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Original Research Article

The Relationship between Pet Ownership and Exploring IgE Mediated Immune Response

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Abstract: ***Background*:** Research on allergy disease has focused a lot of emphasis on pet exposure as a possible risk or protective factor. The prevalence in owning pets, especially dogs, cats, and birds, has significantly increased in recent decades. This study's goal was to look at any possible effects that pet exposure might have on IgE levels. ***Methodology***: A total of 60 participants were enrolled, including 15 healthy controls who had no contact with any pets (neither birds nor cats). Pet owners made up the remaining 45 subjects (exposed to pets). The fluorecare system measures total IgE. ***Results*:** The results of this study showed that the median concentrations of total IgE were significantly higher ($p \leq 0.05$) in pet-exposed individuals (168.40 IU/mL; IQR: 41.5-112) than in the non-pet-exposed group (44.50 IU/mL; IQR: 34-64.50). Group 1 (one pet owner) had the lowest total IgE concentrations among the three groups, with a median of 89.20 IU/mL (IQR: 17.47–128.41), and group 1 (cat owner) had the lowest median level of IgE, 134.06 IU/mL (29.12-405), despite the data showing a statistically significant difference ($p \leq 0.05$) in total IgE concentrations among the groups based on the number of pets. ***Conclusion***: The kind of pet exposure plays a major role in determining IgE concentrations. This implies that there is an additive effect of allergens on sensitization to the allergens, thus resulting in higher allergic sensitization.

Keywords: *Pet Exposure, Total IgE, Cats Owner, Birds Owner*.

INTRODUCTION

Over the past ten years the ownership of pets has increased at an unprecedented rate, especially in major urban communities where a pet provides psychological and social support to humans. The benefits of pet ownership such as the significant stress, loneliness reduction and the positive contributions to general mental health are well-established, but living with these animals in a home setting has also been associated with some negative health effects, primarily allergic diseases [1]. A large percentage of people worldwide are sensitized to pet protein allergens, which also pose a serious risk of developing long-term respiratory conditions like asthma and allergic rhinitis. The relationship between domestic animals and allergy sensitization is complicated and depends on a number of variables, such as the type of domestic animal, the amount and length of interaction with domestic animals, environmental elements including humidity and proper ventilation, and atopy propensity [2].

From a technical perspective, pet allergy is an immune system response that is exaggerated and inappropriate to a particular protein that is present in the dander, saliva, and urine of animals. These proteins act as allergens, capable of inducing a Type 1 hypersensitivity response when they are inhaled or from contact with sensitized individuals. The immune system typically does not react to these benign proteins and this reaction is the first step in the immune system's response to them, during which allergen-specific immunoglobulin E (IgE) antibody production occurs. The FcεRI receptors on the surface of mast cells and basophils are highly attracted to these IgE molecules. The allergen will attach to the bound IgE upon subsequent exposure, causing an instantaneous release of inflammatory mediators such as prostaglandins, histamine, and leukotrienes [3]. With this release, symptoms like sneezing, nasal congestion, ocular irritation and skin rashes occur

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instantaneously. Under more severe conditions these mediators can precipitate bronchoconstriction, acute exacerbations of asthma [4].

The major source of indoor animal allergens is cats and dogs. Fel d 1, a member of the secretoglobin family, is the major allergen in cats. It is secreted primarily by the salivary glands and the sebaceous glands, is minute, and highly buoyant so that it remains in the air for long periods and adheres readily to different surfaces [5]. This facilitates them a cross-diffusion enhancing their presence ubiquitously, even where cats are not. The allergen profile is in dogs highly diverse, at least Can f 1 and Can f2 (lipocalins) are the most prominent. In addition, an allergen Can f 5, produced by male dogs, a prostatic kallikrein, was found and may indicate possible management, for sensitized individuals, to recommend female dogs. With the introduction of component-resolved diagnostics (CRD), it has become feasible to differentiate true sensitization from a specific animal from cross reactivity from structural cross reactivity of a specific protein, in this case serum albumins among different species [6].

The 'Hygiene Hypothesis' posits that a wide spectrum of microbes and animal-derived antigens influences the developing immune system and may provide a benign pathway to immune regulation that affords protection against subsequent development of allergies. According to this theory the exposures activate the innate immune system and facilitate a balance in the T-helper cell (Th2) response away from the pro-allergic Th2 phenotype towards a Th1 or regulatory T cell (Treg) response [7]. However, longitudinal birth cohort studies have shown that being raised by a dog in childhood or on farms lowers the likelihood of allergic sensitization and asthma [8]. However, pet exposure's protective effect is not universal, can depend on timing of exposure, and genetic makeup. For example, even those individuals that are highly exposed can develop sensitization and children born into a strong family history of atopy may develop sensitization despite early exposure, implying that there are complex gene-environmental interactions involved.

Furry pets are the most frequent source for allergenic exposure, but so are avian. Furry pets are the most frequent sources of allergenic exposure, as are avian, but the latter is often overlooked. Parrots, canaries, or pigeons may harbor subjects to avian antigen in their droppings, feathers, and "bird bloom" (powder down). With cats and dogs, exposure to these antigens causes an appropriate IgE-mediated response; however, repeated exposure to avian antigens can cause Hypersensitivity Pneumonitis (HP), “Bird Fancier's Lung” [10]. In this disease there is a more complex immunopathological process including Type III and Type IV (immune complex-mediated and cell-mediated) hypersensitivity reactions. If exposure persists, then chronic inhalation of these proteins can result in granulomatous inflammation of the alveoli and terminal bronchioles which may eventually produce irreversible pulmonary fibrosis and cause severe pulmonary dysfunction [11].

One common misconception about dogs is that there are "hypoallergenic" breeds which will not elicit allergies. But scientific evidence has demonstrated that there are no “hypoallergenic” cat or dog breeds. Research involving measurements of allergen concentrations in homes with a "hypoallergenic" breed versus a traditional breed has shown no significant differences for the major allergens in the home environment, such as Can f 1 [12]. Coat type or shedding habits do not determine the amount of allergens a dog or cat secrete, all dogs and cats release allergens through their skin and saliva. In addition, pet allergens are common environmental pollutants that can be carried on individuals' clothing and fur to other areas like workplaces, schools, and public transit and may even induce symptoms in highly sensitive people who do not even own a pet [13].

Advancements in treatment and diagnostics on a molecular level have revolutionized the management of pet allergies. Component resolved diagnostics would help to better define a patient's sensitization profile and therefore the clinical relevance of the allergy and the future outcome of treatment [14]. The only treatment that can alter the course of a pet allergy is allergen-specific immunotherapy (AIT). AIT is a method that produces immunological tolerance by progressively raising the allergen dosage. The transition from a Th2 to a Th1/Treg response, the generation of "blocking" IgG4 antibodies, and the inhibition of IgE-mediated mast cell degranulation are its hallmarks. Enhancing the safety and effectiveness of AIT for patients with pet allergies is being accomplished through the development of effective and secure delivery mechanisms and the research of recombinant allergens [15]. The widespread nature of animal allergens and the rise in pet ownership places emphasis on the need for a greater understanding of how much the change in the immune system that causes sensitization is influenced by these and other environmental factors. Given the increasing prevalence of widespread allergic diseases around the world, it is crucial to elucidate the mechanisms by which pet exposure impacts immune pathways in order to find preventive and therapeutic measures. The objective of this study was to determine whether there is a potential correlation between the level of IgE and pet exposure.

METHODOLOGY

Study Design and Participants Selection

Participants were recruited from October 2024 to April 2025. There were 60 participants in all, with a mean age of 22.6 years, including 15 healthy controls who were not exposed to any pets (cats or birds) between the ages of (18-25).

The remaining 45 participants, whose ages ranged from (17-24), were pet owners (exposed to pets). Depending on the length of pet exposure, the pet-exposed group (n=45) was further split into three equal subgroups (n=15) per subgroup across three different variables: Group 1: <1 year; Group 2: (1–2) years; and Group 3: >2 years. Additionally, Group 1 has one pet, Group 3 has two to three pets, and Group 3 has more than three pets. Additionally, based on the kind of pet, Group 1 consists of cat owners, whereas Group 3 consists of bird owners. Group 3: Those who own both birds and cats. Participants' responses to questions about duration (number of pets), animal type (cat, bird, or both), length (number of years), and whether the animals were primarily kept indoors, outdoors, or both provided information on pet ownership and non-ownership.

Inclusion Criteria

Young adults (17-25 years) were included in this study, and split into two categories: a control (15 normal young adults) and an experimental group (45 young adults who own a pet). The inclusion criteria were the persons owning cats, the persons owning birds, the persons owning both, according to the number of animals (one to more than three), and the duration of exposure (less than one year, one to two years and more than two years). This was performed to determine the concentration of IgE antibodies involved in allergy against this species of particular plants.

Exclusion Criteria

Exclusion criteria was mainly weight loss, with the aim to exclude people out of the age range of interest (17-25 years). Within the control group, people with previous contact with pets, cats or birds, were excluded to allow for accurate comparisons to be made. When a control group is described as "healthy", it also means that those who do not have chronic pathological factors or immune disorders influencing the assessment of IgE level and for whom we lack sufficient information about the way and place of animal rearing (indoors or outdoors) have been excluded from the study sample to ensure homogenous study samples.

Samples Collection

Samples of blood were withdrawn by venipuncture from (60) participants. Five ml of blood sample was aspirated using a sterile syringe. The blood sample was then transferred into a sterile plain tube, where the clotting process occurred. This procedure was followed by centrifuging the sample at 4000 RPM for 15 minutes to obtain the serum which was subsequently frozen at -20 ºC before measuring the concentration of total IgE.

Measurement of Total IgE Concentrations

Microprofit Bio-tech in Shenzhen provided the Flourecare total IgE diagnostic kit. Based on the immunochromatographic principle, the automated immunoassay analyzer fluorecare® MF-T1000 (Flourecare, China) uses the double antibody sandwich approach to determine the amount of total IgE in human serum or plasma.

Statistical Analysis

The Shapiro-Wilk and Kolmogorov-Smirnov tests were carried out to establish whether the serum levels of IgE were normally distributed. Since the levels of IgE were found to be not normally distributed, the level was reported as a median and IQR (25-75%). The Mann-Whitney U-test (for comparing two groups) or the Kruskal-Wallis test (for comparing more than two groups) were employed to determine whether there were significant differences between medians. A significant probability (p) value was defined as ≤ 0.05. These studies were carried out using IBM SPSS version 25.0, a statistical program.

RESULTS

The results of this study showed that the median concentrations of total IgE were significantly higher ($p<0.05$) in the pet-exposed group (168.40 IU/mL; IQR: 41.5-112) than in the pet-non-exposed group (44.50 IU/mL; IQR: 34-64.50), as shown in (Table 1).

Table 1: Median levels of serum Total IgE between pet exposure people and pet non exposure

Parameters	Groups	N	Median (IQR: 25 – 75%)	*p*- value
Total IgE IU/mL	Exposed pet	45	168.40 (41.5-112)	0.004*
	Non exposed pet	15	44.50 (34-64.50)	

*p ≤0.05= considered statistically significant, n= number of samples, IQR=interquartile range, IU/mL= International unit per milliliter, IQR: interquartile range

There were no statistically significant changes in total IgE levels between the groups according to the length of pet exposure, as shown in (Table 2) ($p > 0.05$).

Table 2: Median level of Total IgE IU/L in the sera of pet exposure people according to the duration of pet exposure

Parameters	Groups	N	Median (IQR: 25 – 75%)	*p*- value
Total IgE IU/mL	Group1	15	284.69 (16.98-917.25)	0.107
	Group2	15	209.50 (116.10-701.56)	
	Group3	15	141.71 (82.28-389.37)	

Group 1 :<1 year; Group 2: 1–2 years, Group 3: >2 years, n= number of sample

The results in Table 3 demonstrated a statistically significant difference ($p \leq 0.05$) in total IgE concentrations across the groups, indicating that having more pets is associated with higher total IgE levels. With a median of 89.20 IU/mL (IQR: 17.47–128.41), Group 1 exhibited the lowest total IgE of the three groups. Group 2's median IgE level increased to 197.03 IU/mL (IQR: 50.59–843.34). Group 3 exhibited the highest IgE levels, with a median of 310.79 IU/mL (IQR: 161.35–701.56). These findings suggest that having more pets in the home is positively correlated with higher IgE levels. This could be because having more animals in the home increases exposure to allergens or strengthens the immune system.

Table 3: Median level of Total IgE IU/L in the sera of pet exposure people according to number of pets

Parameters	Groups	N	Median (IQR: 25 – 75%)	*p*- value
Total IgE IU/mL	Group1	15	89.20 (17.47- 128.41)	0.001*
	Group2	15	197.03 (50.59-843.34)	
	Group3	15	310.79 (161.35-701.56)	

Group 1: one pet; Group 2 :(2-3) pets; Group 3: more than three pets, *= Significant difference at ($p \leq 0.05$), n= number of samples, IQR=interquartile range

The total serum IgE of the study groups varied statistically significantly ($p \leq 0.05$) according to the type of pet exposure (Table 4). The data showed that Group 1 had the lowest median level of IgE (134.06 (IQR 29.12-405) IU/mL). Group 2 (bird owners), on the other hand, had a higher median IgE level of 282.00 (IQR 115-868) IU/m. The highest levels of IgE (436.90 IQR 161.35-701.56) IU/mL were found in participants who were exposed to cats and birds. This suggests that numerous pet exposures may have a cumulative or synergistic effect on allergic sensitization.

Table 4: Median level of Total IgE IU/L in the sera of pet exposure people according to type of pet

Parameters	Groups	N	Median (IQR: 25 – 75%)	*p*- value
Total IgE IU/mL	Group1	15	134.06 (29.12-405)	0.009*
	Group2	15	282(115-868)	
	Group3	15	436.90 (161.35-701.56)	

Group 1: Cat owners; Group2: Bird owners: Group 3: Owners of both (cats and birds), *= Significant difference at ($p \leq 0.05$), n= number of sample, IQR=interquartile range

DISCUSSION

The present study the current research, it was observed that there was a marked elevation ($p \leq 0.05$) in the levels of total IgE among people exposed to pets when compared to those not exposed to pets. This could be explained by the immune response to allergens produced by animals. The elevated level of IgE is caused by sensitization to pet allergens. Cats, dogs, and birds are animals that produce allergens such as Fel d 1, Can f 1, and bird allergens, respectively. This sensitization happens when the immune system detects a threat due to pet proteins and thus activates B cells that release IgE antibodies. These antibodies selectively and avidly bind to high-affinity receptors on mast cells and basophils, resulting in mediators of inflammation being released on the next occasion of challenge [16, 17].

Once inhaled or introduced to the skin, these allergens may trigger an immune response resulting in the production of IgE antibodies against the allergens [18, 19]. The people owning a pet are continuously exposed to airborne allergens from the pets, which could even be found on the furniture, carpets, clothes, and could even be transported to places without any pets through clothing or fur [20]. The prolonged exposure to these allergens causes continuous activation of the immune system; hence, maintaining high total and allergen-specific IgE [21]. People who do not have pets around usually do not have a sensitivity towards these allergens, and hence their specific pet allergen antibodies are either negligible or absent. The total antibodies could only be high if they were sensitive towards other allergens such as pollen or dust mites [22]. The results of this study have shown that the IgE was highest in the subjects who owned both cats and birds compared to those exposed to one animal only. These findings support the hypothesis that individuals are at greater risk for allergy problems if they have been exposed to more than one allergen. Simultaneous exposure to several allergens has been shown to have an additive effect on multisensitized immune cells [23]. Moreover it has been noted that some proteins found in birds are very similar to proteins found in mammalian serum albumins, and so can be quite highly cross-reactive, and this will enhance the overall IgE response [24, 25]. The reasons for this finding can be discussed from the immunological

perspective and through different environmental explanations. First, it can be hypothesized that when there are two allergens at once, the activation of the immune response becomes additive or even synergistic. Cats contain protein allergens called Fel d 1, while birds generate certain proteins contained in their feathers and droppings [26]. As a result, the level of IgE becomes much higher, and the immune response causes inflammation.

There are proteins in cat and bird allergens that might share similar structure called epitopes, and this leads to cross-reactivity. This implies that the body's reaction will be more pronounced when the body is exposed to more than one type of allergen, resulting in increased production of IgE. According to recent research, the similarity between allergens from cats and birds has been shown to cause synergistic reactions by the immune system owing to the presence of shared epitopes between Fel d 1 (in cats) and avian proteins [27]. Houses with multiple pets tend to harbor more indoor allergens, hence poor indoor air quality because of improper cleaning and ventilation. The relationship between having both pets in the house and the resultant increased levels of indoor allergens, which lead to high immune activity and increased IgE, has been confirmed in recent literature [28]. The constant exposure to allergens can lead to long-term activation of the immune system, as indicated by the increase in the levels of IgE as a result of continuous exposure to allergens at home with multiple pets [29]. A primary limitation of the study was its use of total IgE. Future studies should employ the technique of component resolved diagnostics (CRD) in order to distinguish true sensitization from cross reactivity among the different animal species [24, 25].

CONCLUSION

Based on the findings obtained in the current study, the kind of pet exposure plays a major role in determining IgE concentrations. People who are exposed to different kinds of pets, especially cats and birds, had high concentrations of IgE in their blood serum than people who are exposed to just one kind of pet. This implies that there is an additive effect of allergens on sensitization to the allergens, thus resulting in higher allergic sensitization.

Ethical Approval

The study was conducted after approval by the Research Ethics Committee at the Southern Technical University - College of Health and Medical Technology. Verbal consent was also obtained from all study participants.

Conflict of Interest: The author declares that there is no conflict of interest in this article.

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