Baseline Estimates for Companion Animals Living in Households in Hawai'i: Associated Socio-Demographic, and Select Health Variables, as Measured by a Household Survey

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Abstract

Information on companion animals in Hawai'i is lacking. The Hawai'i Department of Health's Hawai'i Health Survey, collected data on adults and households by telephone interview. National estimates of companion animals range from 50-67%. However, the estimate from Hawai'i was lower with 39% of households in Hawai'i having a companion animal that spends part or all of the day indoors, including 29.5% of households with dogs and 14.7% with cats. There may be multiple reasons the count is lower for Hawai'i and possible factors are identified.

There were significant differences in companion animals by ethnicity with Whites having the highest percentage of cats (25.8%) and Japanese the highest percentage of dogs (33.8%). Differences were observed between Asian ethnicities and Native Hawaiians. Specifically, individuals of Japanese ethnicity were more likely to have dogs, while Native Hawaiians were more likely to have cats compared to other Asian and Other Pacific Island ethnicities. Furthermore, companion animals were associated with counties other than Honolulu, lower poverty, ownership of a car or home, women, education, and middle-aged adults. Thus, many households in Hawai'i may not have the resources for a companion animal. Adults who rated their general health excellent had the highest association with having a cat(s). Asthma was higher for women living with dogs than women without cats or dogs. Asthma was lowest for men with cats compared to other groups for men and women.

This study contributes to the understanding of complex interrelationships of humans, animals, and their environment which is gaining momentum under the umbrella of "One Health" by supporting increased collaboration and new data sources.

Keywords

Hawai'i; dog; cat; companion animals; general health; asthma; Asian; NHOPI

Abbreviations

CA = companion animal(s); specifically, cats and dogs CASRO = Council of American Survey Research Organizations CDC = Centers for Disease Control and Prevention COVID-19 = Coronavirus disease 2019 HBRFSS = Hawai'i Behavioral Risk Factor Surveillance System HHS = Hawai'i Health Survey HIHS = Hawaiian Humane Society NHOPI = Native Hawaiians or Other Pacific Islanders SMS = SMS Research & Marketing Services Inc. of Hawai'i ZCTA = ZIP Code Tabulation Area

Introduction

Companion Animals in Households

Estimates of percentages of companion animals (CA) in the continental US households range from 50% to 67%, with the US Census Bureau estimate at 50%, considered "the gold standard", or most reliable.¹⁴ Regardless of the source, percentages have increased in the last 40 years.⁵

Adoptions of CA increased during the coronavirus disease 2019 (COVID-19) pandemic (1 in 5 households acquired a CA). Many CA were from animal shelters which helped more shelters reach their no-kill benchmark of 90% save rate.^{6,7} CA may have provided social support, and physiological and psychological health benefits while human interaction was limited.^{7,8} The American Veterinary Medical Association stated that during the COVID-19 pandemic; "one thing that millions of people have been able to rely on has been the companionship and love of their pets."⁹

On O'ahu, during the COVID pandemic, Feather and Fur Animal Hospital reported increased caseloads during 2020, attributed to increased adoptions and adult awareness of issues with their CA. (Brian Walsh, DVM/Medical Director. Oral Communication. Feather and Fur Animal Hospital. Kailua, HI. A telephone call, September 21, 2020, https://www.featherandfur.com/). Although; there is a history of estimating CA in the US, there is limited information on CA in households in Hawai'i.¹ Two estimates of CA in Hawai'i households (64% and 60%) are higher than many estimates for US households.^{5,10} However, Hawai'i has a mixed reputation for CA: known for being a pet 'obsessed' state by analyzing tweets and hashtags, yet ranked as one of the least pet-friendly states based on home security and anti-abuse laws.¹¹⁻¹⁴

CA Expenditures

Expenditures for CA in the US have increased yearly and indicate the importance of CA. For example, \$136.8 billion was spent on CA in 2022 (10.8% increase from 2021), including \$58.1 billion spent on pet foods and treats (16.2% increase from 2021), and \$35.9 billion on veterinary care and product sales (4.7% increase).¹⁵

Health and the Animal Bond

Multiple research institutes and health researchers are investigating the bond between CA and humans.¹⁶⁻¹⁷ Strikingly, the Human Animal Bond Research Institute estimates \$11.7 billion saved on health care costs associated with having a CA.¹⁸ Notably, the Centers for Disease Control and Prevention (CDC) and research studies report the health benefits of having a CA: improved blood pressure, cholesterol, depression, and cognitive functions. The CDC, also, provides information on possible diseases associated with a specific CA.¹⁹⁻²¹ CA can increase social interaction.²⁰ Additionally, adults with CA may be more attuned to broader social issues. CA can serve as a gateway to concerns inclusive of all nature.²²

Strikingly, given the interrelationship of humans, animals, plants, and their environment, CA researchers from multiple disciplines have proposed to unite human and veterinary medicine under "One Health." The goals of One Health include increasing collaboration, developing data sources, and determining associations that improve health for all.²³

In contrast, negative effects such as asthma and *Toxoplasmo*sis may accompany CA. In childhood, asthma is more likely among boys than girls. As adults, women are more likely to have asthma.²⁴ Cats may carry *Toxoplasmosis* in their feces and transfer the organism to humans. However, contaminated food is the leading cause of *Toxoplasmosis*.²⁵

Abandoned and Free-roaming Cats and Dogs

Abandoned, lost from households, and other free-roaming CA are abundant on O'ahu. The Hawaiian Humane Society (HIHS) estimated that 82% of cats and 51% of dogs taken in were euthanized between 1993-2008.¹⁰ A 2021-2022 report indicated an intake of 12 899 animals with 57% of animals adopted, 13% returned to owners, and 30% of intake animals left unaccounted for (the number euthanized was not reported).²⁶ There are also no-kill shelters in Hawai'i.²⁷

Cat caretakers work with animal organizations in Hawai'i to trap, neuter, release, feed, and care for free-roaming cats.²⁸ Cat sanctuaries (eg, Lāna'i), also provide humane care.²⁹ Additional solutions to prevent euthanasia are increased adoptions, education, enforcement of laws on abandonment, keeping CA indoors, and the more effective reduction of cat numbers with a "higher intensity option" of trap, neuter, and release.³⁰ Also, a new intramuscular injection for cats has been proposed providing long-term contraception.³¹

Objectives

The primary objective of this study is to provide baseline data on CA and associated variables. Additionally, data are presented by ZIP Code Tabulation Area (ZCTA) for planning needs.

Methods

Data are from the Hawai'i Health Survey (HHS, 2011-2012), an annual survey of households and adults who lived in Hawai'i.³² As an anonymous survey, the HHS is exempt from the Internal Review Board process (B. Woods, PhD, DOH IRB Administrator, Hawai'i Department of Health, Email October 2018).

The sample frame for 2011-2012 was all households with landline telephone service and cell phone contracts issued in Hawai'i. The Office of Health Status Monitoring contracted with SMS Research & Marketing Services Inc. of Hawai'i (SMS) to conduct the HHS using Computer-Assisted Telephone Interviewing software to interview a knowledgeable adult \geq 18 years.

Atotal of 10 226 adults were surveyed. The exact survey response rate is not available, due to changes in the surveillance metrics, but is estimated to be similar to the Hawai'i Behavioral Risk Factor Surveillance System (HBRFSS, response of 44.4% in 2011, 38% in 2012) since it was conducted by the same vendor, on the same population, and the response rates were similar in 2010.³³⁻³⁵ Missing responses for CA responses at 2% were not imputed; missing values for income (20%) were imputed (hot-deck method).³⁶

Survey questions included: "Does your household have pets such as dogs, cats, hamsters, birds, or other feathered or furry pets that spend time indoors?" If yes, then the pet type and number were recorded. Questions on households included county, household type, and poverty. Percent poverty was calculated using the US Department of Health and Human Services poverty guidelines for Hawai'i, household income, and household size and was grouped into <100%, 100%-124%, and $\geq 125\%$.³⁷ In 2011, the HHS asked about car ownership, and in 2012 home ownership. Other variables included sex, age, marital status (dichotomized into married and all others; including single, divorced, widowed, and other), employment, and education (ages 18-<25 years were listed separately, as their education may not be completed). Single race/ethnicity (multiple responses were possible) was derived from mother and father's ethnicity. Native Hawaiian was coded first, then the father's first non-White ethnicity, then the mother's. The SF12 Survey® questions assessed general health status.³⁸ Additionally, respondents answered, "Has a medical professional ever told you that you have asthma?" Specific ZCTAs were combined so that sample sizes were over 50.

Survey responses for adults and households were weighted, adjusted, and raked (using SAS MACROS) to bring the survey data into correspondence with the 2010 Census and then adjusted using an SMS growth model specific to Hawai'i.³⁹⁻⁴⁰ Thus, the sample represented 1 079 943 adults and 448 125 households in Hawai'i (2011 and 2012 years averaged).

Data presented are percentages and predicted marginal percentages for households or adults. Non-overlapping confidence intervals or a Wald F (P<.05) value indicate a significant difference. The cutoff for inclusion was a sample size of 50 respondents for the denominator and a relative standard error <.30.

Univariate logistic regression models for the binary outcome, yes/no having a companion cat(s) or dog(s), were constructed for each independent variable with a logit-transformed probability. Select variables were age or age and sex-adjusted, as significant differences existed by age and sex. Data were analyzed using SAS software, version 9.4 (SAS Institute Inc., Cary, NC), and SUDAAN software, version 11.0 (RTI International, Research Triangle Park, NC).

Results

CA in Hawai'i Households

An estimated 174 781 of 448 125 (39.0%) households in Hawai'i had at least one CA (cat, dog, rabbit, other), with more

households reporting dogs (29.5%) than cats (14.7%), **Table 1**. Rabbits (0.8%) and others (4.0%) (*data not shown*) were excluded from further analysis due to their small sample size and heterogeneity, respectively.

Honolulu County, with a large urban area, had the lowest percentage of cats per household (12.0%), compared to all other counties. With more rural areas, Hawai'i County had the highest percentages of households with cats (22.1%) and dogs (35.6%). Households with 1 adult and no children had the lowest percentages of cats (10.5%) and dogs (15.6%) compared to other household types, **Table 1.**

Cats and Dogs and Poverty

The percentage of CA increased with decreasing poverty. The percentage of cats was significantly lower for households <100% of the poverty level compared to those $\ge 125\%$. The presence of CA was significantly associated with owning a car /or owning a home, **Table 1**.

Table 1. Percentage of Households in Hawai'i with Cats and/or Dogs by Household Demographics, Hawai'i Health Survey 2011 and 2012 Weighted Average.

Household Cats and/or Dogs								
Variables	Cat(s)		Dog(s)					
Sample Size n ^a	1 855		2 954					
Weighted	Percent	95% CI	Percent	95% CI				
Total	14.7	(13.8-15.8)	29.5	(26.9-29.5)				
County								
Honolulu	12.0	(10.7-13.3)	29.1	(25.5-29.1)				
Hawaiʻi	22.1	(20.0-24.3)	35.6	(30.6-35.6)				
Kauaʻi	18.6	(16.3-21.1)	31.2	(24.6-31.2)				
Maui	19.2	(17.3-21.3)	29.7	(24.8-29.7)				
Household Type								
One Adult No Children	10.5	(9.0-12.3)	15.6	(13.5-18.1)				
Adults No Children	18.1	(16.6-19.6)	31.1	(29.4-32.9)				
One Adult With Children	19.9	(12.8-29.6)	29.8	(21.0-40.5)				
Adults With Children	12.8	(11.1-14.8)	33.9	(31.1-36.7)				
Federal Poverty Guidelines								
<100%	11.7	(9.7-14.0)	25.9	(22.3-29.8)				
100-124	14.3	(12.2-16.6)	26.1	(23.3-29.2)				
≥125	15.5	(14.3-16.8)	29.2	(27.6-30.9)				
Car Ownership ^₅								
Yes	16.0	(14.6-17.5)	31.2	(29.3-33.1)				
No	8.5	(5.5-13.0)	10.5	(7.1-15.3)				
Home Ownership ^c								
Yes	16.2	(14.6-17.8)	32.1	(29.9-34.3)				
No	11.5	(9.2-14.3)	20.4	(17.1-24.1)				

^a Sample size 10 226 households; ^b Owning a car was asked only in 2011; ^c Owning a home was asked only in 2012

County Maps and Cats and Dogs by ZCTA

Rural areas of Honolulu County, Kaua'i, and Maui had higher percentages of cats in households. The Upcountry and Hāna areas on Maui Island had the highest percentages of cats in households. Dogs in households were highest in the Puna/ Ka'u area of Hawai'i County and the Kailua area of Honolulu County, **Figures 1 and 2**.

Adults Living with Cats and/or Dogs

Women were statistically more likely than men to be living with a CA. There were significant differences by age for adults. The highest percentages were for 35-74 years and the lowest for ages \geq 75. Although the data for ages \geq 75 years has a large enough sample size to present statistically, the sample may be skewed toward healthier adults, **Table 2**.

A higher percentage of married adults (34.0%) had dogs than all others (26.4%, P<.001). Adults with higher levels of education were associated with having a cat (P<.001). Whites had the highest percentage of cats (25.8%), and the Japanese (33.8%), and Whites (32.8%) had the highest percentages for dogs, **Table 2**.

Cats and Dogs and Selected Health Variables

Adults who rated their general health as excellent had the highest percentage of cats at 17.4%. The lowest likelihood of asthma was for men with cats compared to men without cats or dogs and women. Asthma was higher among women with cats and/or dogs (15.7, 16.1%, 16.8%) than women without (13.2%), **Table 3**.





Table 2. Percentage of Adults in Hawai'i Living with Cats and Dogs, Hawai'i Health Survey 2011 and 2012 Weighted Average							
Cat(s) and Dog(s)							
Demographic Variables	Cat(s)			Dog(s)			
	%	(95% CI)	Wald F <i>P</i> -Value	%	(95% CI)	Wald F <i>P</i> -Value	
All Adults	13.9	(12.9-15.0)		30.4	(28.9-32.0)		
Gender							
Men ^a	12.8	(11.3-14.4)	.034	27.9	(25.7-30.2)	.002	
Women	15.1	(13.7-16.6)		32.9	(30.8-35.0)		
Age							
18-34	12.4	(10.2-15.1)	-	30.5	(27.0-34.2)	<.001	
35-44	12.7	(10.1-15.8)		32.1	(28.0-36.5)		
45-54	16.2	(14.0-18.7)	<.001	36.8	(33.4-40.4)		
55-64	17.1	(15.2-19.1)		30.8	(28.3-33.4)		
65-74	14.9	(13.1-17.0)	_	25.8	(23.2-28.6)		
≥ 75°	9.6	(7.9-11.7)		19.1	(16.1-22.4)		
Marital Status	Marital Status						
Married	14.7	(13.4-16.2)	.11	34	(31.9-36.1)	<.001	
All Other ^a	13	(11.5-14.6)		26.4	(24.2-28.8)		
Education							
None-11th Grade	8.2	(5.6-11.9)		24	(18.9-30.0)	.165	
HS Grad/GED	11.4	(9.6-13.5)	<.001	30.3	(27.2-33.6)		
College 1->4 Years	15.7	(14.4-17.0)		31.1	(29.3-33.1)		
Age <25 Yearsª	13	(9.3-17.8)		31.8	(26.2-37.8)		
Ethnicity/ Race ^b							
Native Hawaiian	11.9	(9.6-14.5)		30	(26.6-33.7)	.031	
Filipino	6.8	(4.9-9.4)		25.6	(21.6-30.1)		
Japanese	10.4	(8.3-12.8)	<.001	33.8	(30.5-37.3)		
Chinese	7.8	(5.1-11.6)		25.2	(19.6-31.7)		
White	25.8	(23.2-28.5)		32.8	(30.0-35.8)		
Other Asian	5.6	(3.3-9.4)		27.5	(19.1-37.8)		
Other PI	5.4	(2.3-12.4)		21.6	(12.7-34.3)		
Other ^a	14.2	(10.8-18.5)		31.1	(25.2-37.7)		
Employment							
Employed	14	(12.6-15.4)	505	31.7	(29.7-33.9)	055	
Not Employed	15.9	(11.8-21.2)	525	31.3	(25.5-37.8)	.000	
Other ^a	13.3	(11.8-15.0)		27.9	(25.6-30.3)		

^a referent for Wald F P; ^b age adjusted value

Table 3. Percentage of Adults in Hawai'i Living with Cats and/or Dogs by General Health and Asthma Status, Hawai'i Health Survey 2011 and 2012 Weighted Average

Adults General Health Self-Reported	Cat(s) and Dog(s) by Adult General Health and Asthma							
	(Cat(s)		Dog(s)				
	Adj. %ª	(95% CI)	Adj. %ª	(95% CI)				
Excellent	17.4	(14.9-20.1)	29.4	(26.2-32.9)				
Very Good	15.2	(13.3-17.4)	30.6	(27.9-33.4)				
Good	11.8	(10.3-13.6)	31	(28.3-33.7)				
Fair	11.1	(8.5-14.3)	30.9	(26.4-35.7)				
Poor	14	(10.4-18.6)	29.7	(23.3-36.9)				
Asthma								
Companion Animals	Women		Men					
	Adj. % ^b	(95% CI)	Adj. % ^b	(95% CI)				
Total	14.7	(13.9-15.6)	12.1	(10.2-14.3)				
Cat and Dog	15.7	(12.8-18.9)	14.2	(10.3-19.2)				
Cat Only	16.1	(12.4-20.7)	4.3	(2.0-9.0)				
Dog Only	16.8	(15.0-18.8)	13.9	(11.7-16.4)				
No Cat or Dog	13.2	(11.3-15.4)	12.1	(9.9-14.7)				

^a age and sex adjusted; ^b age adjusted

Discussion

CA in Households in Hawai'i

The percentage of CA in households in Hawai'i at 39% was significantly lower than reported for the US (50%-67%).¹⁻⁵ The reasons may include the survey questions, state quarantine restrictions, fears concerning CA, and the high cost of living. The initial survey question asked about CA that spend at least some time inside; thus, exclusively outdoor CA may not be represented. Quarantine laws, designed to prevent the introduction of rabies in Hawai'i, may have affected the number of CA imported; however, quarantine is now waived for CA with required documentation.⁴¹

Patterns of CA in households were similar to the continental US, dogs were more prevalent than cats, and urban areas (Honolulu County) had fewer CA than more rural counties.^{1-6,42} The estimates of cats may be lower possibly because of myths surrounding cats as independent, aloof, evil, and bad luck (black cat).^{43,44} Interestingly, adults with higher education were significantly more likely to live with a cat than those with less education.

Single adult households had fewer CA compared to other household types, perhaps when the companionship of a cat or dog might be needed.^{1-4,45} Studies have shown that living alone after a heart attack is associated with a higher risk of health problems and death, than not living alone when the companionship of a CA may be of benefit.^{7,46}

This study includes data by ZCTA to aid in disaster planning for CA. The PETS Act, a federal law, requires plans for states and local municipalities, as well as non-profit organizations and private companies, to account for expenditures for household pets and service animals after a major disaster for reimbursement.⁴⁷ In addition, the Planning for Animal Wellness Act (PAW) requires the Federal Emergency Management Agency (FEMA) to form an advisory group to help plan for the needs of animals in disasters.^{48,49}

Patterns of CA for adults were similar to other US studies.^{5,45} Women had a significantly higher percentage of cats and dogs than men. Women and cats have been associated in art and literature, such as Cleopatra's cats, the myths of the crazy cat lady, and the Witch's black cat. Historically, women and cats may have relied on each other in a world when options were limited.^{50,51} The National Park Service, during the anti-suffrage movement, promoted women's role as a homemaker with their companion cat.⁵² Women were also significantly associated with the domestication of dogs as their emotionally supporting and loyal companions.⁵³

Older adults were less likely to have a CA, perhaps when animal companions are needed to improve health status and quality of life.^{54,55} In a retirement study, respondents with a CA considered them a friend.⁵⁶ Among older adults deciding on a retirement community, 70% reported the ability to have a CA as an important factor, as a CA provides "unconditional love".⁵⁴ However, disparities by ethnicity such as chronic conditions and poverty may affect the ability to have a CA for the elderly. Studies of

Native Hawaiians and Other Pacific Islanders (NHOPI) have reported higher chronic diseases, cardiovascular risk factors, cognitive decline, a significantly shorter life span, and higher poverty.⁵⁷⁻⁶¹Interestingly, in the present study, Native Hawaiians had a higher percentage of CA than Other Pacific Islanders but this did not reach statistical significance.

CA and Socioeconomic Variables

Financial resources were highly associated with having a CA: lower poverty, having a car, and a home were significantly associated with cats and dogs. In addition, having a dog or cat was associated with marriage and higher education status.^{4-5,45} The relationships of these variables may be an example of collinearity and future statistical analysis will provide more information.

Socioeconomic status may be especially relevant in Hawai'i given the higher cost of living.³⁷ Recognizing the problem of CA and poverty, the HIHS stated "Pets are family and no one should have to choose between a roof over their head or a pet."⁶²

CA and Ethnicity

The HHS provides data separately by Asian and NHOPI ethnicities, often combined in other studies.⁴² Among Asian groups, the Japanese had the highest percentages of living with dogs and cats. Native Hawaiians and Japanese had the highest percentage of cats among Asian and NHOPI ethnicities. Overall, Japanese and then Whites had the highest percentages of living with dogs. However, further studies are warranted. As reported elsewhere, the White ethnicity was significantly associated with cats.⁴⁵

CA and Health

Better overall general health was associated with having a cat. In contrast, studies have reported an association between CA and mental health indicators (reduced depression, anxiety, isolation, and loneliness), during COVID-19 but either no difference by species or dogs having a higher association than cats.^{63,64} Other research studies, with mixed results, point out the need for further investigations.^{56,64}

However, surveys of pet owners reported that 81% of adults with dogs and 83% of adults with cats felt that their dogs or cats provided companionship, love, company, and affection. Indeed, 59% of adults with dogs and 56% with cats say their CA is like a child or family member.⁶⁵

CA may reduce perceptions of stressful events by providing social support and counteracting other established risk factors such as smoking, elevated blood pressure, obesity, etc. CA may provide a buffering effect to threats (real or perceived).⁶⁶ Also, the benefits may extend to the CA.⁶⁷

Paradoxically, given the possible health benefits of CA on health, women with a CA reportedly have had a higher prevalence of asthma compared to men, as was the case in the present study, however, the association was not significant except for cats.²⁴ Men with cats had a significant decrease in asthma compared to the other groups for men and women. However, this association is complicated as cat exposure has been associated with rhinitis symptoms in men (not measured in the present study).68 Other studies have had mixed results and report complex associations (genetic, environmental, hormonal, etc.) with asthma. Additionally: exposure to CA or farm animals at an early age can be protective against developing asthma.69-73 Thus, sensitization not exposure may be an important factor in triggering asthma.71 Interestingly, a national survey found that 100% of homes sampled had dog allergens and 99.9% cat allergens, as the community may introduce allergens from CA.72,73

Other confounding variables may be poverty and/or smoking. Higher-income adults have had asthma triggers associated with CA but not lower-income adults.⁷⁴ Smoking (not included in the present study) may also be associated with asthma.⁶⁹ Future studies at the molecular level with asthma may further elucidate patterns associated with CA.^{72,73}

Difficulties in assessing the effects of CA on health include understanding the link or association. There may be an apparent link (cofactor associations), an indirect link (enhanced social interaction), or a direct link. Then there is the difficulty of defining health. A broader definition of health is needed, including further investigation of well-being and a sense of social integration.⁶⁶

Given the interconnectedness of humans and CA, uniting them under One Health has been proposed. The goals include providing new data and collaboration on the complex relationship among people, animals, plants, and their environment.²² Already the CDC has published information on possible zoonotic and infectious diseases associated with CA.⁷⁵ Given the increase in research and analysis the future should provide more definitive information on the benefits between humans and their CA[.]

Limitations

This study is cross-sectional thus, associations do not imply cause and effect. The questionnaire excluded households where pets spent all their time outdoors. Respondents without phones were not included. Health data were self-reported. Response rates for the HHS may be lower than surmised; however, they should be similar to the HBRFSS since they were conducted by the same vendor and on the same population (the rates of both surveys were similar in 2010). There may be selection bias as adults with CA may differ in characteristics from adults without.

Conclusions and Recommendations

The present study provides baseline data on CA in Hawai'i and associated variables with many patterns similar to those reported for the US. Having a CA was significantly associated with socio-economic indicators. Given the high cost of living, affordable housing allowing CA, and the cost of care many households do not have the resources for a CA.

The study revealed new data on CA ownership among Asian and NHOPI ethnicities. Among Asian ethnicities, Japanese had the highest association with dogs and cats in the household. Among Asian and NHOPI ethnicities, Native Hawaiians had the highest percentage of cats. CA associations with general health and asthma were not definitive. Future research could benefit from adding survey questions on CA to the HBRFSS, which already has detailed data on health, thus, enabling complex statistical analysis controlling on confounders (eg, poverty, ethnicity). Given the development of One Health, future research will elucidate the complex associations of humans and their CA.

Conflict of Interest

The author does not identify a conflict of interest.

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References

- US Pet Ownership Statistics 2018/2019. Daily Dog Stuff. Accessed November 30, 2019. https:// www.dailydogstuff.com/us-pet-ownership-statistics/
- Table of Contents. 2022 AVMA Pet Ownership and Demographics Sourcebook. Veterinary Economics Division, American Veterinary Medical Association. Published May 2022 Accessed May 2024. https://ebusiness.avma.org/files/ProductDownloads/eco-pet-demographic-report-22-toc-introduction.pdf
- 2014 US Pet Population and Ownership Trends 2019-2020: Dogs, Cats and Other Pets. Business Wire Research and Markets. Updated July 20, 2021. Accessed July 29, 2021. https://www.businesswire.com/news/home/20200720005393/en/US-Pet-Population-and-Ownership-Trends-2019-2020-Dogs-Cats-and-Other-Pets—ResearchAndMarkets.com
- Brulliard K, Clement S. How many Americans have pets? An investigation of fuzzy statistics. *The Washington Post.* Published January 31, 2019. Accessed November 5, 2020. https://www. washingtonpost.com/science/2019/01/31/how-many-americans-have-pets-an-investigationinto-fuzzy-statistics/
- Miller C. Pet Ownership Statistics. spots.com. Updated July 28, 2021. Accessed August 15, 2021. https://spots.com/pet-ownership-statistics#hawaii
- The State of U.S. Animal Sheltering, 2020 Research & Data. Best Friends Network Partners. Accessed December 23, 2023. https://network.bestfriends.org/research-data/research/stateus-animal-sheltering-2020

- Hunjan UG, Reddy J. Why companion animals are beneficial during the COVID-19 pandemic. J Patient Exp. 2020(4):430-432. https://doi.org/10.1177/2374373520938904
- Nieforth LO, O'Haire ME. The role of pets in managing uncertainty from COVID-19. Psychol Trauma. 2020;12(S1):S245-S246. https://doi.org/10.1037/tra0000678
- San Filippo M. National Pet Week is the perfect time to celebrate furry, feathered, or finned friends helping you through the COVID-19 crisis. American Veterinary Medical Association. 2020. Published May 4, 2020. Accessed August 10, 2020. https://www.avma.org/news/pressreleases/avma-national-pet-week-perfect-time-celebrate-furry-feathered-or-finned-friends
- McDowell B, Burns P, Lepczyk CA. Trends in Sheltering and Welfare at the Hawaiian Humane Society, Oahu, Hawaii. J Appl Anim Welf Sci. 2011;14(4):321-339. https://doi.org/10.1080/108 88705.2011.600660
- Hawai'i is one of the most pet-obsessed states in the US, study shows. All Home Connections. KITV 4 ABC Island News. Published June 25, 2019. Accessed August 5, 2019. https://www. kitv.com/story/40706906/hawaii-one-of-the-most-petobsessed-states-in-us-study
- Most Pet-Friendly States in America. Safewise. National. KHON2.com. Published June 7, 2019. Updated: June 10, 2019. Accessed August 5, 2019. https://www.khon2.com/news/national/ most-pet-friendly-states-in-america/2061332828/
- Nakamoto-White E. Lucky Fido lives in Hawaii? Not so much, a new ranking says. Hawaii News Now. Published June 19, 2019. Updated June 20, 2019. Accessed October 6, 2019. https:// www.hawaiinewsnow.com/2019/06/20/report-pets-islands-are-no-paradise/
- U.S. State Laws Rankings Report. Animal Protection. Animal Legal Defense Fund. Published January 2020. Accessed April 7, 2020. https://aldf.org/wp-content/uploads/2020/02/2019-Animal-Protection-US-State-Laws-Rankings-Report.pdf
- 15. Latest Pet Ownership and Spending Data from APPA Reveals Continued Strength of National Pet Industry in the Face of Economic Uncertainty. American Pet Products Association, Inc. Published March 23, 2023. Accessed January 2, 2024. https://www.americanpetproducts.org/ news/press-release/latest-pet-ownership-and-spending-data-from-appa-reveals-continuedstrength-of-national-pet-industry-in-the-face-of-economic-uncertainty
- Center for the Human-Animal Bond. Purdue University College of Veterinary Medicine. Purdue University. Accessed August 30, 2019. https://www.purdue.edu/vet/chab/
- Center to Study Human-Animal Relationships with Environments. University of Minnesota. Updated 2018. Accessed September 7, 2019. http://www.censhare.umn.edu/
- 18. Human Animal Bond Research Institute, HABRI. Accessed March 25, 2020. https://habri.org/
- Ways to Stay Healthy Around Animals. CDC Healthy Pets, Healthy People. National Center for Emerging and Zoonotic Infectious Diseases (NCEZID). Centers for Disease Control and Prevention._Updated November 8, 2023. Accessed January 8, 2024. https://www.cdc.gov/ healthypets/index.html
- Brooks HL, Rushton K, Lovell K, et al. The power of support from companion animals for people living with mental health problems: a systematic review and narrative synthesis of the evidence. *BMC Psychiatry*. 2008;18:31. https://doi.org/10.1186/s12888-018-1613-2
- Patto MV. Neurological perspectives on pets and the elderly: The truth about cats, dogs and grandparents. In: Pastorinho, M, Sousa A, eds. Pets as Sentinels, Forecasters and Promoters of Human Health. Springer, Cham. 2019:269-293. https://doi.org/10.1007/978-3-030-30734-9_12
- Amiot CE, Gagné C, Bastian B. Exploring the role of our contacts with pets in broadening concerns for animals, nature, and fellow humans: a representative study. Sci Rep. 2023;13(1):17079. Published 2023 Oct 10. https://doi.org/10.1038/s41598-023-43680-z
- One World, One Health: Building Interdisciplinary Bridges. Wildlife Conservation Society, Rockefeller University. September 29, 2004. New York City. Accessed April 20, 2023. https:// www.oneworldonehealth.org/sept2004/owoh_sept04.html
- Chowdhury NU, Guntur VP, Newcomb DC, Wechsler ME. Sex and gender in asthma. Eur Respir Rev. 2021;30(162):210067. https://doi.org/10.1183/16000617.0067-2021
- Toxoplasmosis: General FAQs. Source: Global Health, Division of Parasitic Diseases and Malaria. Centers for Disease Control and Prevention. Last Reviewed: December 1, 2022. Accessed January 2023. https://www.cdc.gov/parasites/toxoplasmosis/gen_info/faqs.html
- Hawaiian Humane Society Annual Report July 1, 2021 June 30, 2022. Hawaiian Humane Society. Accessed April 24, 2023. https://issuu.com/hawaiianhumane/docs/hhs_annual_report_2022_final
- NK Animal Advocates LLC. nØKill Network Links. 2023. Accessed March 30, 2023. https:// www.nokillnetwork.org/d/Hawaii/
- Humane Management of Community Cats. CatFriends. Accessed August 2020, https://www. hicatfriends.org/
- 29. Lāna'i Cat Sanctuary. Accessed January 15, 2021. https://lanaicatsanctuary.org
- Boone JD, Miller PS, Briggs JR, et al. A Long-Term Lens: Cumulative Impacts of Free-Roaming Cat Management Strategy and Intensity on Preventable Cat Mortalities. Front Vet Sci. 2019;6:238. https://doi.org/10.3389/fvets.2019.00238
- Vansandt LM, Meinsohn MC, Godin P. et al. Durable contraception in the female domestic cat using viral-vectored delivery of a feline anti-Müllerian hormone transgene. *Nat Commun.* 2023;14:3140. https://doi.org/10.1038/s41467-023-38721-0
- Kromer Baker K, Watters CA, Dannemiller JE, Iwamura ST, Brooks BA. Fish Consumption for the Adult Population of Hawai'i, Collected with a Self-Reported Household Survey. *Hawaii J Health Soc Welf*. 2020;79(2):51-59.
- Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System 2011 Summary Data Quality Report. Version #5 – Revised: 02/04/2013 25p. Accessed April 5, 2023. https://www.cdc.gov/brfss/annual_data/2011/pdf/2011_Summary_Data_Quality_Report.pdf
- Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System 2012 Summary Data Quality Report. Published July 3, 2013, 21p. Accessed April 5, 2023. https:// www.cdc.gov/brfss/annual_data/2012/pdf/SummaryDataQualityReport2012_20130712.pdf
- Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System 2010 Summary Data Quality Report (Version #1). Revised May 2, 2011. Accessed April 4, 2023. https://www.cdc.gov/brfss/annual_data/2010/pdf/2010_Summary_Data_Quality_Report.pdf
- Andridge RR, Little RJA. A review of hot deck imputation for survey non-response. Int Stat Rev. 2010;78(1):40–64. https://doi.org/10.1111/j.1751-5823.2010.00103.x

- 37. US Department of Health and Human Services. Poverty Guidelines, Accessed May 8, 2024. https://aspe.hhs.gov/topics/poverty-economic-mobility/poverty-guidelines
- 38 Ware J. Kosinski M. Keller SD. A 12-item short-form health survey: construction of scales and preliminary tests of reliability and validity. Med Care. 1996;34(3):220-33. https://doi. org/10.1097/00005650-199603000-00003
- 39. Izrael D. Hoaglin DC. Battaglia MP. To Rake or Not To Rake Is Not The Question Anymore with the Enhanced Raking Macro. SUGI Conference, May 2004. Montreal, Canada. Accessed January 10, 2020. https://support.sas.com/resources/papers/proceedings/proceedings/sugi29/207-29. pdf
- 40. Izrael D, Hoaglin DC, Battaglia MP.ASAS Macro for Balancing a Weighted Sample. Proceedings of the Twenty-Fifth Annual SAS Users Group International Conference. 2000:275. Accessed October 10, 2017. https://support.sas.com/resources/papers/proceedings/proceedings/ sugi25/25/st/25p258.pdf
- 41. Animal Quarantine Information Page (Updated). Animal Industry Division. State of Hawaii, Hawai'i Department of Agriculture. Accessed September 12, 2020. http://hdoa.hawaii.gov/ai/ ags/ags-info/
- 42. Strochak S, Goodman L, Zhu J. A housing survey reveals five trends about American pet owners. Urban Wire: Housing and Housing Finance. Urban Institute. Published October 3, 2018. Accessed February 20, 2020. https://www.urban.org/urban-wire/housing-survey-reveals-fivetrends-about-american-pet-owners
- 43. Cosgrove N. 18 Biggest Cat Myths & Misconceptions: Get the Facts Straight. PetKeen. Updated: January 22, 2024. Accessed February 20, 2024. https://petkeen.com/biggest-cat-myths-andmisconceptions/
- 44. Hanson H. Cats Aren't Evil: 5 Feline Myths That Just Aren't True. HuffPost News. 2020 Verizon Media. Published September 16, 2015. Updated September 18, 2015. Accessed October 15, 2020. https://www.huffpost.com/entry/cat-myths-stereotypes_n_55f97edae4b0d6492d63b616
- 45. Saunders J, Parast L, Babey SH, Miles JV. Exploring the differences between pet and non-pet owners: Implications for human-animal interaction research and policy. PloS ONE. 2017;12(6):e0179494. https://doi.org/10.1371/journal.pone.0179494
- 46. Kitamura T. Sakata Y. Nakatani D. et al. Living alone and risk of cardiovascular events following discharge after acute myocardial infarction in Japan. J Cardiol. 2013; 62:257-262. https://doi. org/10.1016/j.jjcc.2013.04.009
- Pets Evacuation and Transportation Standards Act (PDF). Office of Christopher Shavs. Published 47 September 2005. Retrieved August 30, 2007. Accessed May 29, 2024. https://www.congress. gov/109/plaws/publ308/PLAW-109publ308.pdf Titles - S.4205 - 117th Congress (2021-2022): PAW Act. (2022, October 17). Accessed May
- 48 29, 2024. https://www.congress.gov/bill/117th-congress/senate-bill/4205/titles
- United States. Federal Emergency Management Agency. FEMADisaster Program Information1 49. Federal Emergency https://www.fema.gov/
- 50. Szalavitz M. The Science of Women and Cats: The Bond Is Real. Men & Women. Time. Published February 11, 2011. Accessed February 15, 2021. https://healthland.time.com/2011/02/28/ the-science-of-cat-ladies-women-really-do-have-special-bonds-with-cats/
- 51. Horrell S, Oxley D. Gender bias in nineteenth-century England: Evidence from factory children. Econ Hum Biol. 2016;22:47-64. https://doi.org/10.1016/j.ehb.2016.03.006
- 52. Women's Suffrage and the Cat. National Park Service. Updated August 20, 2019. Accessed September 15, 2022. https://www.nps.gov/articles/womens-suffrage-and-the-cat.htm
- Ehlert A. Women's History Month: The Historical Role of Women. In The Domestication of Dogs. 53. Wild Earth. March 8, 2022. Accessed May 8, 2024. https://wildearth.com/blogs/the-wild-times/ the-historical-role-of-women-in-the-domestication-of-dogs/
- 54. Geber SZ, Pets Are Critical For Older Adults. Forbes. Published January 13, 2020. Accessed July 10, 2022. https://www.forbes.com/sites/sarazeffgeber/2020/01/13/pets-are-critical-forolder-adults/?sh=23005997107f
- Hughes MJ, Verreynne ML, Harpur P, Pachana NA. Companion Animals and Health in Older Populations: A Systematic Review. Clin Gerontol. 2020;43(4):365-377. https://doi.org/10.108 0/07317115 2019 1650863
- 56. Mueller, MK, Gee NR, Bures RM. Human-animal interaction as a social determinant of health: descriptive findings from the health and retirement study. BMC Public Health. 2018;18(1):305. https://doi.org/10.1186/s12889-018-5188-0

- 57. Hawaii Health Survey (HHS) 2012 Survey Report Data (Tables and Figures) Hawaii Department of Health. Accessed September 15, 2022. https://health.hawaii.gov/hhs/hawaii-health-survey-2012/
- 58 Ganbat U, Wu YY. Disparities of subjective cognitive decline among Native Hawaiians/Other Pacific Islanders, Asian Americans, and White Americans in Hawai'i: Behavioral Risk Factor Surveillance System 2015 and 2017. Asia Pac J Public Health. 2021 Jul;33(5):587-594. https:// doi.org/10.1177/10105395211020902
- Wu Y, Braun K, Onaka AT, Horiuchi BY, Tottori CJ, Wilkens L. Life Expectancies in Hawai'i: A 59 Multi-ethnic Analysis of 2010 Life Tables. Hawaii J Med Public Health. 2017;76(1):9-14.
- 60 Lim S. Mohaimin S. Min D. et al. Alzheimer's disease and its related dementias among Asian Americans, Native Hawaiians, and Pacific Islanders: A scoping review. J Alzheimers Dis. 2020;77(2):523-537. https://doi.org/10.3233/JAD-200509
- 61. 2013-2017 American Community Survey 5-year Public Use Microdata Samples [SAS Data file]. Retrieved from Table B17020E Poverty Status in the Past 12 Months by Age (Native Hawaiian and Other Pacific Islander Alone): People 65+ Living Below Poverty Level by Race/Ethnicity State: Hawaii. U.S. Census Bureau. (2022). Accessed September 9, 2022. https://data.census gov/cedsci
- Hawaiian Humane Society. Accessed March 15, 2017. https://hawaiianhumane.org/ 62.
- Kogan LR, Currin-McCulloch J, Bussolari C, Packman W, Erdman P. The psychosocial influence 63 of companion animals on positive and negative affect during the COVID-19 pandemic. Animals (Basel). 2021;11(7):2084. https://doi.org/10.3390/ani11072084
- Scoresby KJ, Strand EB, Ng Z. et al. Pet ownership and quality of life: A systematic review of the literature. Vet. Sci. 2021;8(12):332. https://doi.org/10.3390/vetsci8120332
- Springer, J. The 2017-2018 APPA National Pet Owners Survey Debut. 2017-2018 APPA National 65. Pet Owners Survey. The American Pet Products Association, Inc. Accessed January 6, 2024. https://www.almendron.com/tribuna/wp-content/uploads/2018/06/gpe2017-npos-seminar.pdf
- 66 McNicholas J, Gilbey A., Rennie A, Ahmedzai S, Dono JA, Ormerod E. Pet ownership and human health: a brief review of evidence and issues. BMJ. 2005;331(7527):1252-4. doi:10.1136/ bmi.331.7527.1252
- Rault J-L, Waiblinger S. Boivin X, Hemsworth P. The power of a positive human-animal relationship for animal welfare. Front Vet Sci. 2020:7. https://doi.org/10.3389/fvets.2020.590867
- 68 Shargorodsky J, Garcia-Esquinas E, Umanskiy R, Navas-Acien A, Lin SY. Household pet exposure, allergic sensitization, and rhinitis in the U.S. population. Int Forum Allergy Rhinol. 2017;7(7):645-651. https://doi.org/10.1002/alr.21929
- Gasana J, Ibrahimou B, Albatineh AN, Al-Zoughool M, Zein D. Exposures in the indoor envi-69 ronment and prevalence of allergic conditions in the United States of America. J Environ Res Public Health. 2021;18(9):4945. https://doi.org/10.3390/ijerph18094945
- Fall T, Lundholm C, Örtqvist AK, et al. Early exposure to dogs and farm animals and the risk 70 of childhood asthma. JAMA Pediatr. 2015;169(11):e153219. https://doi.org/10.1001/jamapediatrics 2015 3219
- Gergen PJ, Mitchell HE, Calatroni A, et al. Sensitization and exposure to pets: the effect on 71 asthma morbidity in the US population. J Allergy Clin Immunol Pract. 2018;2(1):101-107.e2. https://doi.org/10.1016/j.jaip.2017.05.019
- Arbes SJ Jr, Cohn RD, Yin M, Muilenberg ML, Friedman W, Zeldin DC. Dog allergen (Can f 1) 72. and cat allergen (Fel d 1) in US homes: results from the National Survey of Lead and Allergens in Housing. JAllergy Clin Immunol. 2004;114:111-117. https://doi.org/10.1016/j.jaci.2004.04.036
- Schoos AMM, Nwaru B, Magnus P. Component-resolved diagnostics in pet allergy: Current perspectives and future directions. J Allergy Clin Immunol. 2021;147(4):164-173. https://doi. org/10.1016/j.jaci.2020.12.64093
- Mendy A, Wilkerson J, Salo PM. et al. Endotoxin clustering with allergens in house dust and asthma outcomes in a US national study. Environ Health. 2020;19:35. https://doi.org/10.1186/ s12940-020-00585-v
- About One Health. One Health. Centers for Disease Control and Prevention. Published February 29, 2024. Accessed May 25, 2024. https://www.cdc.gov/onehealth/index.html