



IAP Textbook of Pediatric Allergy

Editors-in-Chief
Neeraj Gupta
Jose Ouseph
Krishna Mohan R

Executive Editors
Uppin Narayan Reddy
Dhanesh Volvoikar

Associate Editors
S Narmada Ashok
Sowmya Nagarajan

Forewords
Neelam Mohan
TU Sukumaran



Contents

SECTION 1: Fundamentals of Allergy

Section Editors: Sanjukta Dey, Soundarya M

1. Introduction to Allergy	3
<i>Neeraj Gupta</i>	
2. Immunology of Allergy	9
<i>Saibal Moitra, Mohammad Ziaul Haque</i>	
3. Pathophysiology of Allergic Diseases	12
<i>Sanjukta De</i>	
4. Epidemiology and Risk Factors of Allergies	21
<i>Soumyashree Bahalia, Jose Ouseph</i>	
5. Allergens in the Indian Perspective	24
<i>Soundarya M</i>	

SECTION 2: Diagnostic Approach

Section Editors: Narayan Prasad Modi, Mohit Poddar

6. Clinical History and Examination	33
<i>Arif Ahmed M</i>	
7. In Vitro Allergy Diagnostics	39
<i>Karthik Nagaraju, Mohit Poddar</i>	
8. In Vivo Tests in Allergic Diseases	47
<i>Narayan Prasad Modi, Sanjay Kumar Sahu</i>	
9. Functional and Advanced Diagnostic Tools in Pediatric Allergy	56
<i>Hima Mathews P</i>	

SECTION 3: Respiratory, Ocular, and Food Allergies

Section Editors: Vikram Patra, Mitesh Kakkad

10. Allergic Rhinitis	83
<i>Mitesh Kakkad</i>	
11. Asthma and Allergy	91
<i>Dhanesh Volvoikar</i>	
12. Eosinophilic Lung Diseases	101
<i>Indu Khosla, Geetesh Baijal</i>	

13. Hypersensitivity Pneumonitis	112
<i>Barnali Bhattacharya</i>	
14. Food Allergy	117
<i>Sowmya Nagarajan, Vikram Patra, Mosam Maroo</i>	
15. Allergic Conjunctivitis in Children.....	125
<i>Sugaranjini Galiyugavaradhan, Shweta Agarwal</i>	

SECTION 4: Skin, Drug, and Insect Allergies

Section Editors: Dipti Pujari, Rama Rajyam

16. Atopic Dermatitis	135
<i>Dipti Pujari</i>	
17. Contact Dermatitis.....	140
<i>Krishna Mohan R</i>	
18. Urticaria and Angioedema.....	146
<i>Rama Rajyam Datti, Spurthi Chitta</i>	
19. Drug Allergy in Children.....	152
<i>Jefferson Daniel</i>	
20. Insect Venom Hypersensitivity	159
<i>S Narmada Ashok</i>	
21. Anaphylaxis.....	163
<i>Jijo Joseph John, Vikram Patra</i>	

SECTION 5: Special Considerations

Section Editors: Nandana Bala, Nayan Mani Deka

22. Allergen Immunotherapy in Children	169
<i>Nandana Bala, S Karthikeyan</i>	
23. Pollution and Allergy in India	176
<i>Shebna A Khader</i>	
24. Climate Changes and Allergies	182
<i>R Prasanna</i>	
25. Allergy and Infections: Intertwined Pathways and Clinical Implications.....	190
<i>Nayan Mani Deka</i>	
26. Vaccination in Allergy.....	195
<i>Tina N Goel</i>	

SECTION 6: Preventive and Holistic Care

Section Editors: Sinchana Bhat, Pavan Kalyan

27. Primary Prevention of Allergies	201
<i>Sinchana Bhat</i>	

28. Secondary and Tertiary Prevention of Allergy	206
<i>Sonia Bhatt, Nimmy Joseph</i>	

SECTION 7: Practical Considerations

Section Editors: Naresh Grover, Surender Kagithapu

29. Setting Up an Allergy Clinic	213
<i>Surender Kagithapu, Naresh Grover</i>	
30. Patient Education and Advocacy in Pediatric Allergy.....	220
<i>Vipul Sharma</i>	

SECTION 8: Future Directions

Section Editors: Mangayarkarshi Sinha, Nihar Ranjan Mishra

31. Advances in Allergy Research	227
<i>Shalini Tyagi</i>	
32. Personalized Medicine in Allergy	230
<i>Mangayarkarshi Sinha</i>	
33. Emerging Allergens and Global Trends.....	239
<i>Nihar Ranjan Mishra, Vineeth Vijayan</i>	

Appendices

1. Pediatric Allergy—Case Scenarios	249
<i>Shalini Tyagi</i>	
2. Drug Compendium	258
<i>Reyaz A Malik</i>	
Index	271

Section Editors: Mangayarkarshi Sinha, Nihar Ranjan Mishra

31. Advances in Allergy Research

Shalini Tyagi

32. Personalized Medicine in Allergy

Mangayarkarshi Sinha

33. Emerging Allergens and Global Trends

Nihar Ranjan Mishra, Vineeth Vijayan

JAYPEE BROTHERS

■ INTRODUCTION

Allergic disorders are a major and growing health concern, particularly in children. Over the past few decades, rapid urbanization, lifestyle transitions, and environmental exposures have contributed to a rising prevalence of asthma, allergic rhinitis, atopic dermatitis, and food allergies. Advances in research have uncovered novel insights into the role of the microbiome, epigenetics, and environmental triggers in allergy pathogenesis. Breakthroughs in diagnostics, including component-resolved testing and non-invasive biomarkers, along with therapeutic innovations, such as biologics, immunotherapy, and precision medicine, are reshaping pediatric allergy care. This chapter reviews these advances with emphasis on their clinical relevance to India.

■ EMERGING CONCEPTS IN ALLERGY PATHOGENESIS

Microbiome and Allergic Disease

Recent advances emphasize the role of the gut microbiome in shaping immune tolerance. A balanced and diverse microbiota in early life promotes healthy immune regulation, while dysbiosis—caused by caesarean delivery, formula feeding, antibiotic exposure, or urban living—predisposes children to asthma, atopic dermatitis, and food allergies. Though interventions such as probiotics, prebiotics, and maternal dietary supplementation have been studied, results remain inconsistent. Select strains, such as *Lactobacillus rhamnosus* GG, show potential in improving tolerance, but large-scale trials are still needed, especially in Indian children, where dietary and environmental factors differ significantly.

Epigenetics in Allergy

Epigenetic modifications, including deoxyribonucleic acid (DNA) methylation and histone acetylation, link environmental influences with allergic predisposition. Maternal nutrition, pollution exposure, and infections can

alter gene expression without changing DNA sequence, thereby modifying immune responses. Population studies have identified methylation changes in genes regulating T-cell activity and antigen presentation in children with food allergies. These epigenetic signatures hold promise as biomarkers for early identification and may pave the way for personalized prevention strategies in high-risk populations.

Hygiene Hypothesis Revisited

The hygiene hypothesis, first introduced by Strachan in 1989, suggested that declining exposure to infectious agents was associated with rising allergy prevalence. Contemporary research refines this view, showing that reduced microbial diversity in early life disrupts immune maturation, promoting Th2-driven allergic responses. Indian studies comparing rural and urban children reveal lower rates of atopy in rural populations, supporting the protective role of environmental microbial exposures. This highlights the influence of lifestyle transitions on allergic risk in India.

■ DIAGNOSTIC ADVANCES

Traditional diagnostic methods, including skin prick and serum IgE testing, have limitations in specificity. Recent innovations provide greater accuracy:

- *Component-resolved diagnostics (CRD)*: Identifies sensitization to individual allergen epitopes, improving diagnostic precision in nut and pollen-food allergies.
- *Noninvasive biomarkers*: Fractional exhaled nitric oxide (FeNO) is validated for eosinophilic asthma; periostin, eosinophil counts, and urinary leukotrienes are promising. Nasal fluid immunoglobulin E (IgE) profiling demonstrates high accuracy and may soon become clinically relevant.
- *Basophil activation test (BAT)*: A functional in vitro assay that measures allergen-induced basophil activation, offering higher diagnostic relevance than sensitization tests alone.

■ THERAPEUTIC INNOVATIONS

Biologics

Biologic therapies have revolutionized the management of severe allergic diseases. Omalizumab (anti-IgE) is effective in asthma and chronic urticaria. Anti-IL-5 agents (mepolizumab and reslizumab) target eosinophilic asthma, while dupilumab [anti-interleukin-4 (anti-IL-4)/IL-13] benefits refractory atopic dermatitis and asthma and may enhance tolerance to allergen immunotherapy. Though highly effective, access and affordability remain challenges in India, underscoring the need for locally relevant cost-effectiveness studies.

Allergen Immunotherapy

Allergen immunotherapy (AIT), via subcutaneous immunotherapy (SCIT) or sublingual immunotherapy (SLIT) routes, remains the only disease-modifying intervention for allergic rhinitis and selected food allergies. Novel approaches include allergoids, epicutaneous patches, and intralymphatic immunotherapy. AIT is gaining interest in India, though accessibility and standardization remain as the main challenges.

Oral Immunotherapy for Food Allergies

Oral immunotherapy (OIT) is gaining traction for food allergies such as peanuts and milk, with advances in safety protocols. Experimental strategies, such as messenger ribonucleic acid (mRNA)-based vaccines, are under exploration. Indian children, due to distinct dietary practices, require region-specific OIT protocols due to dietary habits and cultural practices.

Novel Pharmacologic Agents

Beyond standard antihistamines and leukotriene receptor antagonists, new therapies are being developed for refractory allergic diseases.

- *Janus kinase (JAK) inhibitors and phosphodiesterase-4 (PDE4) inhibitors* offer targeted control in severe atopic dermatitis.
- *Topical calcineurin inhibitors* remain important in steroid-sparing regimens.
- Research is also focused on next-generation antihistamines with improved safety and efficacy profiles.

These agents expand therapeutic options, particularly for patients unresponsive to conventional treatments.

■ PRECISION MEDICINE IN ALLERGY

Personalized Risk Prediction

Advances in genomics, proteomics, and metabolomics are enabling individualized prediction of allergic risk. Candidate genes regulating cytokines, chemokines, and immune pathways have been linked to asthma and food allergies. Predictive models integrating genetic susceptibility, environmental exposures, and biomarker profiles hold promise for early intervention in high-risk children.

Digital Health and Artificial Intelligence

Mobile applications, teleconsultation platforms, and wearable devices allow real-time symptom monitoring and treatment of adherence tracking. Artificial intelligence (AI) is increasingly applied to predict exacerbations and optimize therapy. In India, these technologies may help bridge the urban-rural care gap and improve accessibility to pediatric allergy services.

■ THE CHALLENGES IN THE INDIAN CONTEXT

Population-specific Research in India

Allergen Mapping

Regional studies reveal significant variability in sensitizing allergens. For example, *Parthenium hysterophorus* pollen is common in North India, while fungal spores and food allergens vary by geography. Local mapping is essential for accurate diagnosis and targeted immunotherapy.

Urbanization and Pollution

Rising vehicular emissions and industrial pollutants, particularly fine particulate matter (PM_{2.5}), are strongly associated with the increasing prevalence of asthma and allergic rhinitis in Indian children. Ongoing research aims to elucidate mechanisms and inform public health interventions.

Socioeconomic and Cultural Factors

Traditional dietary practices, regional food exposures, and variable healthcare access influence both risk and management of allergies. Socioeconomic disparities further affect diagnosis, affordability of biologics, and uptake of immunotherapy. Cultural dietary practices, traditional medicine use, and health literacy are important

considerations in designing effective allergy prevention and management strategies for Indian pediatric populations.

■ FUTURE DIRECTIONS

The future of pediatric allergy research and management is rapidly evolving:

- *Universal allergen vaccines* under development may provide broad protection.
- *Microbiome-based interventions* such as designer probiotics and postbiotics could restore immune tolerance.
- *Gene editing and cell-based therapies* may offer solutions for severe refractory cases.
- *AI-driven tools* will enhance diagnostic accuracy and personalized care.
- *Policy-level integration* of allergy prevention and treatment into national child health programs is urgently needed in India.

■ CONCLUSION

Allergic diseases in children are increasing at an alarming pace, driven by complex interactions between genetics, environment, and lifestyle. Advances in microbiome science, epigenetics, diagnostics, biologics, and immunotherapy are reshaping management, moving closer to disease modification and precision care. In India, unique challenges of pollution, regional allergens, and socioeconomic disparities demand context-specific solutions. Collaborative research, policy support, and clinical innovation will be critical to improving outcomes for children with allergies in the years ahead.

■ KEY POINTS

- *Microbiome and epigenetics*: Early-life microbial diversity and epigenetic modifications are crucial in shaping immune tolerance; dysbiosis and pollution-related epigenetic changes increase allergic risk.

- *Novel diagnostics*: Component-resolved diagnostics, nasal fluid IgE assays, and BATs offer greater accuracy and non-invasive assessment compared to traditional tests.
- *Therapeutic innovations*: Biologics (e.g., omalizumab and dupilumab), allergen immunotherapy, and oral immunotherapy for food allergies represent disease-modifying treatments with increasing applicability in India.
- *Precision and digital medicine*: Genomics, AI-based prediction tools, and telemedicine are paving the way for individualized allergy risk assessment and care.
- *Indian context*: Regional allergen mapping, the impact of pollution, and socioeconomic disparities necessitate locally relevant strategies for diagnosis, management, and prevention.

■ SUGGESTED READING

1. Chun Y, Lee JH, Bunyavanich S. Epigenomic and epigenetic investigations of food allergy. *Pediatr Allergy Immunol.* 2024;35(1):14065.
2. Delgado Dolset MI, et al. Dupilumab prior to before AIT improves tolerance and induces metabolomic changes. *EAACI Abstracts.* 2025.
3. Moiniche M, Johansen KH, Parrón-Ballesteros J, Corneliussen JK, Eriksen HH, Kringelum JV, et al. mRNA-delivered consensus allergens induce a neutralizing IgG response against food and pollen allergens. mRNA-delivered consensus allergens induce neutralizing IgG. [Online]. Available from <https://www.biorxiv.org/content/10.1101/2024.02.26.582073v1> EAACI Abstracts. 2025. [Last accessed December, 2025].
4. Strachan D. Family size, infection and atopy: the hygiene hypothesis. *Thorax.* 2000;55(Suppl 1):S2-10.
5. Tan-Lim CSC, Esteban-Ipac NAR. Probiotics as treatment for food allergies among pediatric patients: a 2024 update. *Pediatr Allergy Immunol.* 2025;36(1):e700284.
6. Toda M, Ono SJ. Genomics and proteomics of allergic disease. *Immunology.* 2002;106(1):1-10.

IAP Textbook of Pediatric Allergy

Salient Features

- Comprehensive, India-centric reference addressing the rising burden of pediatric allergic diseases
- Strong foundation in allergy immunology, epidemiology, and pathophysiology
- Structured diagnostic approach with clinical history, in vivo and in vitro testing, and advanced tools
- In-depth coverage of respiratory, food, skin, drug, insect, and ocular allergies
- Dedicated chapters on allergen-specific immunotherapy, pollution, and climate change
- Emphasis on prevention, patient education, and holistic care
- Practical guidance on setting up allergy clinics and advocacy initiatives
- Insights into biologics, precision medicine, and future directions in pediatric allergy
- Authored by leading national experts—an essential resource for pediatricians, trainees, and allergists.

Neeraj Gupta DCH DNB FIAP FRCPC IDPCCM DAA FAAAAI DPSM is a Senior Pediatrician and internationally recognized Pediatric Allergy Specialist with additional expertise in pediatric intensive care and sleep medicine. He has been a key architect in advancing structured, evidence-based pediatric allergy practice in India through academic leadership, national training programs, guideline development, and scholarly publishing. As the Founder Director of India's first national *Diploma in Pediatric Allergy and Asthma (DPAA)*, he has authored over 100 scientific publications and edited several landmark textbooks in allergy. His contributions span the establishment of dedicated pediatric allergy services, advancement of diagnostic and immunotherapy practices, and sustained mentorship of clinicians nationwide. A recipient of multiple national and international honors, Dr Gupta is widely respected for his vision, leadership, and lasting impact on pediatric allergy care in India.

Jose Ouseph MD DCH FIAP DAAI is a Senior Academician and Clinician with over two decades of experience in pediatric teaching and clinical practice. A Professor of Pediatrics, he has played a pivotal role in undergraduate and postgraduate education, examinations, and faculty development. He has held several important leadership positions within the Indian Academy of Pediatrics (IAP) at both state and national levels, contributing significantly to the growth of pediatric allergy and respiratory medicine. A widely respected Teacher and Academic Leader, Dr Ouseph has been a valued Faculty at numerous scientific forums and continues to champion high-quality, evidence-based allergy care for children.

Krishna Mohan R DNB DAA MNAMS ICPP is a distinguished Pediatrician and Pediatric Allergist with a strong foundation in academic medicine and public health service. Trained at leading national institutions, he has contributed extensively to clinical care, teaching, and the development of structured academic programs in pediatric allergy. He has served in key leadership roles within national pediatric bodies and has edited and contributed to several important educational resources in allergy. Recognized as an effective Educator and Speaker, Dr Krishna Mohan remains committed to expanding access to quality pediatric allergy care and strengthening professional education across India.

Shelving Recommendation
PEDIATRIC

ISBN 978-93-7202-333-6



9 789372 023336



Buy from ejaypee



**JAYPEE
BROTHERS**