Original paper

The effect of house dust mite sensitization on skin dermis thickness in children with allergic respiratory diseases

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Abstract

Introduction: An impaired skin barrier has been reported in allergic diseases.
Aim: In this study, we aimed to evaluate dermis thickness in children with house dust allergy without skin symptoms.
Material and methods: This cross-sectional study included children aged 4–18 years with asthma and/or allergic rhinitis. Participants were divided into three groups: healthy controls (n = 50), patients sensitized to house dust mites (n = 60), and patients with negative house dust mite tests (n = 48). The thickness of the dermis layers of the skin was measured at the cubital fossa using an ultrasound.
Results: The median age and gender distribution were similar across the house dust mite-positive and -negative groups and the healthy control group. There was no significant difference between the groups in terms of dermis thickness (p = 0.053). Absolute eosinophils and eosinophil percentage were significantly negatively correlated with dermis (p < 0.05). There was no significant correlation between total IgE, house dust mite specific IgE and skin test values and skin thickness (p > 0.05).
Conclusions: The findings of this study highlight the impact of house dust mite sensitization on skin thickness, offering potential contributions to the management and treatment strategies of allergic diseases.

Key words: house dust mite sensitization, skin barrier, skin thickness, children, allergy.

Introduction

Allergic diseases can manifest as respiratory allergies such as asthma and allergic rhinitis, as well as skin allergies like atopic dermatitis and urticaria, and food allergies [1]. The prevalence of allergic diseases in children is steadily increasing [2]. With growing scientific evidence, the epithelial barrier hypothesis suggests that weakness or damage to the skin's epithelial tissue may be associated with the development of allergic diseases [3–6].

The skin prevents microorganisms, allergens, and irritants from entering the body, emphasizing the importance of maintaining its strong barrier function [7]. Environmental exposures such as global warming, biodiversity loss, pollution, pathogens, allergens, detergents, microplastics, additives in processed foods, and dietary habits can disrupt mucosal and skin barriers [3].

A compromised skin barrier has been reported in allergic skin diseases, such as atopic dermatitis [8, 9]. Even in patients with house dust mite allergy diagnosed with asthma and allergic rhinitis who do not show visible skin symptoms, a disruption in the skin barrier may occur due to the similar clinical course and pathophysiological mechanisms of allergic diseases [10]. A previous study conducted in our clinic found that children with house dust mite allergy diagnosed with asthma and allergic rhinitis had lower skin moisture and sebum content [10].

The skin consists of three layers: the epidermis, dermis, and hypodermis. The epidermis is the outermost layer, made up of stratified squamous epithelium. The dermis is the middle layer, primarily composed of collagen and amorphous connective tissue. The hypodermis, or subcutaneous tissue, is a true endocrine organ composed of fat cell lobules separated by fibrous septa made

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of collagen and blood vessels [11]. When the stratum corneum, a layer of the epidermis, is thinner, the distance that external substances need to travel to penetrate the skin is reduced, leading to increased skin permeability in these areas [12]. To maintain the skin's barrier function, the thickness of these layers must be appropriate.

Aim

In this context, the present study aimed to evaluate the dermis thickness in children with house dust mite allergy who do not exhibit visible skin symptoms.

Material and methods

Study type and design

This cross-sectional study aims to evaluate the thickness of the dermis of the skin in children aged 4–18 years with asthma and/or allergic rhinitis sensitized to house dust mites but without visible skin symptoms. The study included three groups for comparison.

The healthy control group consisted of children aged 4–18 years who had no diagnosis of skin or chronic diseases and visited the paediatric radiology clinic for routine assessments (e.g., growth and development evaluations, imaging studies such as abdominal ultrasound, minor surgical procedures like circumcision). The patient group sensitized to house dust mites included children aged 4–18 years diagnosed with asthma and/or allergic rhinitis, confirmed through positive allergy test results for house dust mites (Der f and/or Der p). Lastly, the patient group with negative house dust mite test results comprised children aged 4–18 years who were also diagnosed with asthma and/or allergic rhinitis but had negative results on allergy testing for house dust mites. Data collection spanned approximately 2 months. All children who met the inclusion criteria and provided informed consent were included in the study.

Exclusion criteria included filaggrin mutations, xerosis, a history of or current atopic dermatitis, and inflammatory, genetic, or infectious diseases (e.g., dermatitis herpetiformis, molluscum contagiosum, tinea, mycosis fungoides, psoriasis, urticaria, scabies). These criteria were excluded to minimize confounding variables that could independently affect skin barrier function and study outcomes.

Figure 1. A thick gel layer is created on the antecubital region and the probe is placed without applying pressure

Evaluations

The sociodemographic characteristics (such as age and gender), haematological parameters (including leukocytes, eosinophils, lymphocytes, and platelets), total IgE levels, and the thickness of the dermis of the skin were evaluated.

The thickness of the dermis of the skin was measured non-invasively using a Siemens Acuson S3000 Ultrasound System (Siemens Medical Solutions USA, Inc), utilizing a 14 MHz linear probe in the paediatric radiology department. A gel membrane was applied to the specified area in the right antecubital region. The thicknesses of the dermis was measured in the magnified images. Measurements were performed with the same device and standard protocols in all participants (Figures 1, 2).

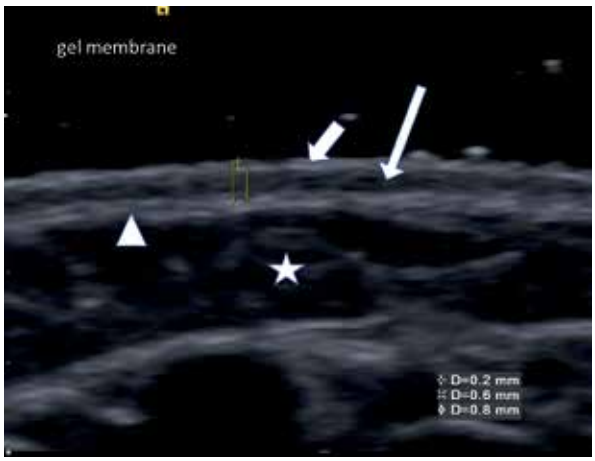

Figure 2. At the top, there is hyperechoic epidermis (short arrow), just below there is hypoechoic dermis (long arrow), and below there is a subcutaneous fat layer (arrowhead) and subcutaneous fat lobules (star)

Statistical analysis

The data analysis and recording were conducted using the IBM SPSS 25.0 software program for Windows, designed for Social Sciences. Descriptive statistics were presented as mean, standard deviation, median, 25–75th percentiles, counts (*n*) and percentages (%). Categorical variables were compared using the χ^2 test. The normality of the distribution of continuous variables was evaluated through visual methods (e.g., histograms and probability plots) and statistical tests (Kolmogorov-Smirnov/Shapiro-Wilk). For continuous variables not following a normal distribution, the Mann-Whitney *U* test was used for comparisons between two groups, and the Kruskal-Wallis test was employed for comparisons among more than two groups. Spearman correlation analysis was applied to assess relationships between non-normally distributed continuous variables. A *p*-value of less than 0.05 was considered statistically significant.

Results

The data of a total of 158 children were evaluated in the study. In the patient group, there were 7 patients with asthma, 51 patients with asthma and allergic rhinitis and 50 patients with allergic rhinitis. There were 60 patients who were house dust mite positive and 48 who were negative. The number of healthy controls was 50.

The median age and gender distribution of the patients who were positive and negative for house dust mite and the healthy group were similar. Of the house dust mite positive and negative patients and the healthy group, 58.3% (n = 35), 56.3% (n = 27) and 60.0% (n = 30), respectively were male. The median age was 10.0 years (7.0–13.0) in patients with house dust mite sensitization and in the healthy control group. In patients without house dust mite sensitization, the median age was 7.0 years (6.0–11.0) (Table 1).

The laboratory values of patients with and without house dust mite sensitization were evaluated. Total IgE, absolute eosinophil count, and eosinophil percentage were significantly higher in patients with house dust mite sensitization ($p < 0.05$). However, no significant differences were observed in WBC, neutrophil, lymphocyte, and platelet values (Table 2).

Dermis thickness was evaluated in children with allergic disease and in the control group. There was no significant difference between the groups in terms of dermis thickness ($p = 0.053$) (Table 3).

Factors associated with dermis thickness of patients with house dust mite sensitization were evaluated. Absolute eosinophils and eosinophil percentage were significantly negatively correlated with dermis ($p < 0.05$). There was no significant correlation between total IgE, house dust mite specific IgE and skin test values and skin thickness ($p > 0.05$) (Table 4).

Table 1. Gender and age distribution of the patient groups and healthy group

Parameter		Group			*P*-value
		House dust mite sensitized (n = 60)	Without house dust mite sensitization (n = 48)	Healthy control (n = 50)	
Gender, *n* (%)	Female	25 (41.7)	21 (43.8)	20 (40.0)	0.931
	Male	35 (58.3)	27 (56.3)	30 (60.0)	
Age [years], median (25–75 percentile)		10.0 (7.0–13.0)	7.0 (6.0–11.0)	10.0 (7.0–13.0)	0.051

Table 2. Laboratory values of patients with and without house dust mite sensitization

Parameter	Group		*P*-value
	House dust mite sensitized (n = 60) Median (25–75 percentile)	Without house dust mite sensitization (n = 48) Median (25–75 percentile)	
WBCs [10^3 mm^3]	7550.0 (6550.0–9030.0)	7545.0 (6385.0–8550.0)	0.429
Neutrophils [10^3/µl]	3420.0 (2520.0–4470.0)	3795.0 (2880.0–4625.0)	0.502
Eosinophils (absolute) [10^3/µl]	400.0 (220.0–710.0)	160.0 (100.0–280.0)	< 0.001
Eosinophils (%)	4.9 (3.3–8.7)	2.3 (1.6–3.6)	< 0.001
Lymphocytes [10^3/µl]	2910.0 (2470.0–3590.0)	2800.0 (2330.0–3330.0)	0.290
Platelets [10^3 mm^3]	311000.0 (273000.0–357000.0)	320000.0 (273500.0–348000.0)	0.918
Total IgE [IU/ml]	287.0 (114.0–548.0)	60.0 (34.0–122.0)	< 0.001
Specific IgE (House dust mite)	40.5 (15.9–91.5)	–	–
SPT (House dust mite)	5.0 (3.0–7.0)	–	–

SPT – skin prick test.

Table 3. Skin thickness values of patients and control groups

Parameter		Group			*P*-value
		House dust mite sensitized (*n* = 60)	Without house dust mite sensitization (*n* = 48)	Healthy control (*n* = 50)	
Dermis thickness [µm]	Median (25–75 percentile)	600.0 (500–800)	600.0 (500–600)	500.0 (40–600)	0.053
	Mean ± SD	615.0 ±203.2	565.0 ±145.1	522.0 ±173.0	

Table 4. Factors associated with dermis thickness of patients with house dust mite sensitization

Parameter		Dermis thickness [µm]
Eosinophils (absolute) [10^3/µl]	*R*	–0.269*
	P	0.043
Eosinophils (%)	*R*	–0.265*
	P	0.047
Total IgE [IU/ml]	*R*	–0.233
	P	0.082
sIgE (house dust mite)	*R*	–0.091
	P	0.504
sIgE (house dust mite)/total IgE	*R*	0.170
	P	0.224
SPT (house dust mite)	*R*	0.206
	P	0.358

SPT – skin prick test.

Discussion

Allergic diseases are among the chronic inflammatory conditions that negatively affect the quality of life of individuals [13]. It is known that the skin barrier function may be impaired in allergic diseases [7]. The integrity and structural properties of the epidermis and dermis layers are important for the skin barrier [14]. Although there are several studies on skin barrier in atopic dermatitis, one of the allergic skin diseases, there are limited studies on skin barrier in respiratory allergies such as asthma and allergic rhinitis [10, 15, 16]. In this study, skin dermis thickness levels were compared in asthma and allergic rhinitis patients with and without house dust mite sensitization as well as in the control group of healthy individuals. The study aims to make an important contribution to understanding the structural effects of allergic respiratory diseases on the skin.

In a previous study conducted in our allergy clinic, skin moisture levels in patients with asthma, allergic rhinitis, and atopic dermatitis were found to be significantly lower compared to the control group [17]. In terms of skin barrier function, it is essential to maintain not only a certain level of skin oil and moisture but also the structural integrity of the epidermis and dermis layers [14]. In this study, no significant difference was observed between the groups in terms of dermis thickness; however, the results were close to the threshold of statistical significance. Patients with house dust mite sensitization had greater dermis thickness compared to both allergic patients without house dust mite sensitization and the healthy control group. Thinner skin areas are reported to be more prone to rapidly reestablishing barrier function due to higher proliferative activity and faster epidermal renewal [14, 18]. Therefore, while patients with house dust mite sensitization and greater skin thickness might be more resistant to external factors that could damage the skin, they could be at a disadvantage in terms of barrier function renewal.

The lack of significant differences in dermis thickness between groups in this study may be attributed to the small sample size, potentially limiting the power to detect subtle variations. Further studies with larger, multicentre cohorts are needed to provide more generalizable results. Moreover, the observed increase in skin thickness among patients with house dust mite sensitization may be attributed to thickening of the skin tissue as a result of allergen-associated inflammatory processes [19]. Further studies are needed to understand the underlying pathophysiological mechanisms of skin thickness and allergic diseases.

Factors associated with dermis thickness of patients with house dust mite sensitization were evaluated. Absolute eosinophils and eosinophil percentage were significantly negatively correlated with dermis. Higher eosinophil levels may be associated with the role of allergic mechanisms in the patients. In the literature, higher blood eosinophil levels have been reported in asthma patients with more frequent attacks, suggesting that eosinophil levels may be related to the clinical severity of the disease [20]. In our study, the lower thickness in patients with higher levels of eosinophils supports the hypothesis that the underlying allergic pathophysiologic mechanisms in allergic diseases may affect the skin structure. When evaluating allergic diseases in clinical practice, blood parameters such as high eosinophil levels may provide predictions about dermal features such as skin thickness. Evaluation of these parameters together may provide better data for disease management. It is conceivable that a certain group of allergic patients at higher risk, especially those with higher eosinophilia levels as found in our study, could be referred for dermal examination. However, further clinical studies with large samples are needed in this respect.

This study has some limitations. Firstly, the limited number of individuals included in the patient and control groups and the fact that the study was conducted in a single centre may limit the generalizability of the results obtained. In addition, since a cross-sectional design was used, the long-term effects of house dust sensitization on skin dermis thickness could not be evaluated.

In addition to the limitations, the study also has strengths. Comparison of children with allergic respiratory diseases with a healthy control group allowed a more comprehensive evaluation of the results. Measurement of dermis thickness by an objective method such as ultrasound increased the accuracy and reliability of the data obtained. The limited number of studies examining the effect of house dust sensitization on skin thickness in the literature makes this a unique study.

Conclusions

We found that skin thickness increased in children with allergic diseases compared to the control group. This increase was more pronounced in children with house dust mite sensitization. The findings of this study have the potential to contribute to the management and treatment strategies of allergic diseases by revealing the effects of house dust sensitization on skin thickness. In children with allergic diseases, multidisciplinary approaches should be adopted in collaboration with dermatology, radiology and paediatric allergists in which skin health is also evaluated. Imaging methods such as ultrasound, which can be used in the diagnosis of skin diseases [21], may also be considered in the management of allergic diseases.

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Ethical approval

Ethical approval was obtained from the Health Sciences University Ümraniye Training and Research Hospital Ethics Committee (Date: 05/09/2024, decision number: 280). Patients and parents were informed before their participation in the study, and informed consent for their participation in the study was obtained.

Conflict of interest

The authors declare no conflict of interest.

References

1. Pascal M, Perez-Gordo M, Caballero T, et al. Microbiome and allergic diseases. Front Immunol 2018; 9: 1584.
2. Gutowska-Ślesik J, Samoliński B, Krzych-Fałta E. The increase in allergic conditions based on a review of literature. Adv Dermatol Allergol 2023; 40: 1-7.
3. Losol P, Sokolowska M, Hwang YK, et al. Epithelial barrier theory: the role of exposome, microbiome, and barrier function in allergic diseases. Allergy Asthma Immunol Res 2023; 15: 705-24.
4. Akdis CA. Does the epithelial barrier hypothesis explain the increase in allergy, autoimmunity and other chronic conditions? Nat Rev Immunol 2021; 21: 739-51.
5. Pat Y, Yazici D, D'Avino P, et al. Recent advances in the epithelial barrier theory. Int Immunol 2024; 36: 211-22.
6. Pawankar R, Akdis CA. Climate change and the epithelial barrier theory in allergic diseases: A One Health approach to a green environment. Allergy 2023; 78: 2829-34.
7. Leung DY, Berdyshev E, Goleva E. Cutaneous barrier dysfunction in allergic diseases. J Allergy Clin Immunol 2020; 145: 1485-97.
8. Peng W, Novak N. Pathogenesis of atopic dermatitis. Clin Exp Allergy 2015; 45: 566-74.
9. Güneş H, Nazik H, Özkars MY, et al. The assessment of skin sebum and moisture content of infants with atopic dermatitis. Turk J Med Sci 2020; 50: 844-8.
10. Altaş U, Altaş ZM, Ercan N, et al. The effect of house dust sensitization on skin sebum and moisture in children with allergic respiratory diseases. Children 2023; 10: 1483.
11. Gilaberte Y, Prieto-Torres L, Pastushenko I, Juarranz Á. Anatomy and function of the skin. In: Nanoscience in Dermatology. Hamblin MR, Avci P, Prow TW (eds.). Academic Press 2016; 1-14.
12. Dąbrowska A, Spano F, Derler S, et al. The relationship between skin function, barrier properties, and body-dependent factors. Skin Res Technol 2018; 24: 165-74.
13. Jarosz M, Syed S, Błachut M, et al. Emotional distress and quality of life in allergic diseases. Wiad Lek 2020; 73: 370-3.
14. Boer M, Duchnik E, Maleszka R, Marchlewicz M. Structural and biophysical characteristics of human skin in maintaining proper epidermal barrier function. Adv Dermatol Allergol 2016; 33: 1-5.
15. Yoshida T, Beck LA, De Benedetto A. Skin barrier defects in atopic dermatitis: from old idea to new opportunity. Allergol Int 2022; 71: 3-13.
16. Altaş U, Akman E, Akbulak Ö, et al. Evaluation of changes in skin sebum and moisture content with treatment in children with atopic dermatitis. J Transl Pract Med 2023; 2: 53-9.
17. Çevik S, Altaş U, Özkars MY. The skin sebum and moisture levels of children with allergic diseases: how predictive are they for house dust mite allergy? Diagnostics 2024; 14: 1348.
18. Fluhr JW, Dickel H, Kuss O, et al. Impact of anatomical location on barrier recovery, surface pH and stratum corneum hydration after acute barrier disruption. Br J Dermatol 2002; 146: 770-6.
19. Beck LA, Cork MJ, Amagai M, et al. Type 2 inflammation contributes to skin barrier dysfunction in atopic dermatitis. JID Innov 2022; 2: 100131.
20. Tran TN, Khatry DB, Ke X, et al. High blood eosinophil count is associated with more frequent asthma attacks in asthma patients. Ann Allergy Asthma Immunol 2014; 113: 19-24.
21. Cisoń H, Białynicki-Birula R. High-frequency ultrasonography: one of the modern imaging diagnostic methods in dermatology. Authors' own experience and review. Adv Dermatol Allergol 2024; 41: 306-13.