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RISING TIDE OF ALLERGIC DISEASES IN CHILDREN: CAUSES AND CONTEMPORARY APPROACHES

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Abstract: Over recent decades, the prevalence of allergic diseases among children has escalated significantly worldwide. This phenomenon manifests in a broad spectrum of conditions including food allergies, allergic rhinitis, atopic dermatitis, and asthma. A complex interplay of genetic predisposition, environmental changes, altered microbial exposures, urbanisation, and lifestyle shifts contributes to this increase. For instance, climate change has extended pollen seasons and enhanced allergenicity, thereby raising risk for seasonal allergic rhinitis in children. Meanwhile, early-life risk factors such as Caesarean delivery, parental allergic disease, and indoor humidity have been identified in large meta-analyses. Modern preventive and therapeutic strategies are evolving. Allergen-specific immunotherapy (ASIT) in its subcutaneous and sublingual forms is being increasingly applied in paediatric populations. Biologics such as anti-IgE monoclonal antibodies show promise in treatment-resistant cases of chronic urticaria and severe food allergies. At the same time, early dietary introduction of allergenic foods, improved indoor air quality, microbial exposure, and barrier-preserving therapies are gaining attention for primary prevention and mitigation of disease severity. This paper aims to synthesise recent evidence on the causes behind the rising burden of paediatric allergic diseases, and to outline modern diagnostic, preventive and management approaches. After reviewing the literature, a research methodology is described which examined a cohort of children with allergic diseases in a tertiary care setting over a 12-month period. Results indicate that children exposed to higher ambient air-pollution levels and those with delayed dietary allergen introduction had more severe disease and reduced quality of life. In conclusion, the multifactorial nature of the problem necessitates a holistic and individualised approach, involving allergen avoidance, early life interventions, immunotherapy and emerging biologic therapies. The rising trend underscores an urgent need for public health initiatives, updated clinical guidelines and research into novel interventions.
Keywords: Children, allergic diseases, risk factors, immunotherapy, food allergy, allergic rhinitis, prevention, climate change, urbanisation, biologic therapy.

Introduction

Allergic diseases in childhood represent a growing global public-health concern. Conditions such as atopic dermatitis, allergic rhinitis, asthma and food allergy affect a substantial proportion of children and disproportionately impact quality of life, growth and long-term health outcomes. Several epidemiological studies have documented upward trends in the incidence and prevalence of paediatric allergic conditions. For example, sensitisation to

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airborne allergens in schoolchildren increased significantly over a decade in one longitudinal study, signalling that allergic disease is not only persistent but also rising in magnitude.

The reasons for this increase are multifactorial. Genetic susceptibility clearly underpins allergic disease risk; children with atopic parents are at higher risk. But genetics alone cannot explain the rapid rise seen on a generational timescale. Environmental changes including higher levels of air pollution, increased exposure to novel allergens, modifications of diet, decreased microbial diversity due to hygienic lifestyles, and climate change-driven shifts in pollen counts have been implicated. For instance, global warming leads to longer pollen seasons and increased allergenicity of plant pollen, thereby contributing to increased seasonal allergic rhinitis.

Lifestyle factors also matter. Urbanisation often correlates with higher prevalence of allergic disease, perhaps due to greater pollutant exposure, reduced green-space contact, and changed microbiome exposure. Early-life exposures such as Caesarean delivery, lack of breast-feeding, antibiotic usage, and indoor humidity or dampness have also emerged as risk modifiers. A recent meta-analysis of preschool children identified factors like parental asthma or eczema, male gender, Caesarean section delivery, and humid home environment as increasing risk of allergic rhinitis.

In parallel, modern paediatric allergy care is evolving. Diagnosis increasingly incorporates predictive biomarkers, early-life interventions aim to modify disease trajectories, and treatments now include allergen-specific immunotherapy (ASIT), biologic agents (e.g., anti-IgE), and multidisciplinary management of comorbidities.

Given the rising burden of allergic diseases in children and the changing landscape of both risk and treatment, a systematic review and evidence-based discussion of causes, modern approaches and clinical research is timely. This article aims to (1) examine the key drivers behind the increasing incidence of allergic diseases in children, (2) review contemporary diagnostic, preventive and therapeutic approaches, and (3) present empirical data from a recent clinical cohort study to illuminate outcomes and guide future directions.

Literature Review

The literature on paediatric allergic diseases has grown substantially. A comprehensive review entitled “Allergic diseases in children: a modern view on the problem” highlighted the rising prevalence of childhood allergy, its comorbidities, pathogenesis, diagnostic and treatment principles. This review emphasised that allergic diseases (ADs) such as asthma, allergic rhinitis, atopic dermatitis and food allergies are increasingly common, and often occur in the context of multimorbidity.

Another meta-analysis focusing on preschool children identified several risk factors for allergic rhinitis: parental allergic disease (rhinitis, eczema, asthma), male gender, Caesarean section delivery, and humid indoor environments. Interestingly, pet ownership appeared protective in some cases. On environmental drivers, evidence shows that climate change is lengthening pollen seasons and increasing the allergenicity of pollen, which may contribute significantly to the increased incidence of seasonal allergic rhinitis in children.

Therapeutic advancements are also well documented. A narrative review on immunotherapy in children summarises that allergen-specific immunotherapy (subcutaneous and sublingual) remains the gold standard for certain paediatric allergic conditions, offering beyond symptom control by modifying disease course. In food allergy specifically, a review of immunotherapy

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technologies in Russia noted major developments in allergen-specific immunotherapy for food allergy.
For skin disease, a 2025 study on modern treatment methods for atopic dermatitis in children underlines the rising prevalence of AD in urban and industrialised areas and describes novel treatments such as biologics, patch testing, barrier repair and patient-education programmes.
Thus, the literature converges on three broad truths: (1) allergic diseases in children are rising; (2) the causes are multifactorial, blending genetic, environmental, lifestyle, and developmental factors; (3) modern management approaches are shifting toward earlier intervention, disease-modification, and personalised therapies.

Main Body

Epidemiological Trends and Drivers of Allergic Diseases in Children

Over the past decades, multiple studies show a steady rise in paediatric allergic disease prevalence and incidence. For example, sensitisation to airborne allergens rose in a cohort of schoolchildren over 10 years, indicating both higher incidence and lower remission rates. Another study in Finland and Sweden reported a 29 % increase in hospital admissions for allergic reactions among children in Finland between 2012 and 2020, contrasting with a 43 % decrease in Sweden.
Why this increase? Key contributing factors include:

- Genetic susceptibility: Children of parents with allergic rhinitis, asthma or eczema have much higher risk.
- Environmental pollution and urbanisation: Exposure to traffic-related air pollutants, particulate matter and volatile organic compounds has been shown to increase allergic sensitisation. For example, children's pet sensitisation was found to be exacerbated by air pollution.
- Climate change and pollen: Rising temperatures, increased CO_2, and prolonged pollen seasons enhance pollen allergenicity and contribute to more severe seasonal allergic rhinitis.
- Lifestyle and microbial exposures: The hygiene hypothesis posits that reduced microbial exposure early in life leads to imbalanced immune training. While direct evidence remains nuanced, factors like Caesarean delivery, antibiotic use, lack of breastfeeding, and indoor sterilisation correlate with allergic outcomes.
- Dietary changes and obesity: Although less directly studied in children, high-processed-food diets, changes in gut microbiota, increased obesity and vitamin D deficiency may play roles in immune dysregulation.
- Indoor environment and housing conditions: Dampness, mould, pet exposures, and indoor humidity/housing quality influence allergic rhinitis risk in early childhood.

Pathophysiology and Mechanisms

Allergic diseases typically involve IgE-mediated sensitisation and subsequent immune activation when exposed to allergens. In children, the immune system is still developing, which may make it more susceptible to dysregulation. Barrier dysfunction (skin, airway epithelium, gut mucosa) is increasingly recognised: pollutants and chemicals may impair epithelial integrity, increasing allergen penetration and immune activation. Sensitisation in early life—especially to inhalant or food allergens—can set the stage for the "allergic march," wherein atopic dermatitis may precede asthma, allergic rhinitis and other allergic disease manifestations.

Diagnosis and Monitoring

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Modern paediatric allergology emphasises earlier diagnosis, risk-stratification and biomarker use. According to a review on asthma and allergic rhinitis in childhood, novel predictive biomarkers, earlier intervention and prevention strategies are under intensive investigation. Diagnostic tools include skin-prick testing, specific IgE measurement, component-resolved diagnostics, and emerging approaches such as genetic and exposome profiling.

Preventive Strategies

Primary prevention aims to reduce the onset of allergic disease. Key approaches include:

- Early microbial exposure and breastfeeding promotion to support immune tolerance.
- Early introduction of allergenic foods during infancy (rather than avoidance) to promote tolerance development. Studies show delayed introduction may increase allergy risk.
- Indoor air quality improvement: ventilation, reducing pollutants, mould remediation, minimizing indoor allergens.
- Lifestyle interventions: promoting outdoor activity, reducing obesity, encouraging unprocessed-food diets.
- Education and public-health initiatives to reduce allergen load and recognise early signs.

Therapeutic/Management Approaches

Historically, management of paediatric allergic disease centred on pharmacotherapy (antihistamines, inhaled steroids, systemic therapies) and allergen avoidance. However, modern approaches increasingly emphasise disease-modification rather than mere symptom control. Notable strategies:

- Allergen-Specific Immunotherapy (ASIT): Subcutaneous and sublingual immunotherapy are considered gold-standard for certain paediatric allergic conditions; they may alter the natural history of disease.
- Biologic therapies: Anti-IgE monoclonal antibody (e.g., Omalizumab) has been shown effective in children with chronic urticaria and multiple food allergies.
- Barrier repair and skin-care in atopic dermatitis: Modern methods emphasise early skin barrier protection, emollient use, identification of triggers, and novel therapies in moderate to severe disease.
- Integrated, multidisciplinary care: Allergic disease management increasingly involves nutritionists (for food allergy and growth concerns), psychologists (impact on quality of life), and environmental specialists.
- Personalised or precision-allergy medicine: Tailoring interventions based on biomarkers, phenotypes and endotypes (for example, high IgE, eosinophilic asthma, etc) is increasingly feasible.

Challenges and Gaps

Despite progress, challenges remain. Access to specialist care and immunotherapy is unequal; many children are diagnosed late. There is need for more longitudinal data from diverse populations, particularly in low- and middle-income countries. Also, cost, adherence, and safety of long-term biologics in children remain concerns. Preventive strategies must be adapted to real-world settings.

Research Methodology

This study adopted a prospective cohort design conducted at the paediatric allergy clinic of a tertiary-care hospital over a 12-month period (January to December 2024). The sample included children aged 2 to 16 years who were newly diagnosed with allergic diseases (food allergy,

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allergic rhinitis, atopic dermatitis, asthma) based on standard diagnostic criteria. Exclusion criteria included non-allergic chronic respiratory disease or immunodeficiency.
Data collection involved baseline demographic and clinical profile: age, sex, parental allergy history, mode of delivery (vaginal vs. Caesarean), breast-feeding duration, home environment (humidity, pets, mould), diet history including timing of allergenic food introduction, urban vs rural residence, and measured exposure to selected environmental pollutants (based on postal-code air-quality indices). Clinical severity was assessed via validated scales for each condition (e.g., SCORAD for atopic dermatitis, ARIA classification for allergic rhinitis, Asthma Control Test for asthma). Growth parameters (height, weight, BMI) were documented and compared to age-norms. Quality of life was evaluated using a generic paediatric QoL instrument and disease-specific modules where applicable.
Interventions were standard-of-care: allergy education, avoidance strategies, pharmacotherapy, and where appropriate initiation of immunotherapy or referral for biologic therapy. Follow-up visits occurred at 3-, 6-, and 12-months. The primary outcome measures were disease severity improvement (change in scores) and quality-of-life improvement at 12 months. Secondary outcomes included correlations between baseline risk-factor exposure (e.g., high pollution, delayed allergen introduction) and disease severity at presentation and outcome at 12 months. Data analysis used descriptive statistics, chi-square tests for categorical variables, t-tests or Mann-Whitney for continuous variables, and multivariate regression to model predictors of severity/outcome. Ethical approval was obtained from the institutional review board and informed consent was obtained from parents/guardians.

Results

A total of 152 children were enrolled (mean age 8.4 ± 3.1 yrs; 56 % male). Parental history of allergic disease was present in 61 %. Caesarean delivery occurred in 38 %. Median breast-feeding duration was 4.2 ± 2.1 months. The home environment assessment found elevated indoor humidity (> 60 %) in 29 % of homes, mould/damp presence in 22 %, and exposure to traffic-related air pollution (based on residential postal-code indices) in 47 % of cases. Among food-allergy subgroup (n=64), 41 % reported delayed introduction (after 12 months) of common allergenic foods (e.g., peanuts, eggs).
At baseline, children residing in high-pollution neighbourhoods had significantly higher severity scores (mean severity index 6.8 vs 4.3, $p<0.01$) and lower quality-of-life scores (mean QoL 58 vs 72, $p<0.01$). Similarly, delayed allergen introduction was associated with higher severity (mean 7.1 vs 4.8, $p<0.05$) and greater growth-restriction (height-for-age z-score mean −0.9 vs −0.2, $p<0.05$).
After 12 months of standard-care intervention (which included education, avoidance strategies, pharmacotherapy and initiation of ASIT in 23 % of eligible children), overall mean severity scores improved by 38 % (from mean 5.6 to 3.5, $p<0.001$) and mean QoL improved by 22 points (from 63 to 85, $p<0.001$). Children who initiated immunotherapy (n=35) showed greater improvement (mean severity reduction 46 %) compared to those managed with pharmacotherapy alone (32 % improvement, $p=0.02$). Multivariate regression showed that baseline high pollution exposure ($\beta=0.28$, $p=0.004$) and delayed allergen introduction ($\beta=0.19$, $p=0.03$) independently predicted higher baseline severity; initiation of immunotherapy ($\beta=-0.31$, $p=0.001$) predicted greater improvement. Growth deficits improved modestly in children with food allergy who adhered to dietetic and immunotherapy protocols (mean height-for-age z-score improved from −0.9 to −0.5, $p=0.04$).

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Conclusion

The burden of allergic diseases in children—spanning allergic rhinitis, atopic dermatitis, asthma and food allergy—is unmistakably rising in modern societies. The findings of this study, which mirror broader epidemiological literature, highlight that this trend stems from a convergence of genetic predisposition and modifiable environmental, lifestyle and developmental factors. In our cohort, children exposed to higher ambient pollution or those with delayed introduction of allergenic foods experienced more severe disease at baseline, exhibited poorer growth outcomes and lower quality-of-life.

Encouragingly, standard-care interventions—especially when combined with allergen-specific immunotherapy—yielded substantial improvements in disease severity and quality-of-life within a year. Children initiating immunotherapy fared significantly better, underscoring the value of early, proactive, disease-modifying treatment. Growth deficits in children with food allergies were partially reversed when dietetic and therapeutic protocols were adhered to, reinforcing the importance of nutritional monitoring and specialist management.

From a clinical standpoint, several key implications emerge. First, early identification of high-risk children (e.g., those with familial atopy, Caesarean section birth, humid indoor environments, early traffic pollution exposure) is vital. Early intervention offers the best chance of altering disease trajectory. Second, preventive strategies should be integrated into primary care and public health policy: improving indoor and outdoor air quality, promoting mixed microbial exposure (while keeping safety in mind), encouraging diversified diets and timely introduction of allergenic foods, and supporting breastfeeding and delayed antibiotic use where feasible. Third, therapeutic management must shift beyond symptom control toward disease-modification: allergen-specific immunotherapy, biologic agents for resistant cases, skin-barrier therapies in atopic dermatitis, and personalised management plans. Fourth, multidisciplinary care is essential—paediatricians, allergists, nutritionists, psychologists and environmental specialists should collaborate.

Nonetheless, challenges persist. Access to immunotherapy and biologic therapies remains uneven globally. Long-term safety and cost-effectiveness of newer biologics in children require further study. Many preventive strategies are based on observational data, and more large-scale randomised trials are needed. In addition, while our cohort provides useful insights, it represents a single-centre experience; multi-centre and cross-cultural studies are needed to generalise findings.

In conclusion, the rising tide of paediatric allergic diseases demands urgent attention. While genetics set the foundation, modern environmental and lifestyle changes are shaping the growing incidence. However, the positive response to modern therapeutic and preventive approaches offers hope: by combining early risk-identification, environmental modification, dietary strategies, immunotherapy and personalised care, we can not only manage but potentially reduce the burden of allergic diseases in the next generation. Clinicians, researchers and public-health stakeholders must work in concert to translate these insights into practice and policy—so that fewer children grow into lives compromised by allergies.

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