Received: 21 September 2024 | Accepted: 20 January 2025

DOI: 10.1111/vde.13329

Veterinary Dermatology

ORIGINAL ARTICLE

Prevalence and lesion distribution of atopic dermatitis in small-to-medium breed dogs in Korea

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Abstract

Background: Canine atopic dermatitis (cAD) varies in prevalence and lesion distribution across breeds. In contrast to Western countries, many Asian countries favour small-to-medium dog breeds. However, previous studies have focused primarily on medium-to-large dog breeds.

Objectives: To analyse the prevalence and lesion distribution of cAD in common breeds in Korea, focusing on breed-specific characteristics.

Animals: Nine small-to-medium breeds (<25 kg body weight) were selected from 331 client-owned dogs with cAD, representing 77% of the total cAD group.

Materials and Methods: Breeds selected included Maltese, miniature/toy poodle, shih tzu, bichon frise, cocker spaniel, Pomeranian, French bulldog, Yorkshire terrier and Dachshund. The prevalence of these breeds was compared to the registered dog population. Photographs of skin lesions from each dog were reviewed, and the lesion distribution was analysed by breed.

Results: Shih tzu, cocker spaniel and French bulldog had a higher prevalence of cAD compared to the registered dog population ($p<0.01$). Lesions were most commonly present on the ventral aspects of the body in 51% of shih tzus; lip folds (64%), tail folds (27%) and paws (73%) in French bulldog; and 71% of Dachshunds had dorso-lumbar distribution.

Conclusions and Clinical Relevance: Of the small-to-medium breeds in this study, shih tzu, cocker spaniel and French bulldog had a higher prevalence of cAD compared to the registered dog population, while specific body sites were affected in shih tzu, French bulldog and Dachshund.

KEYWORDS
breed, canine atopic dermatitis, dogs, Korea, lesion distribution

INTRODUCTION

Canine atopic dermatitis (cAD) is a common skin condition in dogs,[1,2] with lesions observed predominantly on the face, pinnae, abdomen, groin, axillae, cubital flexors and paws.[3,4] Breed predisposition and lesion distribution can vary in atopic dogs, resulting in diverse breed-specific clinical presentations.[5–7] Preferred breeds can vary by country, leading to geographical differences in the breeds selected for cAD studies.[5,8,9]

Previous research from Western countries has focused predominantly on medium-to-large dog breeds. A study from Switzerland on cAD predisposition focused on breeds such as boxer, bull terrier, Vizsla and basset hound.[10] Likewise, a study from Australia, which analysed the increased risk of cAD, concentrated on breeds including beagle, boxer, bulldog, bull mastiff, great Dane, Labrador retriever, shar-pei and Staffordshire terrier.[9]

A more geographically extensive study on lesion distribution of cAD analysed data collected from 15 countries, including those in Europe, North and South America, and Japan.[6] This study demonstrated that breeds such as the boxer, Dalmatian, German shepherd dog, shar-pei, French bulldog and West Highland white terrier (WHWT) tend to develop lesions more frequently in certain specific areas.[6]

Ji-Hye Ryu and Jung-Hun Kang contributed equally to this work (first authors).

In contrast to Western countries, small-to-medium dog breeds are more common in many Asian countries, including Korea.[11–13] However, research on the prevalence and lesion distribution of cAD in small-to-medium dog breeds is still limited. In this study, we aimed to identify the prevalence of cAD in small-to-medium dog breeds in Korea and analyse which breeds have a higher prevalence of cAD compared with the registered dog population. Additionally, this study analysed breed-specific associations with particular body sites using a comprehensive dataset collected from photographs of skin lesions.

MATERIALS AND METHODS

Ethics

Written informed consent was obtained from dog owners, including permission for the use of patient information and clinical data for each patient in the study. Only photographs of the skin lesions were taken for analysing the lesion distribution, and identifiable patient images were not used.

Study design

Photographs of lesions from dogs with cAD were collected from the Dermatology Department of the Veterinary Medical Teaching Hospital at Seoul National University and from three other private veterinary practices in Korea from January 2023 to November 2023: ORIGIN Veterinary Dermatology Clinic in Busan, Ilsan Animal Medical Center in Gyeonggi-do, and Green Animal Medical Center in Gyeonggi-do. Data were recorded from photographs using software designed to annotate lesions at specific body sites. An analysis of the registered dog population from the Ministry of Agriculture, Food and Rural Affairs of Korea was performed.[14] A total of 331 dogs from 42 different breeds were included in this study. Among these, small-to-medium breeds that represented 77% of the cAD group—Maltese, miniature/toy poodle, shih tzu, bichon frise, cocker spaniel, Pomeranian, French bulldog, Yorkshire terrier and Dachshund—were selected.

Inclusion criteria

Patients diagnosed with cAD were included based on history and clinical signs, fulfilling at least five criteria established previously,[15] and all dogs were on adequate parasite control to rule out flea bite hypersensitivity. Dogs included in the study were negative for ectoparasite infestations and dermatophytosis through skin scraping and examination of the hair (Wood's lamp and fungal culture). Only patients with no improvement after a 6–8 week elimination diet trial with commercial hydrolysed diets were included. Dogs with concurrent secondary bacterial or yeast infections also were included.

Lesion distribution

Software designed for labelling and annotation (LIME RESEARCH; Lime Solution Corp.) was used to record the locations of the lesions observed in the photographs. Several photographs were obtained of dogs presenting with lesions at multiple sites.

Each photograph of the 44 body sites was reviewed by referral veterinarians. The list of body sites is presented in Table S1 in the Supporting Information.

Statistical analysis

The breed-specific proportions in the registered dog population were compared with those in the cAD group to determine prevalence of cAD. Breed-specific lesion distributions were compared to determine which body sites were more frequently affected in the nine breeds with cAD selected in this study.

Statistical analyses were performed using the chi-squared test or Fisher's exact test to identify significant differences, and odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to determine the strength and accuracy of these associations. All statistical analyses were conducted using R software (version 4.4.0; R Foundation for Statistical Computing), with statistical significance set at $p<0.05$ for all tests.

RESULTS

Breed-specific prevalence of cAD

Shih tzu ($p=0.001$, OR=1.78, CI=1.25–2.52), cocker spaniel ($p<0.001$, OR=5.22, CI=3.47–7.84) and French bulldog ($p<0.001$, OR=4.07, CI=2.23–7.42) represented a significantly higher proportion of dogs with cAD relative to the registered dog population.

The number and proportion of dogs of each breed are shown in Table 1. Both the cAD group and registered dog population are presented. Breeds with a significantly higher proportion of cAD than the registered dog population are highlighted.

Breed-specific lesion distribution

The French bulldog, shih tzu and Dachshund breeds showed statistically significant differences in lesion distribution compared to the other breeds selected in this study.

Table 2 presents the number and proportion body sites affected for each breed, highlighting statistically significant associations where the proportion in a specific breed exceeds that in other breeds. Figure 1 shows the silhouettes of different dog breeds coloured to represent the proportion of affected body sites for that breed: 0%–25% (blue), 26%–50% (yellow), 51%–75% (orange) and 76%–100% (red).

TABLE 1 Prevalence of canine atopic dermatitis by breed.

Breed	cAD cases	Registered dog population
Maltese	68 (20.5%)	647,323 (22.3%) 1st
Poodle	50 (15.1%)	514,455 (17.7%) 2nd
Shih tzu	**35 (10.6%)****	181,254 (6.2%) 5th
Bichon frise	27 (8.2%)	183,170 (6.3%) 4th
Cocker spaniel	**25 (7.6%)*****	44,763 (1.5%) 12th
Pomeranian	22 (6.6%)	322,697 (11.1%) 3rd
French bulldog	**11 (3.3%)*****	24,321 (0.8%) 19th
Yorkshire terrier	11 (3.3%)	138,021 (4.8%) 6th
Dachshund	7 (2.1%)	51,047 (1.8%) 10th
Total	331	2,902,469

Note: Statistically significant results are indicated in bold and underlined text.

Abbreviation: cAD, canine atopic dermatitis.

**$p<0.01$; ***$p<0.001$.

French bulldog showed a significantly higher prevalence of lesions in several regions, specifically, in the perilabial (lower), dorsal tail, left forepaw (dorsal and ventral), right forepaw (dorsal and ventral) and left hind paw (dorsal and ventral).

Shih tzu showed a significantly high prevalence of lesions at specific sites including ventral and right dorsal neck, right forelimb (caudal), left cubital flexor, ventral trunk, left and right axillae, forehead and right forepaw (dorsal).

Relative to other breeds, Dachshunds were significantly more affected on the left and right dorsal thorax.

Statistical results of prevalent atopic lesion sites for these significant breeds, including *p*-value, OR and 95% CI are presented in Table S2.

DISCUSSION

In this study, we analysed the prevalence and lesion distribution of cAD across various common breeds in Korea. Dog breed sizes are classified by weight, with small-to-medium dog breeds generally defined as those weighing <25 kg.[16] In this classification, small-to-medium dog breeds accounted for a large proportion of the registered dog population.[14] Accordingly, 93% of the 331 dogs with cAD in this study were small-to-medium breeds. By contrast, the large breeds predominant in previous studies, such as golden retriever, Labrador retriever and boxer, accounted for only 1.8% of the total dogs with cAD in the present study. This distribution of breeds is significantly different from that reported in previous studies that focused primarily on medium-to-large dog breeds.[5,6]

We also found that shih tzu, cocker spaniel and French bulldog breeds have a high prevalence of cAD. Although Maltese, poodle and Yorkshire terrier are common in Korea, these breeds did not show a significantly different prevalence of cAD compared with the registered dog population. Although a direct analysis of cAD prevalence was not performed, a study of dogs on which an intradermal allergen test was performed in Thailand included a significant number of poodle and shih tzu.[17] Furthermore, previous studies have shown that French bulldogs are predisposed to cAD in countries such as Switzerland and Germany.[5,10] Another study from Korea reported an increased prevalence of cAD in cocker spaniel, pug and fox terrier breeds.[18] This result was consistent with our findings in cocker spaniels. In the present study, bichon frise showed no significant difference in cAD prevalence, while a study conducted in Australia reported an increased risk for cAD in this breed.[9]

Regarding the breed-specific distribution of lesions, we revealed that shih tzus with cAD were predominantly affected by lesions involving the ventral neck, joint flexures, ventrum and axillae. Characteristic lesion distribution in atopic shih tzu has not been reported previously. *Malassezia* dermatitis can occur secondarily to cAD, and its risk is reportedly elevated in shih tzu.[19] The lesion distribution of *Malassezia* dermatitis primarily involves the ventral neck and axillae.[20] The higher risk of secondary *Malassezia* dermatitis in atopic shih tzus may be attributed not only to their skin folds in the ventral neck and axillae, which structurally predispose these regions to *Malassezia* overgrowth, but also to the characteristic distribution of atopic lesions on the ventrum discovered in the present study.

Lesions were particularly prevalent in the lip folds and tail folds of French bulldog with cAD. One study reported a predisposition for facial lesions in atopic French bulldogs, although specific areas within the face were not further detailed.[5] Another study, which analysed more detailed sites, found that atopic lesions in French bulldog were located primarily on the eyelids, axillae, and the flexural surfaces of the limbs.[6] Although this study and the present study observed differences in the specific facial areas affected, both showed a tendency for lesions of the face.[6] The wrinkled skin in this breed predisposes them to intertriginous dermatitis.[21] Additionally, we revealed that French bulldog developed lesions more frequently in the distal extremities. Paws are typically known to be a commonly affected area in cAD, yet our results showed that the prevalence of lesions on the paws was more concentrated in French bulldog compared to that in other breeds.[5–7,22,23]

In the present study, Dachshunds with cAD exhibited lesions on the dorsal thorax, significantly more than did other breeds. However, further research is needed because of the small sample size of Dachshunds ($n=7$) in this study. In general, the dorso-lumbar area is not a commonly affected site for atopic lesions in the dog.[15] However, one study reported that shar-pei and WHWT with cAD commonly exhibit lesions in the dorso-lumbar area.[6] Thus, not all breeds, yet some specific breeds with cAD, frequently develop lesions in the dorso-lumbar area.

The present study showed that the prevalence of ear lesions in cocker spaniels did not significantly differ from that in other breeds. The cocker spaniel is predisposed to developing otitis externa and is commonly affected by cAD.[24,25] Nevertheless, the Cocker spaniels

TABLE 2 Lesion frequency and proportion of affected body sites by breed in dogs with atopic dermatitis. Breeds with significantly higher odds ratios for each site compared to the other eight breeds are indicated.

	Breed								
Body site	**Maltese (*n*=68)**	**Poodle (*n*=50)**	**Pomeranian (*n*=22)**	**Shih tzu (*n*=35)**	**Bichon frise (*n*=27)**	**Cocker spaniel (*n*=25)**	**Dachshund (*n*=7)**	**Yorkshire terrier (*n*=11)**	**French bulldog (*n*=11)**
Perilabial (upper)	9 (13%)	10 (20%)	2 (9%)	3 (9%)	5 (19%)	4 (16%)	2 (29%)	1 (9%)	2 (18%)
Perilabial (lower)	14 (21%)	8 (16%)	0 (0%)	11 (31%)	4 (15%)	9 (36%)	0 (0%)	2 (18%)	**7 (64%)****
Nasal bridge	10 (15%)	7 (14%)	2 (9%)	7 (20%)	3 (11%)	2 (8%)	2 (29%)	3 (27%)	4 (36%)
Ventral neck	11 (16%)	9 (18%)	2 (9%)	**14 (40%)*****	1 (4%)	5 (20%)	2 (29%)	1 (9%)	2 (18%)
Lt. Dorsal neck	3 (4%)	2 (4%)	2 (9%)	5 (14%)	3 (11%)	0 (0%)	0 (0%)	2 (18%)	1 (9%)
Rt. Dorsal neck	4 (6%)	2 (4%)	2 (9%)	**7 (20%)***	3 (11%)	1 (4%)	1 (14%)	1 (9%)	1 (9%)
Lt. Pinna (outer)	3 (4%)	2 (4%)	1 (5%)	2 (6%)	0 (0%)	1 (4%)	1 (14%)	1 (9%)	1 (9%)
Rt. Pinna (outer)	4 (6%)	4 (8%)	2 (9%)	3 (9%)	1 (4%)	2 (8%)	2 (29%)	2 (18%)	1 (9%)
Lt. Pinna (medial)	42 (62%)	33 (66%)	9 (41%)	22 (63%)	11 (41%)	17 (68%)	4 (57%)	5 (45%)	9 (82%)
Rt. Pinna (medial)	43 (63%)	34 (68%)	11 (50%)	23 (66%)	14 (52%)	17 (68%)	4 (57%)	6 (55%)	8 (73%)
Lt. Dorsal thorax	17 (25%)	14 (28%)	9 (41%)	12 (34%)	7 (26%)	6 (24%)	**5 (71%)***	2 (18%)	3 (27%)
Rt. Dorsal thorax	13 (19%)	**20 (40%)***	7 (32%)	10 (29%)	5 (19%)	7 (28%)	**5 (71%)***	2 (18%)	1 (9%)
Lt. Lumbo-Sacral area	9 (13%)	8 (16%)	2 (9%)	5 (14%)	4 (15%)	2 (8%)	3 (43%)	2 (18%)	1 (9%)
Rt. Lumbo-Sacral area	8 (12%)	10 (20%)	3 (14%)	8 (23%)	2 (7%)	4 (16%)	2 (29%)	2 (18%)	1 (9%)
Lt. Forelimb (cranial)	0 (0%)	1 (2%)	0 (0%)	2 (6%)	0 (0%)	1 (4%)	0 (0%)	1 (9%)	1 (9%)
Rt. Forelimb (cranial)	0 (0%)	2 (4%)	0 (0%)	2 (6%)	0 (0%)	0 (0%)	0 (0%)	1 (9%)	1 (9%)
Lt. Forelimb (caudal)	2 (3%)	1 (2%)	0 (0%)	3 (9%)	1 (4%)	0 (0%)	0 (0%)	1 (9%)	1 (9%)
Rt. Forelimb (caudal)	0 (0%)	1 (2%)	0 (0%)	**3 (9%)***	1 (4%)	0 (0%)	0 (0%)	0 (0%)	1 (9%)
Lt. Hind limb (cranial)	4 (6%)	4 (8%)	2 (9%)	5 (14%)	2 (7%)	2 (8%)	2 (29%)	1 (9%)	3 (27%)
Rt. Hind limb (cranial)	3 (4%)	7 (14%)	2 (9%)	6 (17%)	2 (7%)	0 (0%)	2 (29%)	2 (18%)	1 (9%)
Lt. Hind limb (caudal)	4 (6%)	10 (20%)	3 (14%)	7 (20%)	2 (7%)	1 (4%)	0 (0%)	1 (9%)	3 (27%)
Rt. Hind limb (caudal)	8 (12%)	8 (16%)	3 (14%)	6 (17%)	3 (11%)	1 (4%)	0 (0%)	1 (9%)	3 (27%)
Lt. Elbow	1 (1%)	0 (0%)	1 (5%)	1 (3%)	0 (0%)	0 (0%)	0 (0%)	1 (9%)	1 (9%)
Rt. Elbow	1 (1%)	0 (0%)	0 (0%)	1 (3%)	0 (0%)	0 (0%)	0 (0%)	1 (9%)	1 (9%)
Lt. Cubital flexor	12 (18%)	6 (12%)	2 (9%)	**10 (29%)***	4 (15%)	5 (20%)	1 (14%)	0 (0%)	3 (27%)
Rt. Cubital flexor	11 (16%)	6 (12%)	2 (9%)	9 (26%)	2 (7%)	4 (16%)	1 (14%)	0 (0%)	1 (9%)
Ventral trunk	14 (21%)	20 (40%)	9 (41%)	**18 (51%)***	7 (26%)	7 (28%)	3 (43%)	5 (45%)	2 (18%)
Inguina	23 (34%)	27 (54%)	11 (50%)	19 (54%)	11 (41%)	11 (44%)	4 (57%)	4 (36%)	7 (64%)

TABLE 2 (Continued)

Body site	Breed								
	Maltese (*n*=68)	**Poodle (*n*=50)**	**Pomeranian (*n*=22)**	**Shih tzu (*n*=35)**	**Bichon frise (*n*=27)**	**Cocker spaniel (*n*=25)**	**Dachshund (*n*=7)**	**Yorkshire terrier (*n*=11)**	**French bulldog (*n*=11)**
Tail (dorsal)	3 (4%)	4 (8%)	1 (5%)	3 (9%)	0 (0%)	2 (8%)	1 (14%)	0 (0%)	**3 (27%)***
Tail (ventral)	9 (13%)	**15 (30%)***	1 (5%)	9 (26%)	2 (7%)	4 (16%)	3 (43%)	3 (27%)	1 (9%)
Lt. Axilla	13 (19%)	11 (22%)	1 (5%)	**14 (40%)****	5 (19%)	4 (16%)	2 (29%)	3 (27%)	5 (45%)
Rt. Axilla	9 (13%)	14 (28%)	1 (5%)	**15 (43%)****	5 (19%)	5 (20%)	3 (43%)	3 (27%)	4 (36%)
Lt. Periocular	22 (32%)	21 (42%)	3 (14%)	12 (34%)	11 (41%)	6 (24%)	1 (14%)	3 (27%)	4 (36%)
Rt. Periocular	23 (34%)	**22 (44%)***	3 (14%)	11 (31%)	11 (41%)	4 (16%)	0 (0%)	2 (18%)	6 (55%)
Forehead	2 (3%)	3 (6%)	0 (0%)	**5 (14%)***	0 (0%)	2 (8%)	1 (14%)	1 (9%)	1 (9%)
Lt. Forepaw (dorsal)	22 (32%)	16 (32%)	2 (9%)	14 (40%)	8 (30%)	10 (40%)	3 (43%)	3 (27%)	**8 (73%)****
Rt. Forepaw (dorsal)	18 (26%)	19 (38%)	2 (9%)	**17 (49%)***	8 (30%)	7 (28%)	3 (43%)	2 (18%)	**9 (82%)****
Lt. Forepaw (ventral)	24 (35%)	18 (36%)	5 (23%)	17 (49%)	13 (48%)	12 (48%)	5 (71%)	3 (27%)	**10 (91%)*****
Rt. Forepaw (ventral)	21 (31%)	20 (40%)	5 (23%)	16 (46%)	10 (37%)	13 (52%)	4 (57%)	3 (27%)	**9 (82%)****
Lt. Hind paw (dorsal)	20 (29%)	16 (32%)	2 (9%)	12 (34%)	9 (33%)	8 (32%)	4 (57%)	2 (18%)	**8 (73%)****
Rt. Hind paw (dorsal)	20 (29%)	18 (36%)	3 (14%)	13 (37%)	7 (26%)	8 (32%)	4 (57%)	3 (27%)	6 (55%)
Lt. Hind paw (ventral)	21 (31%)	20 (40%)	3 (14%)	12 (34%)	9 (33%)	11 (44%)	3 (43%)	2 (18%)	**8 (73%)***
Rt. Hind paw (ventral)	20 (29%)	20 (40%)	1 (5%)	14 (40%)	10 (37%)	9 (36%)	4 (57%)	4 (36%)	7 (64%)
Perineum	36 (53%)	31 (62%)	10 (45%)	21 (60%)	15 (56%)	19 (76%)	4 (57%)	6 (55%)	9 (82%)

Note: Statistically significant sites for each breed are presented in bold and underlined text.

*$p<0.05$; **$p<0.01$; ***$p<0.001$.

FIGURE 1 Illustration of atopic dogs with affected body sites by breed.

involved in this study did not show a distinct pattern of atopic lesions concentrated in the concave pinna compared with other breeds.

Maltese, Pomeranian, bichon frise and Yorkshire terrier did not show a significantly higher prevalence of atopic lesions at specific sites than the other breeds. According to a previous study, atopic lesions in Maltese were frequently observed on the ventrum and paws.[7] Nevertheless, no studies have analysed the distribution of atopic lesions in Pomeranian, bichon frise and Yorkshire terrier.

The limitations of this study include the small number of dogs with cAD, including French bulldogs ($n=11$), Yorkshire terriers ($n=11$) and Dachshunds ($n=7$). Owing to the lack of data on the duration of the disease and drug administration, the lesion distribution in this study was limited to the condition at the time of imaging. Therefore, further studies with larger sample sizes and more detailed clinical histories are required.

CONCLUSIONS

In this study, 9 small-to-medium breeds <25 kg body weight) were selected from 331 client-owned dogs with cAD, representing 77% of the total cAD group. Among the selected breeds, shih tzu, cocker spaniel and French bulldog had a high prevalence of cAD. Moreover, the most prevalent body sites varied based on breed-specific characteristics in shih tzu (ventral aspect), French bulldog (face and paws) and Dachshund (dorsal thorax). Although Maltese, poodle, Pomeranian, bichon frise, cocker spaniel and Yorkshire terrier accounted for a larger proportion of both the registered dog population and the cAD group in this study, no significant characteristic patterns were observed in the site distribution affected by lesions.

AUTHOR CONTRIBUTIONS

Ji-Hye Ryu: Conceptualization; methodology; data curation; investigation; formal analysis; writing – original draft. **Jung-Hun Kang:** Data curation; supervision; validation; writing – review and editing. **Yeong-Hun Kang:** Validation. **Min-Sun Kim:** Investigation. **Hyun-Jung Kim:** Conceptualization. **Eun-A. Huh:** Conceptualization. **Sung-Hoon Kim:** Data curation; formal analysis. **Jong-Soo Jeon:** Investigation. **Cheol-Yong Hwang:** Project administration; validation; supervision.

ACKNOWLEDGEMENTS

The authors appreciate the veterinarians who assisted with the image acquisition and data collection. The animal registration data used in this study were provided by the Ministry of Agriculture, Food and Rural Affairs of Korea (MAFRA) through their Open API, under the Creative Commons Attribution-ShareAlike licence (CC BY-SA). The original data can be accessed via the public data portal of MAFRA.

FUNDING INFORMATION

This study was supported by AIFORPET Corp.

CONFLICT OF INTEREST STATEMENT

No conflicts of interest have been declared.

DATA AVAILABILITY STATEMENT

Research data are not shared.

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Résumé
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Resumen
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Zusammenfassung
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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Ryu J-H, Kang J-H, Kang Y-H, Kim M-S, Kim H-J, Huh E-A, et al. Prevalence and lesion distribution of atopic dermatitis in small-to-medium breed dogs in Korea. Vet Dermatol. 2025;00:1–8. https://doi.org/10.1111/vde.13329