41 (0.02)	3.72 (0.04)	< 0.001	3.42 (0.02)	3.79 (0.04)	< 0.001	3.35 (0.03)	3.75 (0.03)	< 0.001
Hours worked per week by the adult respondent	28.74 (0.44)	28.25 (0.52)	30.19 (0.82)	0.046	28.36 (0.51)	30.38 (0.89)	0.048	27.89 (0.57)	30.28 (0.68)	0.007
Adult and child live in a house (as opposed to a duplex, building with 3 or more units, mobile home or other)	69%	62%	89%	< 0.001	66%	80%	< 0.001	60%	85%	< 0.001
Housing cost: Monthly rent or mortgage payment	1163.59 (17.86)	1107.17 (21.43)	1329.59 (33.0)	0.026	1125.64 (16.5)	1327.88 (65.0)	0.003	1059.65 (17.60)	1352.08 (39.4)	< 0.001
How long adult respondent has lived in the house (number of months)	67.36 (1.32)	64.61 (1.49)	75.45 (2.80)	< 0.001	65.85 (1.44)	73.9 (3.20)	< 0.001	63.76 (1.62)	73.89 (2.3)	< 0.001
Interview was completed in a language other than English for adult respondent	28%	35%	6%	< 0.001	34%	2%	< 0.001	40%	5%	< 0.001
Adult had more than one sexual partner in the last year	5%	5%	4%	0.091	5%	4%	0.312	5%	4%	0.050
Adult respondent's percentage of life in the US (0–100%)	75.9	70.2	92.6	< 0.001	71.4	95.3	< 0.001	66.5	92.8	< 0.001
Adult respondent was of Hispanic or	37%	44%	17%	< 0.001	43%	11%	< 0.001	49%	16%	< 0.001

continued…

Table 1. Distribution of covariates included in the propensity score model by ownership (weighted to account for sample design). ...continued

Latino race/ethnicity										
Adult respondent was of Asian race/ethnicity	9%	11%	4%	< 0.001	11%	3%	< 0.001	12%	4%	< 0.001
Adult respondent was of African American race/ethnicity	7%	8%	4%	< 0.001	8%	3%	0.002	8%	4%	< 0.001
Adult respondent was of Other race/ethnicity	5%	4%	6%	0.250	5%	4%	0.288	4%	5%	0.420
Adult respondent was of White race/ethnicity	42%	32%	70%	< 0.001	33%	79%	< 0.001	26%	71%	< 0.001
Adult respondent was born in the US	56%	47%	83%	< 0.001	48%	89%	< 0.001	41%	84%	< 0.001
Adult respondent worked full time (as opposed to part time, unemployed and looking for work, not working)	64%	63%	66%	0.155	64%	66%	0.201	63%	67%	0.044
Activity level of the child compared to other children of the same age (1 = a lot less, 2 = a little less, 3 = about the same, 4 = a little more physically active, 5 = a lot more)	3.48 (0.02)	3.44 (0.03)	3.62 (0.03)	< 0.001	3.46 (0.02)	3.58 (0.04)	0.005	3.42 (0.02)	3.6 (0.03)	< 0.001
Child currently has asthma	10%	10%	10%	0.630	10%	8%	0.085	10%	10%	0.954
How long ago the child last saw a doctor (1 = never, 2 = more than 3 years ago, 3 = 2–3 years ago, 4 = 1–2 years ago, 5 = one year ago or less)	4.87 (0.01)	4.86 (0.01)	4.88 (0.02)	< 0.001	4.87 (0.01)	4.84 (0.02)	< 0.001	4.87 (0.01)	4.87 (0.01)	< 0.001
Child is limited in ability to do age-appropriate things	6%	6%	6%	0.902	6%	6%	0.827	6%	6%	0.847
Child is male	51%	52%	48%	0.052	52%	48%	0.151	53%	48%	0.022
Child had reduced physical activity because of a serious injury in the last 12 months	5%	4%	7%	< 0.001	4%	9%	< 0.001	3%	7%	< 0.001
Have a cat	19%	14%	34%	< 0.001	—	—	—	—	—	—
Have dog	25%	—	—	—	21%	46%	< 0.001	—	—	—

Table 2. Child outcomes by ownership status (weighted to account for sample design).

	Outcomes Examined[a]									
	Overall	Dog Ownership			Cat Ownership			Dog or Cat Ownership		
		Do not have a dog (n = 3,601[b])	Have a dog (n = 1,590)	p	Do not have a cat (n = 3,942[b])	Have a cat (n = 1,249[b])	p	Do not have a dog or cat (n = 2,955[b])	Have a dog or cat (n = 2,236[b])	p
	Mean (*SD*) or %	Mean (*SD*) or %	Mean (*SD*) or %		Mean (*SD*) or %	Mean (*SD*) or %		Mean (*SD*) or %	Mean (*SD*) or %	
General Health (1 = poor, 5 = excellent)	4.04 (0.02)	3.94 (0.02)	4.32 (0.03)	< 0.001	3.97 (0.02)	4.34 (0.04)	< 0.001	3.87 (0.03)	4.34 (0.03)	< 0.001
Doctor has said child has ADD/ADHD	4.8%	4.2%	6.4%	0.023	4.4%	6.6%	0.047	4.1%	5.9%	0.043
Weight (kg)[c]	31.25 (0.23)	31.00 (0.28)	31.98 (0.38)	0.037	31.22 (0.26)	31.40 (0.47)	0.735	30.97 (0.31)	31.74 (0.34)	0.086
Adult is a lot or a little concerned about the child's feeling and mood[d]	42.6%	44.6%	33.9%	0.076	46%	25.5%	0.001	48%	29.6%	< 0.001
Adult is a lot or a little concerned about the child's behaviord	43.7%	44.1%	42.1%	0.763	46.5%	29.6%	0.012	47.2%	35.4%	0.040
Adult is a lot or a little concerned about the child's ability to learn[d]	32.5%	33.7%	27.2%	0.285	34.3%	23.4%	0.102	36.2%	23.8%	0.020
Child is NOT generally obedient[e]	42.1%	44.2%	36.1%	< 0.001	43.3%	36.8%	0.007	45.5%	36.2%	< 0.001
Child played hard enough to breath hard 3 or more days in the last week	71.7%	67.80%	83.50%	< 0.001	68.40%	86.20%	< 0.001	65.10%	83.80%	< 0.001

[a] Sample size for analysis is 5,191 unless otherwise specified; [b] These counts reflect ownership among all 5,191 individuals; some analyses were run on a subset of individuals as indicated; [c] Weight information only available for 4,300 children; analysis restricted to this subsample; [d] Only applicable to children under 7; analysis restricted to the 659 children with this outcome available; [e] Only applicable to children 6 and older; analysis restricted to the 4,532 children with this outcome available.

Table 3. Results of regression analyses: unadjusted and adjusted using a double robust model for all outcomes (weighted to account for sample design).

	Have Dog[a]			Have Cat[a]			Have Dog or Cat[a]		
	Coefficient (*SE*)	OR[e]	*p*	Coefficient (*SE*)	OR[e]	*p*	Coefficient (*SE*)	OR[e]	*p*
Child General Health									
Unadjusted	0.39 (0.04)	—	< 0.001	0.37 (0.04)	—	< 0.001	0.46 (0.04)	—	< 0.001
Double robust model	0.02 (0.03)	—	0.331	0.04 (0.03)	—	0.195	0.03 (0.03)	—	0.314
Child's Weight[b]									
Unadjusted	0.99 (0.47)	—	0.037	0.18 (0.54)	—	0.735	0.78 (0.45)	—	0.086
Double robust model	0.22 (0.26)	—	0.408	0.08 (0.41)	—	0.838	0.08 (0.26)	—	0.760
ADD/ADHD (Modeling probability doctor told you child has ADD/ADHD)									
Unadjusted	—	1.56	0.023	—	1.54	0.047	—	1.46	0.043
Double robust model	—	1.27	0.143	—	1.17	0.375	—	1.24	0.194
Concern About Feelings (Modeling probability that adult is a lot or a little concerned)[c]									
Unadjusted	—	0.64	0.076	—	0.40	0.001	—	0.45	< 0.001
Double robust model	—	1.26	0.316	—	0.75	0.275	—	0.92	0.726
Concern About Behavior (Modeling probability that adult is a lot or a little concerned)[c]									
Unadjusted	—	0.92	0.762	—	0.48	0.012	—	0.61	0.040
Double robust model	—	1.35	0.200	—	0.76	0.314	—	0.93	0.755
Concern About Learning (Modeling probability that adult is a lot or a little concerned)[c]									
Unadjusted	—	0.73	0.285	—	0.59	0.102	—	0.55	0.020
Double robust model	—	0.99	0.962	—	1.21	0.508	—	0.84	0.505
Concern About Obedience (Modeling probability that adult said child is generally obedient)[d]									
Unadjusted	—	1.41	< 0.001	—	1.31	0.007	—	1.47	< 0.001
Double robust model	—	1	0.978	—	0.88	0.132	—	0.90	0.200
Playing Hard (Modeling probability child played hard enough to breath hard 3 or more days in the last week vs. <3 days)									
Unadjusted	—	2.40	< 0.001	—	2.88	< 0.001	—	2.77	< 0.001
Double robust model	—	1.17	0.107	—	1.08	0.508	—	1.15	0.142

[a] Sample size for analysis is 5,191 unless otherwise specified; [b] Weight information only available for 4,300 children; analysis restricted to this subsample; [c] Only applicable to children under 7; analysis restricted to the 659 children with this outcome available; [d] Only applicable to children 6 and older; analysis restricted to the 4,532 children with this outcome available; [e] Odds ratio (OR) only shown for logistic regression models. Regression coefficients only are shown for linear regression models.

Discussion

Our results suggest that there are substantial differences in a range of measures of health status between children in dog/cat owning and non-owning households. The majority of these differences were in the direction of children in pet-owning households having better health. However, individuals select into dog/cat ownership and the predictors of ownership may also be associated with health status. When a range of selection variables were controlled for using regression and propensity score adjustment, the effects were reduced and failed to reach statistical significance in all cases.

These results for both physical and psychological health appear to contradict the empirical results cited earlier. The physical health benefits of pet ownership are hypothesized to primarily be due to greater activity. In this study, we assessed activity indirectly (i.e., via weight, and via reports of "playing hard"); when activity levels have been assessed directly previously, the effect of dog ownership has been found to be small (Owen et al., 2010). For psychological health, there is strong experimental evidence that interacting with dogs (and probably cats) provides social support and reduces stress and anxiety in children. One possibility for the failure to find an effect in our research is that of the buffering hypothesis (Cohen & Wills, 1985). The hypothesis is that social support is beneficial for psychological health only when there are potentially adverse stressful events. If this is the case for animal interaction, it is likely that a population-based study such as this will be unable to detect an effect. Given the failure to find an effect of pet ownership in this population, we believe that statements exclaiming the benefits of pet ownership for children are at best premature, and that this remains "an unsubstantiated hypothesis" (Herzog, 2011).

This research has some limitations. First, despite the relatively large sample size, the data were collected from a geographically limited (but ethnically and racially diverse) population in California. Second, the survey question used in our analysis only assessed ownership and did not assess length of ownership or level of interaction with the pet. Certainly, effects of pet ownership may vary with length of ownership or quality/quantity of interaction. Third, our study did not have variables available to assess stress and/or anxiety, outcomes previously found to be associated with the presence of a pet, as described earlier. Lastly, the research was cross-sectional, and therefore we were unable to investigate temporal relationships between pet ownerships and health outcomes. Future work focused on measuring length of ownership, quantity/quality of interaction, and their associations with health outcomes over time are warranted.

Conclusion

This research indicates that pet owners differ from non-owners on a number of factors that may also be related to child health and development; when these differences are controlled for, we found no evidence for a beneficial effect of pet ownership for child health. Moreover, the current results suggest that some of the previous evidence of positive benefits of pets may be attributable to confounding.

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Conflict of Interest

The authors have no potential conflicts of interest.

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