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Dogs, Cats and Asthma: Will We Ever Really Know the True Risks and Benefits?

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Early in our medical careers many of us were told that allergies “cause” asthma. However, we probably also heard, usually from a pulmonologist, that there was no scientific evidence demonstrating a causal link between allergies and asthma. After years of study why is the relationship between allergies and asthma still debated?¹

An important challenge in understanding the relationship of allergic sensitization to asthma is our broadening understanding of the complex interactions among many variables which ultimately lead to an abnormally responsive lung. Lung hyperresponsiveness appears to be the final common pathway responsible for the various symptoms we cluster together for a diagnosis of asthma. Efforts to understand the different pathophysiological processes responsible for pulmonary hyperactivity have led to the concept of asthma phenotypes or underlying endotypes.² Among the recognized phenotypes, allergic asthma appears to be the most common.³ Allergic asthma is typically defined by an observed association between asthma symptoms and exposure to an airborne allergen when IgE antibodies specific for the same allergen can be demonstrated. However, studying the relationships between allergen exposure and asthma in humans is difficult. The large number of exposure, genetic and behavior variables to be considered requires studying large numbers of participants to obtain adequate statistical power, but as the number of participants increases, the feasibility of obtaining uniform, detailed, medical histories relating allergen exposures to asthma symptoms typically declines. Allergen exposures in chambers or by bronchial challenge are criticized as having allergen doses substantially larger than the estimated exposures in normal environments. Even the correlation of allergen-specific IgE antibodies to asthma has become increasingly complex. Several studies have shown that simply classifying a person as atopic based on a single specific IgE test grossly over simplifies the patterns of allergic sensitization present among individuals.⁴ Others have shown that the relationships of allergen-specific IgE to allergic reactions depends upon the concentrations of IgG antibodies of the same specificities.⁵

Perhaps the clearest example of allergic sensitivity causing asthma is provided by the study of occupational asthma. When non-sensitized workers begin a new job and become exposed to a new allergen, some individuals will develop allergic sensitization and then begin to have typical asthma symptoms. Prompt removal of affected workers from the workplace will reduce symptoms and lead to resolution of asthma in some workers.⁶ Again, the argument against occupational asthma proving the link between allergy and asthma are the unusually high airborne concentrations of allergens typical of risky occupational settings.

To better define the relationship of allergic sensitization to asthma a study needs a large number of participants living in normal home environments prospectively followed over many years. Ideally the home environments would only have a potentially sensitizing level of exposure to one allergen. In this issue, Perzanowski and colleagues have taken advantage of a large cohort (3,430 children) living in the relatively unique home environments of northern Sweden to further investigate the relationship of allergy to asthma.⁷ The cities where the participants lived, Kiruna and Lulea, are located just above and below the Arctic Circle (currently, 66°33'46.6"N) or slightly further north than Fairbanks, AK. Because of the heating required during the prolonged winters there are virtually no dust mites or cockroaches making dogs and cats the only major sources of persistent indoor allergens. The investigators found that the concurrent concentrations of cat- and dog-specific IgE antibodies were strongly related to the prevalence and severity of asthma among the participants at 19 years-of-age. Increasing concentrations of cat- and dog-specific IgE were associated with increasing prevalence and severity of asthma. Interestingly, while the prevalences of sensitization to cat and dog were nearly equal, the odd ratios for asthma were noticeably higher when current dog IgE was >17.5 IU/ml than when cat IgE was above this concentration. The collinearity between cat- and dog-specific IgE antibody concentrations made it impossible to statistically answer the question of whether cat or dog IgE was more strongly related to asthma. However, multivariable analysis showed that cat and dog

specific IgE were each more strongly related to asthma than grass or birch pollen IgE. The strong associations between the concentrations of antibodies and asthma was repeatedly seen whether the outcome was physician diagnosed asthma, current asthma, asthma medication use or wheezing episodes. Analysis of IgE concentrations to specific cat and dog allergen components resulted in even greater odds ratios for asthma. When the intercorrelations between IgE responses to the four dog and three cat allergen components were calculated the greatest correlation was between Can f 3 and Fel d 2 which are both serum albumins having similar structures. The correlation between the cat (Fel d 4) and dog (Can f 2) lipocalins was modest.

The results of the current study are similar to the previous study of the relationship of cat allergy to asthma among children residing in the dry, high-altitude, environment of Los Alamos, NM.⁸ Los Alamos was chosen for study because the dry climate and elevation combined to make homes virtually free of dust mites and cockroaches. Asthma was ascertained by questionnaire, spirometry, and histamine challenge and allergic sensitization was ascertained by skin testing. Unfortunately, dog extract was not included among the skin tests. When children (n=16) both sensitized and exposed to high cat allergen concentrations (>10 µg Fel d 1/g dust) were compared to the 90 children without asthma the odds ratio of cat sensitivity associated asthma was 6.2 (95% CI, 2.2 to 17.6, p<0.001). However, even for children who had always resided in the relatively dust mite- and cockroach-free environment of Los Alamos, sensitization to these perennial allergens was found in some children.

Both the current and Los Alamos studies found that cat and dog allergen concentrations were relatively high even in homes without a resident animal. These findings are consistent with other studies showing that animal allergens are distributed to homes, schools and public buildings where animals are not resident by adhering to the clothing of pet owners.⁹ Indeed the current

study found that of those participants with high concentrations of IgE antibodies to cat, 85% did not have a cat in the home and 48% did not have either a cat or dog in the home.

Unfortunately, the current study in Sweden did not enroll children until they were 7 or 8 years-of-age. Most studies that have shown a protective effect on allergic disease risk from cat and dog exposure have shown that the protective effect depends upon pet exposure during the first year of life. Some of these “pet protective” studies suggest that cats and dogs alter the home microbiome (resident populations of various bacterial, fungal, and viral organisms) and that exposure of children in the home to the microbes associated with cats and dogs, reduces their risks of becoming allergic and developing asthma.¹⁰ An important but unanswered question is the source of the risk-reducing microbes associated with cats and dogs in homes. The organisms may be the animal’s commensal microbes or they may be microbes from soil or other outdoor sources that adhere to the animal and are carried into and deposited in the home. If the reduced risk of allergy associated with pets is related to transport of outdoor microbes, the unique climate of northern Sweden might show dramatically different home microbial communities associated with resident cats and dogs. The low humidity of homes during long winters might also substantially affect home microbial communities. Studying the microbiomes of homes with and without cats and dogs throughout a year in northern Sweden would likely be highly revealing.

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