Pro: Pets Prevent Allergies

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Disclosures

• In the past year I have been:
  – Advisory board, Merck Childhood Asthma Network
• No discussion of off label drug use
• Research Support: National Institutes of Health
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Evidence that an Association is the Result of Cause and Effect

1. Temporality – required!
2. Strength
3. Dose-response
4. Consistency
5. Biologic plausibility
6. Specificity – least important
7. Analogy

Temporality – required!

• Pet exposure must have occurred prior to allergic disease outcome
• Most of the literature suggests that exposure must occur in early life for effect
• Critical “window” of exposure
  – 1st year of life or earlier
Strength of Relationship

• Stronger relationships are more likely to be related

• Pet and allergic outcomes typically show a risk reduction of ~20-30% (Odds ratios of 0.7-0.8)
  – Moderate strength
Dose-response

• How to assess a dose-response relationship with pets and allergies
• Number of pets
• Size of pets
• Variety of pets
• Few studies have evaluated variables related to “dose” of pet exposure
Consistency

• Have multiple studies provided similar outcomes
• Meta-analyses of pet studies
• Meta-analyses of other animal exposures
• Studies of other potentially related exposures
Meta-analysis of Farm & Pet Exposure vs Allergy Risk

Tse K, Horner AJ. Seminar Immunopath 2008;30:53-62
Does Pet Ownership in Infancy Lead to Asthma or Allergy at School Age? Pooled Analysis of Individual Participant Data from 11 European Birth Cohorts

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Abstract

Conclusions: Pet ownership in early life did not appear to either increase or reduce the risk of asthma or allergic rhinitis symptoms in children aged 6–10. Advice from health care practitioners to avoid or to specifically acquire pets for primary prevention of asthma or allergic rhinitis in children should not be given.

Plos One 2012;7:e43214
European Birth Cohorts Combined

• Outcome = allergic sensitization
• Cat vs no pet = 0.87 (0.73, 1.04)
• Dog vs no pet = 0.65 (0.45, 0.95)
• Dat & dog vs no pet = 0.68 (0.40, 1.18)
  – Very consistent with other meta-analyses
• Many differences between studies and outcome measures

Plos One 2012;7:e43214
Common Features of Published Studies

- Exposure impact of animals only in 1st year of life
- Farm animals and household pets have similar effects
- Reduced risk is not allergen specific
- Animal exposure alters risk of other diseases of immune dysregulation e.g. Th1 diseases – IBD
Common Features of Published Studies

• Impact does not correlate well with
  – Animal allergen concentration
  – Endotoxin concentration
  – Muramic acid concentration

• Effects of C-section versus vaginal delivery
  – Exposure to maternal microbiota
Biologic plausibility

- Pets = germs = hygiene hypothesis
- Pets = intense allergen exposure
- Pets = altered microbiome
Specificity

• Early exposure to pets decreases the risk of immunologic diseases related to inadequate immune regulation
Analogy

• Early exposure to pets shares features of early exposure to farm animals
  – Less risk of allergic disease
• Early exposure to pets shares features of growing up in less well developed countries
  – Less risk of allergic disease
• Early exposure to pets shares features of growing up with older siblings
  – Less risk of allergic disease
Drinking Water Microbes and Atopy

- 563 children, 7-16 years, living in Finnish- and Russian-Karelia
- Skin prick tested with 14 common allergens and foods
- Finnish children significantly more sensitization – 48% vs 16%
- Multivariable analysis – sex, cat < 1 yr, microbes in water

Farm Animals, Cats, Dogs and the Gut Microbiome (Microbiota) Hypothesis

• Gut microbiota develops rapidly in infancy but not fully developed until ~ 18 months
• Infant gut microbiota highly dependent upon maternal gut microbiota
• 14 of 17 observational studies show differences in gut microbiota in allergic and non-allergic children or their symptoms

Our Conceptual Model of How Pets Influence Allergic Disease

- Household Characteristics
- Microbial Community Composition In Home
- Prenatal Immune Status
- Baby’s Genotype, Season, SES, Upper Resp Infect, Antibiotics, Diet, Activity, Pets, Other Children, Pollutants, Stress
- Early Immune Response & Development
- Persistent Immune Response Phenotype
- Allergic Asthma
Wayne County Health Environment Allergy and Asthma Longitudinal Study = WHEALS

- Goal: detailed examination of household pets on allergy risk
  - 1st year of life
  - Endotoxin
  - Antibiotics
- Diverse cohort
  - Socioeconomic status
  - Race
  - Urban versus suburban residence
- Large sample size
Do Pets Alter Home Dust Microbiome

• 18 house dust samples WHEALS
• 6 ≥ 1 dogs, 6 ≥ 1 cat, 6 without pets
• PhyloChip analysis of microbial taxa present
  – Insufficient DNA in 2 dust samples
• Homes with dogs
  – More types of bacteria present, richer, p < .04
  – More diverse, p < .04

Do Pets Alter Home Dust Microbiome

- 337 bacterial taxa significantly increased in dog-owning homes
  - Proteobacteria (112 taxa)
  - Actinobacteria (63 taxa)
  - Firmicutes (47 taxa)
  - Bacteroidetes (41 taxa)
  - Spirochaetes (22 taxa)
  - Verrucomicrobia (7 taxa)
- These are phyla common in the human gastrointestinal tract

Trajectory Of Total IgE By Prenatal Pet Status

WHEALS

IgE decreased 28% with pets
(p<0.001, adjusted for sex and race)

Trajectory Of Total IgE By Prenatal Pet Status
WHEALS

Conclusion

• Current studies meet all of the criteria proposed by A. B. Hill for a cause and effect relationship between pet exposure and reduced risk of allergic sensitization

• Increasing evidence of a profound impact of the microbiome on immune development
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