ASTHMA ALLERGY IMMUNOLOGY
ASTIM ALLERJİ İMMÜNOLOJİ

doi: 10.21911/aai.2025.1005
Asthma Allergy Immunol 2025;23:310-317

RESEARCH ARTICLE

Received: 08.08.2025 • Accepted: 25.10.2025
Online Published: 01.12.2025

Indoor Cat Exposure and Respiratory Outcomes in Cat-Allergic Children: A Retrospective Study from a High-Feline-Density Region

Damla BAYSAL BAKIR[1], Ozge ATAY[1], Halime YAGMUR[1], Gizem KABADAYI[1], Beste OZSEZEN[2], Nevin UZUNER[1]

[1] Department of Pediatric Immunology and Allergy, Dokuz Eylül University Faculty of Medicine, İzmir, Türkiye
[2] Department of Pediatric Pulmonology, Dokuz Eylül University Faculty of Medicine, İzmir, Türkiye

Corresponding Author: Damla Baysal Bakir ✉ damla.baysalbakir@deu.edu.tr

ABSTRACT

Objective: Among children sensitised to cat dander, the impact of indoor exposure on nasal symptoms, asthma prevalence, and control remains unclear. In regions with many free-roaming cats, distinguishing the clinical effects of indoor versus outdoor exposure is particularly challenging. This study aimed to compare direct ownership with environmental exposure in respiratory allergies and evaluate the independent effects of indoor contact.

Materials and Methods: Between October 2024 and June 2025, children aged 6–18 years who presented with allergic rhinitis and had cat-specific sensitisation confirmed by skin prick testing (wheal ≥3 mm) or serum-specific IgE (≥0.35 kU/L) were retrospectively evaluated. Participants were classified as "indoor exposure" (household cat) or "outdoor exposure" (no household cat, outdoor contact). TNSS, physician-diagnosed asthma, c-ACT, pulmonary function, and laboratory findings were compared between groups. Potential confounders, including age, sex, and polysensitisation, were adjusted for using multivariable regression.

Results: A total of 97 children (median age: 12 years; 54% male) were included. The indoor exposure group had higher TNSS values (median: 8 vs. 7; p = 0.02), a greater prevalence of asthma (71% vs. 48%; OR = 3.30, 95% CI: 1.17–9.30, p = 0.024), and lower c-ACT/ACT scores (median: 20 vs. 22; β = –0.376; B = –3.285, 95% CI: –5.806 to –0.765, p = 0.012) compared to the outdoor exposure group. In multivariable analyses, persistent rhinitis phenotype and moderate-to-severe rhinitis severity were the main determinants of TNSS. In contrast, indoor exposure was the primary factor associated with asthma and poorer asthma control.

Conclusion: Indoor cat exposure is an independent risk factor for asthma development and poor symptom control in children with cat dander allergy. TNSS is primarily associated with the rhinitis phenotype and disease severity. In managing children with cat allergy, not only pet ownership but also environmental exposure should be clinically considered when evaluating disease control.

Keywords: Allergic rhinitis, asthma in children, environmental exposure, cat allergens

INTRODUCTION

Cat dander is a major allergen known to cause IgE-mediated sensitisation in more than 10% of individuals worldwide. It is recognised as one of the most common triggers of allergic diseases such as allergic rhinitis (AR), conjunctivitis, and asthma (1). Among several identified cat allergens, Fel d 1 is the principal protein associated with sensitisation and symptoms. It can be detected not only in homes with cats but also in about one-third of cat-free homes, as it adheres to small particles and disperses widely, thereby increasing exposure risk (2).

ORCID Damla Baysal Bakir / 0000-0003-2317-3281, Ozge Atay / 0000-0002-7673-3601, Halime Yagmur / 0009-0008-6132-3686, Gizem Kabadayi / 0000-0002-5627-7979, Beste Ozsezen / 0000 0002 0052 8361, Nevin Uzuner / 0000-0001-8862-7825

Copyright © 2025 The Author(s). This is an open-access article published by Turkish National Society of Allergy and Clinical Immunology under the terms of the Creative Commons Attribution License (CC BY NC) which permits unrestricted use, distribution, and reproduction in any medium or format, provided the original work is properly cited. No use, distribution or reproduction is permitted which does not comply with these terms.

In industrialised countries, rising pet ownership and energy-efficient building designs further amplify indoor Fel d 1 exposure. Allergen accumulation is facilitated by upholstered furniture and insulated environments, while Fel d 1 can also be transported via cat owners' clothing into cat-free settings. Airborne Fel d 1 levels are regarded as the most reliable indicator of exposure, and moderate levels in children have even been linked to a greater risk of sensitisation compared with high levels (3, 4). This widespread and difficult-to-control exposure contributes to symptom exacerbations, particularly in highly sensitised individuals, and limits the effectiveness of conventional allergen avoidance strategies.

Studies in patients with confirmed cat allergy provide more clinically relevant insights than data from the general population. In a controlled exposure study, asthmatic patients exhibited rhinitis, conjunctivitis, and both early- and late-phase asthmatic responses, with symptom severity increasing alongside exposure duration. Notably, rhinitis severity was significantly associated with asthmatic responses, underscoring that exposure to cat allergen can trigger both upper and lower respiratory tract symptoms (5). The results suggest that in individuals with cat allergy, exposure can trigger not only upper but also lower respiratory tract symptoms.

While household cat ownership is a well-established risk factor in sensitised individuals (6), outdoor exposure may also contribute to symptoms in regions with a high density of free-roaming cats. A study from Turkey reported that cat ownership in children with AR and confirmed cat allergy was associated with poorer rhinitis control and a higher prevalence of asthma (7). In İzmir, where the present study was conducted, official data recorded 119,801 registered cats in 2025; however, the actual outdoor population is likely much higher when unregistered and stray cats are included (8).

Given that symptoms in sensitised children may be triggered by both indoor and environmental exposure to cats, a comparative assessment of exposure types is clinically relevant. Therefore, this study retrospectively evaluated the impact of indoor cat ownership on nasal symptom severity in children with AR and confirmed cat allergy, and secondarily compared indoor and outdoor exposure with respect to asthma prevalence, asthma control, pulmonary function, and laboratory markers of atopy (skin prick test (SPT) wheal diameter, specific IgE, total IgE, eosinophils).

MATERIALS and METHODS

Study Design

This retrospective, cross-sectional study was conducted by reviewing the electronic medical records (Probel system) of children aged 6-18 years who presented with AR symptoms to the Department of Pediatric Immunology and Allergy between October 2024 and June 2025. Eligible patients reported worsening of rhinitis symptoms upon cat contact and had confirmed sensitisation to cat allergen. The study was approved by the institutional ethics committee (Approval number: 2025/26-27) and carried out in accordance with the principles of the Declaration of Helsinki. Patients who were sensitised to cat allergen but did not report symptom exacerbation upon contact, or who had received systemic or local treatment for AR (nasal/oral corticosteroids, nasal antihistamines, oral antihistamines, or montelukast) within the preceding month, were excluded from the analysis (Figure 1). All data were entered into a standardised data collection form prior to analysis.

Clinical and Laboratory Assessment

The diagnosis and classification of AR were established according to the ARIA guidelines, based on symptom duration and severity (9). Nasal symptom severity was determined from medical records using the Total Nasal Symptom Score (TNSS), calculated by rating each of the following symptoms—nasal congestion, rhinorrhea, nasal itching, and sneezing—on a scale from 0 to 3, with a total possible score ranging from 0 to 12 (10).

Sensitisation to cat epithelium (*Felis domesticus*) was defined as a SPT result—wheal diameter ≥3 mm larger than the negative control—and/or a positive cat dander-specific IgE level (≥0.35 kU/L; Thermo Fisher Scientific, Uppsala, Sweden). The SPT panel included additional aeroallergens: pollens (*Poaceae*, *Artemisia vulgaris*, *Betula alba*, *Olea europaea*, *Fagus sylvatica*, *Alnus glutinosa*, *Phleum pratense*), house dust mites (*Dermatophagoides pteronyssinus*, *D. farinae*), animal dander (*Felis domesticus*, *Canis familiaris*), molds (*Alternaria alternata*, *Aspergillus fumigatus*, *Cladosporium herbarum*), and cockroach (*Blattella germanica*) (Lofarma S.p.A., Milan, Italy). Patients sensitised to only one aeroallergen were classified as "monosensitised," whereas those sensitised to two or more distinct aeroallergens were classified as "polysensitised."

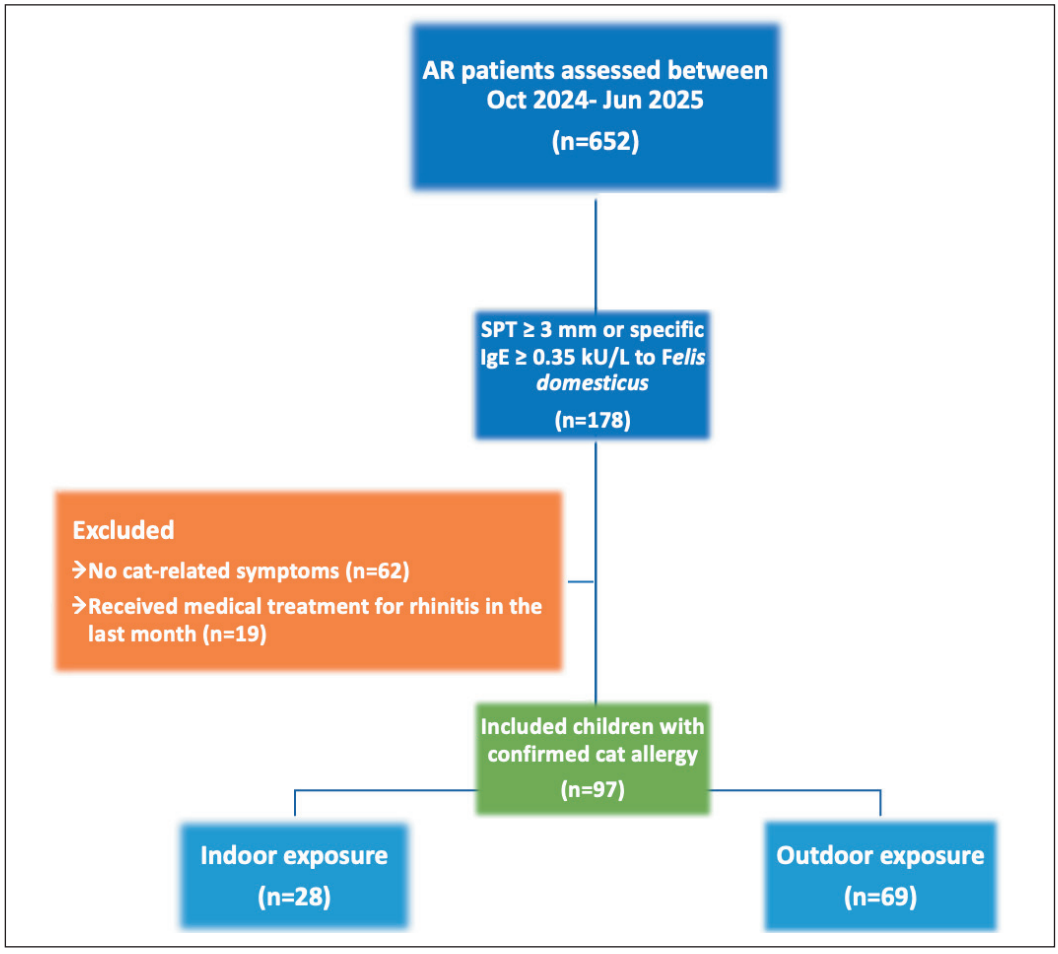

Figure 1: Flowchart illustrating the patient selection process. Between October 2024 and June 2025, 652 children with AR were evaluated. Among them, 178 had confirmed sensitisation to Felis domesticus (defined as SPT wheal ≥ 3 mm or specific IgE ≥ 0.35 kU/L). After excluding patients without cat-related symptoms (n = 62) and those who had received medical treatment for rhinitis within the last month (n = 19), 97 patients with confirmed cat allergy were included. Based on exposure status, participants were categorised into indoor (n = 28) and outdoor (n = 69) exposure groups.

Patients' physical examination findings at presentation (allergic shiners, Dennie-Morgan crease, transverse nasal crease) and ocular symptoms (e.g., burning, itching, tearing) were retrospectively reviewed. Laboratory assessments included absolute eosinophil count (/mm^3) and percentage obtained from complete blood count, as well as total and cat-specific serum IgE levels (kU/L). Comorbid asthma was diagnosed according to the Global Initiative for Asthma (GINA) 2025 guidelines (11). In patients with asthma, the treatment step at presentation, pulmonary function test (PFT) parameters [FEV_1, FEV_1/FVC], and age-appropriate asthma control scores were recorded: the Childhood Asthma Control Test (c-ACT) for children aged 6-11 years (12) and the Asthma Control Test (ACT) for adolescents aged ≥12 years. For this retrospective analysis, information on exposure (household cat ownership) and outcomes (asthma diagnosis, TNSS, c-ACT/ACT scores, and pulmonary function) was abstracted from medical records documented at the same outpatient visit. Specifically, TNSS and asthma control scores were extracted from patient questionnaires routinely completed during visits, and pulmonary function test results were retrieved from standardised records.

Group Classification and Comparative Analysis

Patients were classified into two groups according to the type of exposure:

- Indoor exposure group: Patients who had a cat in their household.

- Outdoor exposure group: Patients without a household cat who reported symptom exacerbation upon contact with cats in outdoor environments.

The groups were compared in terms of clinical findings and laboratory parameters to directly assess the impact of household cat ownership versus outdoor-only exposure. In addition, within the indoor exposure group, the age at which the cat was acquired (years), duration of contact (months), and intensity of contact (e.g., sleeping in the same bed) were analysed in relation to symptom severity and asthma-related parameters.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics version 29.0 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed using both visual methods (histograms, Q-Q plots) and analytical tests (Kolmogorov-Smirnov test). For comparisons between two groups, the Independent Samples t-test was used for normally distributed variables, while the Mann-Whitney U test and Kruskal-Wallis test were applied for non-normally distributed variables. Correlations between continuous variables were evaluated using Pearson or Spearman correlation analyses, depending on distribution characteristics. Descriptive statistics were presented as mean ± standard deviation for normally distributed variables, median (interquartile range, IQR) for non-normally distributed variables, and frequency (n) with percentage (%) for categorical variables. Multivariable linear regression analysis was performed to identify determinants of TNSS and c-ACT/ACT scores, while logistic regression analysis was used to determine factors associated with asthma. Potential confounders, including age, gender, additional aeroallergen sensitisations, and indoor cat ownership, were included in the regression models. A *p*-value <0.05 was considered statistically significant.

RESULTS

Of the 97 children included in the study, 54% were male, and the median age was 12 years. Most patients had moderate-to-severe and persistent rhinitis, and 70% reported ocular symptoms. The majority were polysensitised, with pollen and mold allergens being the most common co-sensitisations.

The primary analysis was a direct comparison between children with and without a household cat. All patients were classified according to indoor cat ownership into an indoor exposure group (n = 28) and an outdoor exposure group (n = 69), and these groups were compared in terms of clinical findings and laboratory parameters (Table I). Notably, it was ascertained that none of the children in the outdoor exposure group had a history of prior cat ownership, thereby minimising the risk of misclassification.

In patients with a household cat, the mean age at first cat contact was 10 ± 3.5 years, and the mean duration of exposure was 35 ± 24 months; 44% reported sleeping in the same bed as their cat. Compared with the outdoor group, the indoor group had a significantly higher TNSS (median: 8 vs. 7, p = 0.02), a higher prevalence of asthma (71% vs. 48%, p = 0.03), and lower median c-ACT/ACT scores (median: 20 vs. 22, p = 0.02). When applying validated cut-offs for asthma control (c-ACT ≤19 for ages 6-11; ACT <20 for ≥12), uncontrolled asthma was observed in 72% of the indoor group and 58% of the outdoor group, with no significant difference between groups (p = 0.144). Although obstructive patterns on PFT were more frequent in the indoor exposure group (30% vs. 9.4%), the difference did not reach statistical significance (p = 0.056). No significant differences were observed in FEV_1 or FEV_1/FVC z-scores between the groups. Additionally, in patients with a household cat, neither longer duration of contact nor sleeping in the same bed was significantly associated with TNSS, ACT score, or asthma prevalence (p > 0.05).

Laboratory measurements revealed no significant differences between the groups in cat-specific IgE, total IgE, or eosinophil levels. Notably, patients in the outdoor group had larger cat SPT wheal diameters (p < 0.001), which correlated with cat dander-specific IgE levels (r_s = 0.253, p = 0.04).

In the multivariable linear regression analysis (F[6,88] = 5.991, R^2 = 0.290, p < 0.001), higher TNSS values were significantly and positively associated with the persistent rhinitis phenotype (β = 0.324, p = 0.001) and moderate-to-severe rhinitis severity (β = 0.261, p = 0.007) (Figure 2A). Indoor cat exposure, age, gender, and polysensitization were not significantly associated with TNSS (p > 0.05).

In the logistic regression analysis assessing factors associated with asthma (Nagelkerke R^2 = 0.094), indoor cat exposure emerged as the only independent predictor (B = 1.194, OR = 3.30, 95% CI: 1.17-9.30, p = 0.024) (Figure 2B). Age (p = 0.44), gender (p = 0.70), and the presence of polysensitization (p = 0.19) were not significantly associ-

Table I: Characteristics of the Study Population According to Cat Exposure Type

	Indoor exposure (n=28)	Outdoor exposure (n=69)	General population (n=97)	*p*
Age (years)	13 (10-16)	11 (8-14)	12 (9-14)	*0.01*
Gender, male (%)	43	58	54	0.18
Rhinitis severity (%)				
• Mild	21	38	33	0.12
• Moderate-severe	79	62	67	
Rhinitis duration (%)				
• Intermittent	29	49	43	0.06
• Persistent	71	51	57	
TNSS	8 (7-10)	7 (4-9)	8 (6-9)	*0.02*
Conjunctival symptoms (%)	77	67	70	0.24
Asthma (%)	71	48	55	*0.03*
Asthma treatment step	2 (2-3)	2 (2-3)	2 (2-3)	0.81
c-ACT/ACT score	20 (14-21)	22 (19-24)	21 (18-23)	*0.02*
Airway obstruction (%)	30	9.4	17	0.056
Lung function parameters				
• FEV1 z-score	0.5 ± 1.1	0.1 ± 1.1	0.1 ± 1.5	0.99
• FEV1/FVC z-score	1.1 ± 1.7	0.4 ± 1.7	0.4 ± 1.6	0.58
Poly-sensitisation (%)	82	91	88	0.19
Other allergen sensitisations (%)				
• Dust mite	22	32	29	0.32
• Pollen	75	81	80	0.49
• Mold	42	31	33	0.32
• Dog dander	18	39	32	0.05
• Cockroach	5	5.4	5	0.95
Laboratory parameters				
Eosinophil				
• Absolute count (/mm^3)	500 (300-1100)	400 (200-600)	400 (300-600)	0.051
• Percent (%)	5 (4-10)	5 (3-7)	5 (3-8)	0.14
Total IgE (kU/L)	256 (91-838)	312 (146-686)	303 (131-730)	0.78
Cat-specific IgE (kU/L)	38 (11-100)	26 (8-100)	29 (10-100)	0.59
Cat SPT wheal size (mm)	4 (3-5)	5 (4-7)	5 (4-7)	*<0.001*

TNSS: total nasal symptom score, **c-ACT:** childhood asthma control test, **ACT:** asthma control test, **FEV$_1$ z-score:** forced expiratory volume in 1 second, expressed as z-score, **FEV$_1$/FVC z-score:** z-score of forced expiratory volume in 1 second to forced vital capacity ratio, **IgE:** immunoglobulin E, **SPT:** skin prick test

**Continuous variables are presented as mean ± SD or median (IQR: 25th–75th percentile), as appropriate. Categorical variables are presented as number (%).*

ated with asthma. In the multivariable analysis of c-ACT/ACT scores ($R^2 = 0.238$, $p = 0.046$), the independent effect of indoor cat exposure persisted ($\beta = -0.376$; $B = -3.285$, 95% CI: -5.806 to -0.765; $p = 0.012$), with the median ACT score being 3.3 points lower than in the outdoor exposure group (Figure 2C). Other variables, including age ($p = 0.07$), asthma treatment step ($p = 0.39$), polysensitization ($p = 0.14$), and gender ($p = 0.19$), had no significant effect on c-ACT/ACT scores.

DISCUSSION

In this study, the effects of indoor cat exposure on nasal symptom severity, asthma prevalence, and asthma control were comprehensively evaluated in children with confirmed sensitisation to cat dander. The indoor exposure group had significantly higher TNSS scores, a greater prevalence of asthma, and lower c-ACT/ACT scores. Although the association between TNSS and indoor expo-

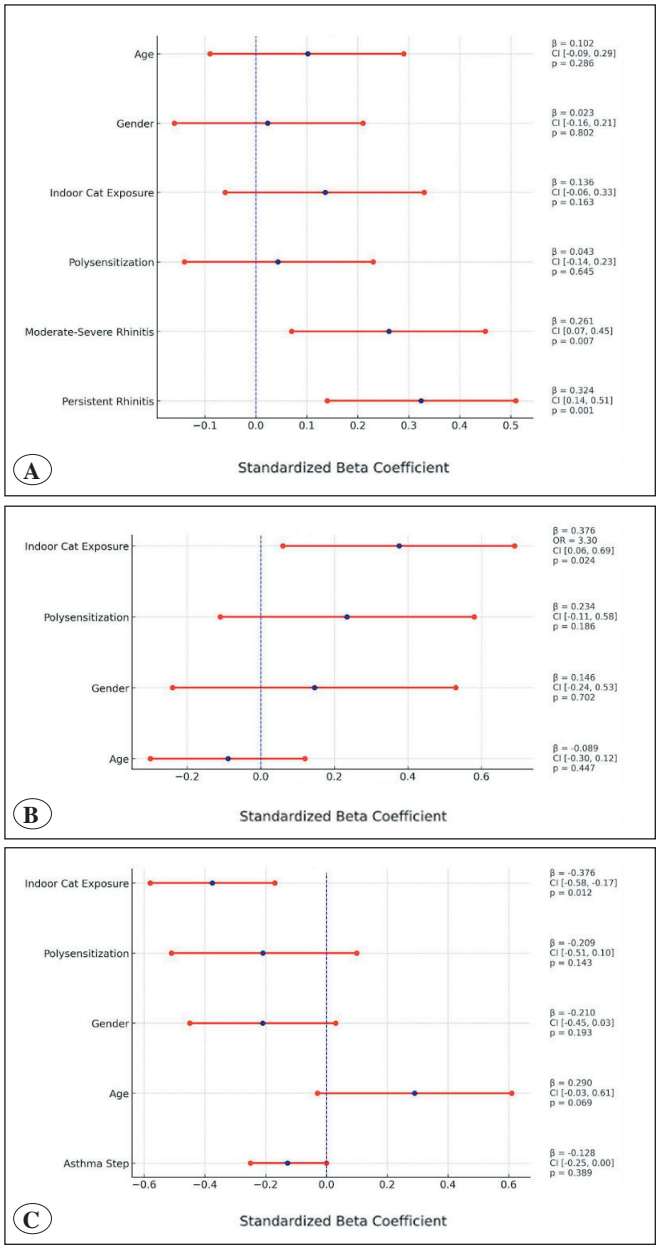

Figure 2: Forest plots illustrating the results of multivariate regression models assessing the association between clinical and demographic variables and **(A)** Total Nasal Symptom Score (TNSS), **(B)** asthma presence, and **(C)** asthma control test (ACT) in children with confirmed AR and cat dander allergy. Each model presents standardised beta coefficients and corresponding 95% confidence intervals (CI) for the predictors. The vertical dashed line represents the null value (β=0). Statistically significant associations (p<0.05) were identified for persistent and moderate-severe rhinitis in the TNSS model **(A)**, and for indoor cat exposure in both the asthma prevalence **(B)** and ACT **(C)** models.

sure lost significance in multivariable analyses, the effects on asthma and asthma control remained independent. Conversely, variables such as duration of exposure and sleeping in the same bed with the cat were not significantly associated with symptom severity or disease control. These findings indicate that, while the contribution of environmental exposure cannot be overlooked, the presence of a household cat constitutes a notable risk factor for lower respiratory tract symptoms.

TNSS is a widely used measure of subjective effects of allergen exposure (13). In our study, although TNSS was higher in children with indoor cat exposure, this association lost significance in multivariable regression analyses. The finding that persistent and moderate-to-severe rhinitis were the strongest determinants of TNSS suggests that symptoms are influenced not only by exposure but also by disease characteristics, consistent with previous reports (14). SPT wheal diameter was larger in the outdoor group, correlated only with cat-specific IgE, supporting the view that skin test size reflects sensitisation rather than clinical severity.

In regions with a high cat population, environmental exposure can be substantial even in the absence of a household cat. Indeed, a study conducted in İzmir demonstrated detectable levels of Fel d 1 allergen in house dust samples from homes without cats, with a reported cat sensitisation rate of 44.7% (15). Similarly, our findings indicate that outdoor exposure may play a non-negligible role in the development of clinical symptoms among sensitised individuals.

On the other hand, indoor cat exposure in our study was significantly associated with both asthma prevalence and disease control. Multivariable analysis showed that children with a household cat had an approximately threefold increased risk of asthma and lower c-ACT/ACT scores, independent of age, gender, treatment step, and polysensitisation. This supports the hypothesis that cat dander may promote lower airway inflammation and impair asthma control in sensitised children.

Several studies have reported that cat sensitisation during childhood is a strong predictor of asthma development in adolescence (16, 17). In contrast, others have found no association or even a protective effect of early-life exposure (18-20). These contrasting findings highlight the role of timing. While early exposure may induce tolerance, the

mean age at first contact in our cohort was 10 years, suggesting that later exposure may increase asthma risk rather than prevent it.

Our study adds to the literature by focusing specifically on children with clinically confirmed cat allergy, rather than sensitisation alone, and by adjusting for multiple clinical and laboratory variables in multivariable analyses. Conducted in a region with a particularly high density of environmental cats, it provides novel insight into the relative impact of indoor versus outdoor exposure. While outdoor contact may contribute to rhinitis symptoms, indoor cat ownership was identified as the leading independent risk factor for asthma prevalence and poor asthma control, highlighting the need to counsel sensitised families about the risks associated with keeping a cat at home.

This study has several limitations. Its retrospective design, relatively small overall sample size, and particularly the limited number of children in the indoor exposure group (n = 28) may restrict the statistical power of subgroup analyses and the generalizability of findings, particularly given the limited number of monosensitised patients**.** In addition, the absence of quantitative assessment of environmental Fel d 1 levels restricts the ability to establish causal relationships and objectively measure exposure. Furthermore, for the outdoor exposure group, precise information on the timing, duration, and frequency of cat contact was not available, which reduces interpretability. Moreover, data on some potential confounders, such as environmental tobacco smoke exposure, dog ownership, recent infections, and cat-related characteristics (breed, age, neutering, coat type), were not consistently available in this retrospective dataset and thus could not be included in the analyses. Future prospective multicenter studies incorporating larger cohorts, quantitative measurement of environmental allergen levels, component-resolved diagnostic approaches, and long-term follow-up may enable more accurate identification of candidates for immunotherapy and a better evaluation of the effectiveness of environmental interventions.

Acknowledgements

I sincerely thank my sister, Gülce Baysal, for generously assisting with the graphical representation of the regression analyses.

Conflict of Interest

The authors have no conflicts of interest to declare.

Funding

The authors received no funding for this article.

Data Availability Statement

All data generated or analysed during this study are included in this article. Further inquiries can be directed to the corresponding author.

Author Contributions

Concept: **Damla Baysal Bakır, Nevin Uzuner,** Design: **Damla Baysal Bakır, Özge Atay,** Data collection or processing: **Damla Baysal Bakır, Halime Yağmur, Gizem Kabadayı,** Analysis or Interpretation: **Damla Baysal Bakır, Beste Özsezen,** Literature search: **Damla Baysal Bakır, Özge Atay,** Writing: **Damla Baysal Bakır,** Approval: **All authors.**

REFERENCES

1. Trifonova D, Curin M, Riabova K, Karsonova A, Keller W, Grönlund H, et al. Allergenic activity of individual cat allergen molecules. Int J Mol Sci 2023;24:16729.
2. Custovic A, Simpson A, Pahdi H, Green RM, Chapman MD, Woodcock A. Distribution, aerodynamic characteristics, and removal of the major cat allergen Fel d 1 in British homes. Thorax 1998;53:33-8.
3. Popescu FD, Ganea CS, Panaitescu C, Vieru M. Molecular diagnosis in cat allergy. World J Methodol 2021;11:46-60.
4. Liccardi G, D'Amato G, Russo M, Canonica GW, D'Amato L, De Martino M, et al. Focus on cat allergen (Fel d 1): immunological and aerodynamic characteristics, modality of airway sensitization and avoidance strategies. Int Arch Allergy Immunol 2003;132:1-12.
5. Piotin A, Godet J, Domis N, de Blay F. Rhinoconjunctivitis severity induced by cat exposure influences early and late asthmatic responses: Evidence from an environmental exposure chamber. Clin Exp Allergy 2024;54:596-606.
6. Celedón JC, Litonjua AA, Ryan L, Platts-Mills T, Weiss ST, Gold DR. Exposure to cat allergen, maternal history of asthma, and wheezing in first 5 years of life. Lancet 2002;360:781-2.
7. Yegit OO. Impact of direct and indirect cat allergen exposure patterns on allergic rhinitis and asthma in cat-sensitized patients. Med Bull Haseki 2023;61:267-72.
8. Haber Ekspres. İzmir'de evcil hayvan sayısı belli oldu: 212 bin hayvan kimliklendirildi. [Internet]. 2025 [cited 2025 Aug 7]. Available from: https://www.haberekspres.com.tr/kimliklendirilen-ev-hayvani-sayisi-izmirde-212200e-ulasti
9. Benson M, Reinholdt J, Cardell LO. Allergen-reactive antibodies are found in nasal fluids from patients with birch induced intermittent allergic rhinitis, but not in healthy controls. Allergy 2003;58:386-93.
10. Ellis AK, Soliman M, Steacy L, Boulay MÈ, Boulet LP, Keith PK, et al. The Allergic Rhinitis - Clinical Investigator Collaborative (AR-CIC): nasal allergen challenge protocol optimization for studying AR pathophysiology and evaluating novel therapies. Allergy Asthma Clin Immunol 2015;11(1):16.

11. Global Initiative for Asthma (GINA). Global strategy for asthma management and prevention, 2025. Access date: 7 July 2025. Available from: https://ginasthma.org/
12. Uysal MA, Mungan D, Yorgancioglu A, Yildiz F, Akgun M, Gemicioglu B, et al. Turkish Asthma Control Test (TACT) Study Group. The validation of the Turkish version of Asthma Control Test. Qual Life Res 2013;22:1773-9.
13. Wang Y, Xiong L, Yin X, Wang J, Zhang Q, Yu Z, et al. House dust mite allergen levels in households and correlation with allergic rhinitis symptoms. Am J Rhinol Allergy 2014;28:193-6.
14. Bousquet PJ, Demoly P, Devillier P, Mesbah K, Bousquet J. Impact of allergic rhinitis symptoms on quality of life in primary care. Int Arch Allergy Immunol 2013;160:393-400.
15. Gulbahar O, Sin A, Mete N, Kokuludag A, Kirmaz C, Sebik F. Sensitization to cat allergens in non-cat owner patients with respiratory allergy. Ann Allergy Asthma Immunol 2003;90:635-9.
16. Howard R, Belgrave D, Papastamoulis P, Simpson A, Rattray M, Custovic A. Evolution of IgE responses to multiple allergen components throughout childhood. J Allergy Clin Immunol 2018;142:1322-30.
17. Noertjojo K, Dimich-Ward H, Obata H, Manfreda J, Chan-Yeung M. Exposure and sensitization to cat dander: asthma and asthma-like symptoms among adults. J Allergy Clin Immunol 1999;103:60-5.
18. Mishra PE, Han YY, Hill K, Rosser FJ, Forno E, Acosta-Pérez E, et al. Persistent cat ownership and asthma in a longitudinal study of Puerto Rican youth. Ann Allergy Asthma Immunol 2024;133:545-9.
19. Gaffin JM, Spergel JM, Boguniewicz M, Eichenfield LF, Paller AS, Fowler JF, et al. Effect of cat and daycare exposures on the risk of asthma in children with atopic dermatitis. Allergy Asthma Proc 2012;33(3):282-8.
20. Stokholm J, Chawes BL, Vissing N, Bønnelykke K, Bisgaard H. Cat exposure in early life decreases asthma risk from the 17q21 high-risk variant. J Allergy Clin Immunol 2018;141(5):1598-606.