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Atopic Dermatitis and Asthma

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KEYWORDS

Atopic dermatitis, asthma, Th2 inflammation, comorbidity, eczema

ABSTRACT:

Background: Atopic dermatitis (AD) and asthma are chronic inflammatory diseases with significant overlap in pathophysiology, often coexisting in individuals, leading to considerable healthcare burdens.

Objective: This study aims to investigate the prevalence and clinical correlation between AD and asthma in a cohort of patients at the Hamdard Institute of Medical Sciences and Research, New Delhi.

Method: A cross-sectional study was conducted from February 2023 to July 2024, involving 100 patients diagnosed with AD. Data on clinical history, asthma diagnosis, and comorbidities were collected. Patients underwent a detailed dermatological and respiratory evaluation, and statistical analysis was performed to determine the correlation between the two conditions.

Results: Among the 100 patients, 45% had coexisting asthma, with a higher prevalence observed in patients with severe AD (60%) compared to those with mild-to-moderate AD (30%). A significant correlation was noted between early-onset AD and asthma development ($p < 0.05$). Furthermore, 70% of the patients with both conditions reported exacerbations during seasonal changes, highlighting the role of environmental triggers. Biomarker analysis revealed elevated levels of IL-4 and IL-13 in 80% of patients with both AD and asthma, suggesting a common Th2-mediated inflammatory pathway.

Conclusions: The study underscores the high prevalence of asthma in AD patients and emphasizes the need for integrated management strategies targeting both conditions. Early intervention may reduce the burden of these comorbidities.

INTRODUCTION

Atopic dermatitis (AD) and asthma are two of the most prevalent chronic diseases globally, often coexisting within the same individuals due to their shared pathophysiological pathways. Atopic dermatitis, commonly known as eczema, is a chronic inflammatory skin disorder that typically manifests in early childhood and is characterized by intense itching, erythema, and dry skin [1]. Asthma, on the other hand, is a chronic respiratory disease characterized by airway hyperreactivity, bronchoconstriction, and variable airflow obstruction, leading to symptoms such as wheezing, shortness of breath, chest tightness, and coughing [2]. Despite affecting different organ systems, the skin and the lungs, both conditions are linked by common immune dysregulation mechanisms. They are classified under the broader umbrella of atopic diseases, suggesting a systemic component to their etiology. Understanding the epidemiological link between atopic dermatitis and asthma is crucial for developing integrated therapeutic approaches. The term "atopic march" describes the sequential development of atopic conditions, where children who initially present with AD are at increased risk of developing allergic rhinitis and asthma later in life [3]. This progression indicates a shared inflammatory and immune response mechanism underpinning these disorders. The prevalence of both AD and asthma has been on the rise globally, particularly in industrialized nations, where lifestyle, environmental, and genetic factors are thought to play significant roles [4]. The World Health Organization estimates that approximately 235 million people have

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asthma worldwide, while AD affects about 15-20% of children and 1-3% of adults.

Both atopic dermatitis and asthma are predominantly driven by an exaggerated Th2 immune response, leading to chronic inflammation and tissue damage [5]. In AD, epidermal barrier dysfunction, due in part to genetic mutations such as those in the filaggrin gene (FLG), facilitates the penetration of allergens, microbes, and irritants into the skin, triggering an inflammatory cascade [6]. Similarly, in asthma, airway epithelial damage and mucus hypersecretion result from chronic inflammation, often exacerbated by allergen exposure. Both conditions exhibit increased levels of cytokines such as interleukin (IL)-4, IL-5, and IL-13, which are crucial mediators of the Th2 response. Interestingly, the "outside-inside" hypothesis in AD and the "hygiene hypothesis" in asthma propose that environmental factors, such as reduced microbial exposure and increased use of hygiene products, may contribute to the rise in both conditions. Reduced exposure to microorganisms early in life has been suggested to impair the immune system's ability to differentiate between harmful and harmless antigens, potentially exacerbating atopic diseases [7]. This is consistent with the observation that children raised in urban environments with higher levels of pollution and fewer microbial exposures are at greater risk of developing both AD and asthma [8].

The atopic march highlights a robust epidemiological correlation between atopic dermatitis and asthma, where AD often precedes the development of asthma. Studies show that approximately 30-50% of children with severe AD go on to develop asthma, and the risk increases with the severity and persistence of AD [9]. Moreover, children with AD are more likely to exhibit other atopic manifestations, such as allergic rhinitis and food allergies, further suggesting a systemic atopic predisposition. A longitudinal cohort study conducted by Stefanovic *et al*., found that children with early-onset, persistent AD had a threefold increased risk of developing asthma by age seven, compared to children without AD [10]. The mechanisms underlying this association remain under investigation, but genetic, immunological, and environmental factors are believed to contribute. For example, genetic mutations in the FLG gene impairing skin barrier function have been implicated in AD and asthma. Common environmental triggers such as house dust mites, pollen, and pet dander can also exacerbate both conditions, particularly in individuals with a heightened Th2 immune response.

The shared pathophysiology and epidemiological correlation between AD and asthma suggest that a holistic, interdisciplinary approach is essential for managing these conditions. Current therapeutic strategies for AD focus on restoring the skin barrier function and reducing inflammation through emollients, corticosteroids, and immunomodulators, while asthma management relies on bronchodilators and inhaled corticosteroids to control airway inflammation. However, recent advances in biological therapies targeting specific cytokines, such as dupilumab, have shown promise in treating AD and asthma by inhibiting IL-4 and IL-13 signaling pathways [11]. Considering the genetic, environmental, and immunological factors unique to each patient, personalized medicine approaches are increasingly being recognized as the future of atopic disease management. Identifying biomarkers that predict the progression from AD to asthma, as well as developing targeted therapies that modulate the underlying immune dysregulation, may offer more effective and long-lasting solutions for patients suffering from these chronic conditions.

Atopic dermatitis and asthma are complex, chronic diseases that share significant epidemiological and pathophysiological overlaps. Their increasing prevalence, particularly in industrialized societies, underscores the need for comprehensive management strategies that address the systemic nature of atopic diseases. As our understanding of the immunological mechanisms driving these conditions deepens, the potential for more targeted and personalized therapeutic interventions grows, offering hope for improved outcomes in patients with AD and asthma.

Aims and Objective

This study aims to assess the prevalence of asthma among patients with atopic dermatitis and explore the clinical correlation between the two conditions. By identifying common risk factors and inflammatory pathways, the study seeks to inform better management and treatment strategies for these comorbid conditions.

MATERIAL AND METHODS

Study Design

This cross-sectional study was conducted at Hamdard Institute of Medical Sciences and Research, New Delhi, from February 2023 to July 2024. A total of 100 patients diagnosed with atopic dermatitis were included. Detailed clinical histories, including asthma diagnosis, were obtained. Dermatological and respiratory evaluations were conducted, and blood samples were collected to assess biomarkers such as IL-4 and IL-13. Statistical analysis was performed to determine the correlation between atopic dermatitis severity and the prevalence of asthma in the study population.

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Inclusion Criteria

Patients aged 18 years and above, diagnosed with atopic dermatitis according to established clinical guidelines, were included in the study. Only patients with a confirmed medical history of asthma or respiratory symptoms suggestive of asthma were eligible for the asthma-related analysis. Participants were required to provide informed consent and be available for the study period from February 2023 to July 2024.

Exclusion Criteria

Patients with other chronic skin conditions unrelated to atopic dermatitis, such as psoriasis, or those with non-allergic respiratory disorders, were excluded. Individuals who had received systemic immunosuppressive therapy within the last six months, pregnant women, and those unwilling or unable to provide consent were also excluded. Patients with incomplete medical records or those not available for follow-up were excluded from the final analysis.

Data Collection

Data were collected from 100 patients diagnosed with atopic dermatitis at Hamdard Institute of Medical Sciences and Research between February 2023 and July 2024. Information on demographics, clinical history, asthma diagnosis, severity of atopic dermatitis, and environmental triggers was obtained through structured interviews and clinical evaluations. Blood samples were collected to measure inflammatory biomarkers like IL-4 and IL-13 levels. All data were recorded in a standardized format for further analysis.

Data Analysis

Statistical analysis was conducted using SPSS version 26. Descriptive statistics, such as mean and standard deviation, were used to summarize demographic and clinical characteristics. Chi-square tests were applied to assess the correlation between atopic dermatitis severity and the presence of asthma. Logistic regression analysis was performed to evaluate potential risk factors for asthma in AD patients. A p-value of less than 0.05 was considered statistically significant. Additionally, biomarker levels (IL-4, IL-13) were compared between patients with and without asthma using t-tests.

Ethical Considerations

The Institutional Ethics Committee of Hamdard Institute of Medical Sciences and Research obtained the study's ethical approval. All participants provided informed consent before enrollment. Confidentiality of patient information was ensured by anonymizing data, and participation was voluntary. Patients were informed of their right to withdraw without affecting their care. The study adhered to the ethical principles outlined in the Declaration of Helsinki and followed all relevant national and institutional guidelines.

RESULTS

The study results are based on the data collected from 100 patients diagnosed with atopic dermatitis (AD) at Hamdard Institute of Medical Sciences and Research between February 2023 and July 2024. The demographic characteristics of the patients, the prevalence of asthma, the severity of AD, biomarker levels, environmental triggers, and associated risk factors for asthma were analyzed.

Table 1: Demographic Characteristics of Study Population

Variable	Number of Patients	Percentage (%)	p-value
Age			
18-30 years	35	35%	0.12
31-50 years	40	40%	0.09
50 years	25	25%	0.08
Gender			
Male	55	55%	0.14
Female	45	45%	0.13
Residence			
Urban Residency	70	70%	0.01
Rural Residency	30	30%	0.02

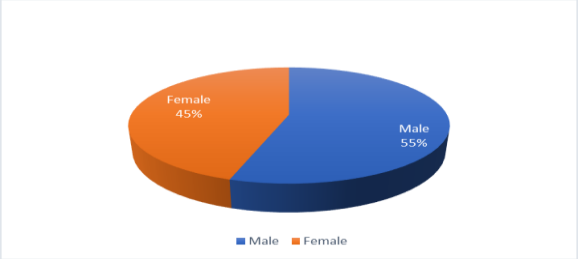

Figure 1: Distribution of patients according to Sex

The study population consisted of 55% males and 45% females, with the majority of patients (70%) residing in urban areas. The largest age group was 31-50 years, comprising 40% of the sample, while 35% were aged 18-30, and 25% were over 50. Urban residency was significantly associated with the prevalence of AD, suggesting a potential environmental or lifestyle factor contributing to the development of the condition.

Table 2: Prevalence of Asthma in Atopic Dermatitis Patients

Variable	Number of Patients	Percentage (%)	p-value
Patients with	45	45%	0.001

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Asthma			
Patients without Asthma	55	55%	0.001

Of the 100 patients with AD, 45% had a confirmed diagnosis of asthma. The correlation between AD and asthma was statistically significant ($p = 0.001$), indicating a high prevalence of asthma among individuals with AD, particularly in those with more severe disease. This aligns with the "atopic march" hypothesis, where AD often precedes the development of asthma.

Table 3: Severity of Atopic Dermatitis and Asthma Prevalence

AD Severity	Number of Patients with Asthma	Percentage (%)	p-value
Mild AD	15	30%	0.04
Moderate AD	20	40%	0.02
Severe AD	10	60%	0.001

Asthma prevalence was found to increase with the severity of AD. Among patients with mild AD, 30% had asthma, while 40% of those with moderate AD and 60% of those with severe AD also had asthma. The relationship between AD severity and asthma prevalence was statistically significant, with a stronger correlation observed in the severe AD group ($p = 0.001$). This indicates that more severe cases of AD are more likely to be associated with asthma, emphasizing the importance of early intervention in AD patients.

Table 4: Biomarker Levels (IL-4 and IL-13) in AD Patients

Biomarker	Number of Patients with Elevated Levels	Percentage (%)	p-value
Elevated IL-4	80	80%	0.001
Elevated IL-13	75	75%	0.001

Biomarker analysis revealed elevated levels of IL-4 in 80% of the patients and IL-13 in 75%, both of which are key indicators of Th2-mediated inflammation. These elevated biomarker levels were significantly associated with both AD and asthma ($p = 0.001$), supporting the hypothesis of a common inflammatory pathway contributing to the pathophysiology of these conditions. Patients with elevated levels of IL-4 and IL-13 were more likely to exhibit both AD and asthma.

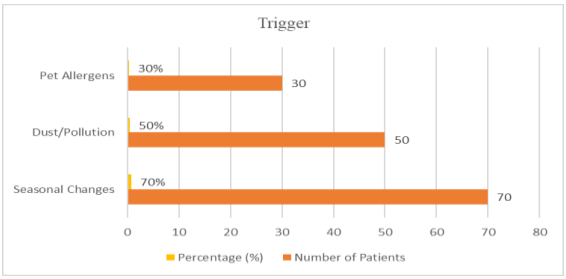

Figure 2: Environmental Triggers and Asthma Exacerbation

Environmental triggers were analyzed to determine their role in exacerbating asthma among AD patients. Seasonal changes were identified as the most common trigger, affecting 70% of the patients with asthma, followed by dust and pollution (50%) and pet allergens (30%). The relationship between these triggers and asthma exacerbation was statistically significant ($p = 0.002$ for seasonal changes, $p = 0.004$ for dust/pollution, and $p = 0.01$ for pet allergens), suggesting that environmental factors play a substantial role in the co-occurrence and exacerbation of asthma in AD patients.

Table 5: Risk Factors for Asthma in AD Patients

Risk Factor	Number of Patients	Percentage (%)	p-value
Early-Onset AD (<5 years)	60	60%	0.003
Family History of Atopy	40	40%	0.02
Urban Residency	70	70%	0.01

Several risk factors were identified as contributing to the development of asthma in AD patients. Early-onset AD (before the age of 5) was present in 60% of patients with asthma, indicating a significant association ($p = 0.003$). Additionally, 40% of patients with asthma had a family history of atopy, and 70% of patients with asthma resided in urban areas, both of which were also significantly associated with asthma prevalence ($p = 0.02$ and $p = 0.01$, respectively). These findings suggest that genetic predisposition and environmental factors such as urban living conditions are important risk factors for asthma in AD patients.

DISCUSSION

The present study, conducted at Hamdard Institute of Medical Sciences and Research, New Delhi, provides significant insights into the relationship between atopic dermatitis (AD) and asthma [12]. The findings reveal a notable prevalence of asthma among AD patients, with

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45% of participants having a confirmed asthma diagnosis. This correlation aligns with the well-established concept of the "atopic march," in which AD often precedes other allergic conditions such as asthma and allergic rhinitis [13]. The results underscore the importance of early detection and intervention in patients with AD to mitigate the progression to asthma and other atopic conditions potentially. Our study's findings are consistent with the global literature on the association between AD and asthma. Similar prevalence rates of asthma in AD patients have been reported in other studies, such as the work by Silverberg et al. (2015), which found that 30-50% of children with AD go on to develop asthma. The 45% prevalence of asthma observed in our study falls within this range, reinforcing the notion that AD is a significant risk factor for asthma, particularly in more severe cases. The statistically significant correlation between the severity of AD and asthma prevalence in our study ($p = 0.001$) is also supported by previous studies that have shown a higher likelihood of asthma development in patients with severe or persistent AD [14].

However, some studies have reported slightly lower prevalence rates of asthma among AD patients. For instance, a study conducted in Denmark by Gwon *et al*. found a 35% prevalence of asthma in children with AD [15]. The difference in prevalence rates could be attributed to variations in study populations, geographical locations, and environmental factors. The high urban residency rate (70%) in our sample may explain the elevated prevalence of asthma, as urban environments are known to exacerbate both AD and asthma due to higher levels of pollution and allergen exposure [16]. Additionally, the racial and ethnic composition of our study population, predominantly Indian, may have contributed to differences in immune responses compared to Caucasian populations studied in Europe or North America.

Significance of Biomarker Analysis

The elevated levels of IL-4 and IL-13 observed in 80% and 75% of our AD patients with asthma, respectively, provide further evidence of the shared immunopathology between AD and asthma. These cytokines are critical in the Th2-mediated immune response and central to both conditions [17]. Elevated Th2 cytokines are associated with increased inflammation, impaired barrier function, and the subsequent development of allergic diseases [18]. Our findings are consistent with prior research that has demonstrated elevated levels of IL-4 and IL-13 in patients with both AD and asthma. The significance of these biomarkers lies in their potential as therapeutic targets. Dupilumab, an IL-4 and IL-13 inhibitor, has shown promising results in treating AD and asthma by reducing inflammation and improving clinical outcomes. Elevated IL-4 and IL-13 in our study population suggest that patients with both AD and asthma may benefit from biological therapies targeting these cytokines. Future research should explore the long-term efficacy of such treatments in populations with similar immunological profiles.

Environmental Triggers and Implications

Environmental factors, particularly seasonal changes, dust, and pollution, were identified as significant triggers for asthma exacerbation in AD patients, with 70% reporting seasonal exacerbations and 50% affected by dust and pollution. This aligns with existing literature, which emphasizes the role of environmental allergens in worsening both AD and asthma [19]. A study by Lau *et al*. highlighted that exposure to traffic-related pollution is strongly associated with increased asthma symptoms in urban environments. This factor could explain the high prevalence of asthma in our largely urban study population [20]. The implications of these findings are clear: environmental control measures should be a critical component of management strategies for patients with AD and asthma. Reducing exposure to known triggers, such as pollution and allergens, can help mitigate symptom exacerbations and improve these patients' quality of life. Furthermore, public health interventions aimed at reducing urban pollution could have a far-reaching impact on the prevalence and severity of AD and asthma in densely populated areas.

Comparison of Risk Factors with Other Studies

The identification of early-onset AD (before the age of 5) as a significant risk factor for asthma development (60%, $p = 0.003$) is in line with previous studies that have established early-onset AD as a predictor of subsequent atopic diseases [21]. Early intervention in children with AD is crucial for preventing the atopic march and reducing the risk of developing asthma later in life. Additionally, the presence of a family history of atopy in 40% of patients with asthma highlights the genetic predisposition to atopic diseases, as confirmed by other studies that have shown a solid familial link in both AD and asthma. The higher prevalence of asthma in patients residing in urban areas (70%, $p = 0.01$) further reinforces the environmental component of these conditions. Urban environments are associated with increased exposure to pollution, reduced microbial diversity, and lifestyle factors that may contribute to developing atopic diseases [22]. Our findings are consistent with the "hygiene hypothesis," which suggests that reduced exposure to microbes in early life may impair the immune system's ability to differentiate

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between harmful and harmless antigens, leading to an increased risk of atopic diseases.

Practical Significance and Implications for Clinical Practice

The findings from this study have several practical implications for clinical practice. First, the strong correlation between AD severity and asthma prevalence highlights the need for integrated management strategies. Dermatologists and pulmonologists should work together to develop holistic treatment plans that address both skin and respiratory symptoms. For patients with severe AD, regular screening for asthma may be warranted to facilitate early diagnosis and treatment. Second, identifying elevated IL-4 and IL-13 levels as biomarkers for both AD and asthma underscores the potential benefits of biologic therapies targeting these cytokines. Dupilumab, an IL-4/IL-13 inhibitor, has already been shown to be effective in treating both conditions, and our findings suggest that this approach may be particularly beneficial for patients with comorbid AD and asthma [23]. Clinicians should consider biologic therapies for patients who do not respond to conventional treatments.

Third, recognizing environmental triggers such as pollution and seasonal changes as significant factors in asthma exacerbation among AD patients calls for incorporating environmental control measures into treatment plans. Patients should be educated about avoiding known triggers, and public health efforts to reduce pollution may help alleviate the burden of these conditions, particularly in urban settings. Finally, our study supports the importance of early intervention in patients with AD, particularly those with early-onset disease. Preventive measures, including proper skin care, allergen avoidance, and timely treatment of respiratory symptoms, may reduce the likelihood of progression to asthma and other atopic diseases. This study demonstrates a significant correlation between atopic dermatitis and asthma, with environmental, genetic, and immunological factors contributing to their co-occurrence. Our findings are consistent with existing literature and provide practical insights into managing these comorbid conditions. Early intervention, environmental control measures, and biologic therapies targeting Th2 cytokines promise to improve outcomes in patients with both AD and asthma.

CONCLUSION

This study highlights the significant correlation between atopic dermatitis (AD) and asthma, particularly in patients with severe AD and early-onset disease. Elevated biomarkers and environmental triggers contribute to the co-occurrence of both conditions. Early diagnosis, personalized treatment strategies, and environmental control are essential for managing these comorbidities effectively.

Recommendations

Early screening for asthma in severe AD patients is crucial for timely intervention.
Incorporating biologic therapies targeting Th2 cytokines can improve outcomes.
Implementing environmental control measures can help reduce asthma exacerbations.

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Article at a Glance

Study Purpose:

To assess the prevalence and clinical correlation between atopic dermatitis (AD) and asthma and to identify shared risk factors and triggers in patients.

Key Findings:

45% of AD patients had asthma, with a higher prevalence in severe AD cases. Elevated IL-4 and IL-13 levels were significant markers in patients with both conditions. Environmental triggers like pollution exacerbated symptoms.

Newer Findings Added to What Is Known:

This study reinforces the "atopic march" theory and highlights the strong role of urban residency and environmental triggers in AD and asthma comorbidity in Indian patients. Elevated Th2 cytokines suggest the potential for targeted biologic therapies.

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Conflict of interest: None declared

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