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Trends in Pediatric Allergic Diseases in the Post–COVID-19 Era Diagnosis-Specific Patterns, Key Drivers, and Implications for Health Services: A Literature Review

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ABSTRACT

The COVID-19 pandemic acted as a natural experiment that reshaped children's daily lives, allergen exposure, respiratory viral ecology, and access to health services. This narrative review summarises evidence (2016–2025) on post-pandemic trends in major pediatric allergic diseases and highlights diagnosis-specific patterns and plausible drivers. Across settings, pediatric asthma showed the most consistent signal: acute exacerbations and emergency visits decreased during strict non-pharmaceutical interventions, then rebounded or shifted seasonally after restrictions eased and schools reopened, tracking renewed viral transmission. Allergic rhinitis showed the most heterogeneous response, reflecting the balance between indoor-outdoor exposure (e.g., house dust mite vs pollen), masking behaviours, and normalisation of service utilisation. Atopic dermatitis generally showed stable or declining prevalence but potential increases in severity, flares, sleep disturbance, and quality-of-life burden related to stress and disrupted care. Food allergy trends were mixed, while anaphylaxis patterns depended strongly on data sources and care-seeking behaviour. Post-pandemic interpretation and planning should stratify by diagnosis, age, and care setting, and prioritise seasonal preparedness, exposure management, continuity of care, and hybrid service models.

Keywords: pediatric allergy; COVID-19; asthma exacerbations; allergic rhinitis; atopic dermatitis; food allergy; anaphylaxis; non-pharmaceutical interventions; health services utilization

INTRODUCTION

The COVID-19 pandemic has drastically changed the lives of children worldwide. In-person school activities have been suspended, outdoor playtime has been reduced, mask-wearing has become a habit, and children are spending more time indoors. These significant changes have indirectly impacted allergen exposure, respiratory tract viral infection patterns, and how families access health services.

In the early stages of the pandemic, various studies showed a sharp decline in childhood asthma attacks and emergency room visits. However, after restrictions were eased and schools reopened, there was a resurgence or change in the seasonal pattern of asthma attacks. This phenomenon suggests that the main triggers of asthma, especially respiratory viral infections, were "suppressed" during the pandemic and reappeared after normal social activities returned [1-4].

Interestingly, these changes are not uniform across allergic diseases. Allergic diseases in children do not occur uniformly. Asthma, allergic rhinitis, atopic dermatitis, and food allergies show different patterns. Therefore, healthcare workers need to understand that post-pandemic trends are disease-specific, not simply a "general increase in allergies" [5-7]. Post-pandemic trends in childhood allergic disease should be communicated in language that is accessible and relevant to clinical practice and child health service planning [8, 9].

SPECIFIC DIAGNOSIS TRENDS

• Childhood Asthma

Asthma is a childhood allergic disease that has shown the most marked changes during and after the pandemic. Nearly all countries have reported a decrease in asthma attacks and emergency room visits during social distancing. In the United States, national surveillance data showed a decrease in emergency room visits for asthma throughout 2020–2022 compared with 2019, with the largest decrease in 2020 [4].

After schools reopened, many studies showed that the surge in asthma attacks is closely linked to increased transmission of respiratory viruses.

A study in New York City showed that school policies and levels of viral circulation were directly associated with increased acute care visits for childhood asthma [2].

The pattern is similar in other countries. In Colombia, pediatric asthma hospitalisations changed markedly between the periods before, during, and after the pandemic [1]. A study in South Korea also showed that reduced viral infections during restrictions contributed to a decrease in asthma exacerbations in 2020 [3].

Healthcare workers need to understand that not all the post-pandemic increase in asthma is directly due to COVID-19 infection. Some studies have shown no direct link between SARS-CoV-2 infection and the emergence of new asthma [10], while others have found an increased risk in certain conditions [11]. This difference is likely influenced by variations in study design and population characteristics.

In the post-pandemic era, childhood asthma control needs to focus more on preparedness for the viral infection season, optimisation of controller therapy, and family education when children return to full school [2, 4, 12].

Cross-country evidence shows a remarkably consistent pattern: during the strict restriction phase (NPI: masking, school restrictions, mobility restrictions), emergency room visits, hospitalisations, and childhood asthma exacerbations declined sharply, then after restrictions were eased, there was a rebound, changes in seasonal patterns, or changes in severity profiles**.** Hospitalisation and acute care data show that these "declines" are often not due to asthma "disappearing," but rather to dominant triggers (especially respiratory viruses) being temporarily suppressed, along with changes in treatment behaviour.

A study in Colombia showed a decrease in inpatient/ER-based events during the NPI period, followed by a change in pattern after easing [1]. Similar findings were observed in a nationwide analysis in South Korea, which confirmed that exacerbations decreased during the NPI period and then increased again when triggers changed, including changes in the virus mix and pollution levels [3]. In fact, several studies show that post-easing may result in more severe phenotypes, for example, an increase in asthma status compared to the pre-pandemic period, consistent with the return of infection circulation after masking and distancing are reduced [12].

From a service perspective, emergency department-based studies in Taiwan and the United States also showed a decrease in asthma emergency department visits during the lockdown period; interpretation requires distinguishing between "decreased service burden" and "true epidemiological decline," as access, fear of hospitalization, and changes in exposure play a significant role [13, 14].

Clinically, for healthcare worker education, the key message is: childhood asthma in the post-pandemic era needs to be understood as a condition that is very sensitive to trigger dynamics (viral ecology) and children's interaction patterns in school /community settings. Some studies suggest that asthma control may improve when NPI is high, but may potentially worsen after school resumes and trigger exposure increases [15].

Other data emphasise that although emergency room visits decreased during the pandemic, the proportion of inpatient/PICU risk in incoming patients can be higher, leading to the phenomenon of "severity" selection (mild cases do not come, severe cases do), and this may continue in certain post-pandemic phases [16].

At the mechanistic level, cohort reports suggest that patterns of severity of asthma-triggering viral infections change throughout the NPI phase and beyond, so the seasonality of asthma exacerbations may "shift" and not always return to pre-2020 levels [17]. Therefore, the post-pandemic childhood asthma service strategy should emphasise high virus transmission period preparedness (education on controller medication adherence, asthma action plans, and exacerbation alerts), while remaining critical that service visit-based indicators are proxies influenced by treatment-seeking behaviour and service access [6, 18].

As additional context, changes in visit patterns and allergy testing during the pandemic may also influence the asthma-allergy "map" observed in clinics, for example, changes in allergy visit patterns and sensitization patterns [19, 20], while bibliometric studies show a surge in research attention on the topic of asthma/AR related to COVID-19 [21]. For post-NPI survey-based symptom trends, there were reports of increased wheezing/asthma-like symptoms between 2021–2023, consistent with a resurgence of infections and increased social mixing [22].

- **Allergic Rhinitis (AR)**

Allergic rhinitis shows a more diverse pattern than asthma. During the pandemic, mask use and reduced outdoor activities can reduce the symptoms of pollen-induced rhinitis, but spending more time indoors can actually aggravate rhinitis due to house dust mites**.**

In China, analysis of outpatient visits in 2018-2023 showed a gradual increase in visits for allergic rhinitis, with a clear seasonal pattern [7]. A specific study in Shanghai showed that during lockdown, symptoms and visits for house dust mite allergic rhinitis changed with increasing indoor exposure [23].

In addition to the symptoms, Laboratory testing patterns also changed. Studies of specific IgE show changes in sensitisation and polysensitisation rates in children between the restriction and relaxation phases, reflecting changes in the allergen exposure mix and testing patterns [23].

Changes in services also played a role. In Japan, there was a decline in visits and hay therapy. Declines during the pandemic likely reflect reduced visits to health facilities, not a true reduction in disease [24].

Various international studies show that Allergic rhinitis is a childhood allergic disease with the most heterogeneous response to the COVID-19 pandemic, because it is greatly influenced by behavioural changes (masks, outdoor activities), allergen types (pollen vs. house dust mites), and access to healthcare. An analysis based on outpatient visits in China during the period 2018–2023 showed an increase in the number of Allergic rhinitis visits from year to year, including during the pandemic period, which likely reflects a combination of *catch-up diagnosis*, changes in treatment behaviour, and accelerated post-restriction detection [7]. This finding confirms that visit-based data should be interpreted as a *proxy for service burden*, not as pure biological prevalence.

Data from Southeast Asia and East Asia show similar patterns, but with local nuances. In Malaysia, the trend in clinical prevalence of Allergic rhinitis from 2017 to 2022 showed fluctuations: a decline before the pandemic, followed by changes during and after the pandemic, likely influenced by the persistence of mask use and changes in health-seeking behaviour [25]. In South Korea, long-term analysis from 1995 to 2022 shows that the prevalence of Allergic rhinitis in children is increasing secularly, and the COVID-19 pandemic appears to have only served as a short-term modifier, not a reversal of long-term epidemiological trends [26].

Specific studies on house dust mite-induced Allergic rhinitis provide important mechanistic insights. Research in Shanghai showed that during the *lockdown*, dominance of indoor allergen exposure may increase symptoms and visits in children with house dust mite Allergic rhinitis, while in the post- restriction relaxation phase, visits may decrease, especially in the polysensitized group, as outdoor exposure and trigger redistribution increase [23]. This emphasises the importance of differentiating Allergic rhinitis based on allergen phenotype in interpreting post-pandemic trends.

From the service system side, several studies highlight that Changes in service utilisation do not always parallel changes in symptoms. In Japan, pandemic policies have influenced hay therapy patterns. fever and outpatient visits, so that decreases or increases in visits may reflect service adaptations and self-medication, not actual changes in disease activity [24]. Similar findings were observed in an analysis of insurance claims in South Korea, where pediatric Allergic rhinitis claim rates during 2018-2021 were significantly influenced by service access during the pandemic and normalised after restrictions were eased [27].

From a population perspective, United States data show that the prevalence of respiratory allergies in children increased between 2018 and 2021, a period that includes the pandemic phase, with possible contributions from changes in exposure, symptom reporting, and family health awareness [28]. Another cross-sectional study from China provides a useful snapshot of pediatric Allergic rhinitis prevalence as context for the post-pandemic disease burden, although it did not directly compare the pre- and post-pandemic phases [29].

Protective behavioural aspects also play an important role. Studies from the Middle East region show that Mask use during the pandemic can reduce Allergic rhinitis symptoms in some children, so that the removal of mask habits in the post-pandemic era has the potential to trigger a resurgence of symptoms and service visits [30]. In the context of service planning, artificial intelligence-based modelling of the dynamics of Allergic rhinitis outpatient visits in China provides important insights into the anticipated surge in services following the easing of restrictions, although the study did not directly compare pre- and post-pandemic periods [31].

Educational and clinical implications from all this evidence are that the post-pandemic trend in allergic rhinitis cannot be interpreted solely as an increase or decrease in disease, but rather as a complex interaction between indoor-outdoor exposure, persistent protective behaviours, and the normalisation of access to health services. Therefore, pediatric healthcare workers need to comprehensively assess Allergic rhinitis. phenotypic (allergen type), contextual (family behaviour), and systemic (service pathway) so that the interpretation of trends and management planning becomes more targeted [7, 23, 26]. Interpretation of allergic rhinitis trends should take into account allergen type (indoor vs outdoor) and changes in treatment behaviour, rather than just the number of clinic visits [7, 20, 23].

- **Atopic Dermatitis (AD)**

In contrast to asthma, most studies show that the incidence or prevalence of atopic dermatitis has been relatively stable during the pandemic. However, many children experience worsening of symptoms, more frequent flares, and decreased quality of life, particularly due to stress, sleep disturbances, and limited access to face-to-face services [9].

South Korean national data show a decline in the prevalence of AD in adolescents after the pandemic began, after years of increases. These findings should be interpreted cautiously as they may be influenced by changes in treatment and diagnosis behaviour [5].

In addition, during the pandemic, a phenomenon emerged: mask-associated dermatitis, especially on children's faces. This condition can exacerbate AD or cause irritant dermatitis that mimics AD, necessitating diagnostic vigilance in primary care [32]. Globally, although the number of AD cases increases with population growth, age-adjusted

incidence rates tend to be stable or decreasing in some regions [33, 34].

In contrast to asthma, most scientific evidence suggests that Atopic dermatitis (AD) in children did not experience a consistent increase in incidence or prevalence during the COVID-19 pandemic, but did show significant changes in severity, flare frequency, and quality of life. A multinational systematic review reported that in many populations, the incidence and prevalence of AD are relatively stable, but the clinical course of the disease is influenced by psychosocial stress, changes in daily routines, and limited access to face-to-face health services during the pandemic [9].This finding confirms that the clinical burden of AD is not always reflected by prevalence figures alone**.**

National epidemiological data from South Korea provide important additional insights. Analysis of AD prevalence trends in adolescents over the long period 2009–2022 shows a decrease in prevalence after the pandemic began, after a gradual increase. However, the authors emphasise that this decrease should be interpreted with caution, as it may reflect diagnostic artefacts and changes in service-seeking behaviour rather than a true decline in disease [5].Another national survey study in South Korea also showed a similar pattern: a long-term increase in AD prevalence, which then turned downward until 2022**,** with the pandemic suspected to play a role as a modifying factor through changes in service access and family behaviour [35].

Although prevalence remains relatively stable or decreasing, several indicators of severity show a worsening trend. Studies assessing the relationship between AD, sleep disturbances, and the COVID-19 pandemic in children indicate that stress, changes in routine, and sleep disturbances during the pandemic may exacerbate AD symptoms**,** thereby increasing the functional burden of the disease even though the diagnosis rate does not increase [36]. This is in line with the findings that the severity and impact of AD on quality of life are more sensitive to environmental and psychosocial changes than prevalence rates.

Analysis of national trends in allergic disease also supports the view that the AD response to the pandemic has been heterogeneous and age-dependent. A nationwide allergy trend study in South Korea during 2005–2021 showed that AD and asthma had different patterns of change across age groups, with the pandemic period modifying the trend slope in some groups of children and adolescents [37].

Furthermore, recent epidemiological studies confirm that the direction of global AD trends varies across regions, influenced by genetic, environmental, and service system factors, so changes during the COVID-19 era need to be placed in the context of broader long-term trends [38]. Lifestyle changes during the pandemic are also a significant factor. Studies comparing the incidence and prevalence of allergic diseases before and during the pandemic show that pandemic-related lifestyle changes (more time at home, changes in hygiene habits, stress) can influence DA, but the effect is not uniform and is highly dependent on the population subgroup and the outcome definition used [39]. In the post-pandemic context, the focus is shifting from pure epidemiology to management adaptations, including the use of digital education and tele dermatology as strategies for continuity of care for pediatric AD, although this approach was not intended to assess changes in incidence [40].

The overall conclusion of this evidence is that in the post-pandemic era, childhood atopic dermatitis is best understood as a disease with relatively stable prevalence but high vulnerability to increased severity due to stress, sleep disturbances, and changes in access to services. Therefore, pediatric healthcare workers need to emphasise monitoring severity, quality of life, and therapy adherence, as well as integrating hybrid service models (face-to-face and digital) to maintain continuity of AD care in the post-pandemic era [5, 9] [36].

- **Food Allergies and Anaphylaxis**

Food allergies showed a more heterogeneous trend pattern compared to respiratory allergic diseases in the period before and after the COVID-19 pandemic. Analysis of the prevalence of children in the United States showed that the prevalence of food allergies actually decreased slightly between 2018 and 2021, while asthma and respiratory allergies increased during the same period, confirming that the dynamics of food allergies do not always run parallel to those of respiratory allergies [28].

Longitudinal data from the UK also show that epidemiological trends in food allergies fluctuate over the long term, with variations between age groups and allergen types, so the pandemic is more appropriately positioned as an inflexion point in pre-existing trends, rather than as the sole determinant of change [41].

Although Food Allergies have not always been reported to increase directly after the pandemic, COVID-19 infection is known to be associated with an increase in the incidence of other allergic diseases, such as asthma, allergic rhinitis, and atopic dermatitis in children, which pathophysiologically can act as a comorbidity pathway and indirect risk factor for Food Allergies [42].

A recent comprehensive review emphasised that changing global food allergy patterns are largely influenced by multifactorial factors, including changes in early life diet, food introduction practices, microbiota exposure, public health policies, and increased awareness and accuracy of IgE -based diagnosis [43].

In line with this, electronic- based health Records in the United States show a decline in the prevalence of peanut allergy and IgE -based food allergies in infants, which is associated with the widespread implementation of early food introduction guidelines, a phenomenon that remains relevant in

the post-pandemic context due to changes in infant feeding behavior during that period [44].

Studies from Asia indicate that food allergies remain a significant health burden in children, with variations in risk influenced by genetic, environmental, and nutritional factors, although not all studies explicitly compare the pre- and post-COVID-19 periods [45]. In addition, studies in pediatric populations, Multiculturalism in the pandemic era, highlight that post-pandemic food allergy challenges are more related to access to services, delayed diagnosis, and socioeconomic disparities than to pure changes in incidence [46].

Food allergies and anaphylaxis show unique patterns. Long-term data show an increasing trend in pediatric anaphylaxis, but during the early stages of the pandemic, emergency room visits decreased due to mobility restrictions and concerns about seeking treatment [8, 47].

Decrease in emergency room visits during the pandemic. This does not mean that the incidence of anaphylaxis has decreased; rather, it reflects changes in care-seeking behaviour. After restrictions were eased, the burden on anaphylaxis services tended to increase again [48]. Health systems must remain prepared for an increase in anaphylaxis, with consistent standards of management and guaranteed access to epinephrine [8].

DISCUSSION

Overall, cross-national evidence suggests that the COVID-19 pandemic has not resulted in a uniform directional change in the epidemiology of childhood allergic disease, but rather has reinforced diagnosis-specific divergence patterns, which are influenced by complex interactions between environmental exposure, viral ecology, community behaviour, and access to health services.

In asthma, most studies consistently show a sharp decline in emergency department visits and hospitalisations during periods of social distancing, followed by a rebound or shift in exacerbation patterns after policy easing, which is primarily associated with the return of respiratory virus circulation, changes in school policies, and modifications in service-seeking behaviour [1-4, 49].

This finding is reinforced by national surveillance data and ED-based analysis, which show that the decline during the pandemic is more reflective of suppression of triggers and changes in care-seeking, not a true reduction in biological incidence [18, 47].

In allergic rhinitis, most studies show an accelerating trend post-pandemic, especially when measured as outpatient visits, with strong seasonal variation. This increase likely reflects the predominance of indoor allergen exposure, a rebound in social activity, and increased recognition and utilisation of services after the lockdown phase [7, 23, 26, 50].

In contrast, in atopic dermatitis, global and national evidence tends to show stability or decline in prevalence, although some studies report increased severity or flares in certain subgroups, which are associated with psychosocial stress, disruption of care routines, and limited access to services during the pandemic [5, 9, 51, 52].

Interestingly, data on anaphylaxis and acute allergic disease show a directional pattern. Data sources and case definitions. National ED visit and claims-based studies in several countries report long-term increasing trends that continue beyond the pandemic period, likely influenced by the increasing burden of food allergies, clinical awareness, and changes in coding practices [8, 53, 54]. However, inpatient-based or early-phase pandemic studies show a decrease in acute presentations, which confirms that the interpretation of trends is highly sensitive to the service context and the denominator used [48, 55].

Conceptually, these findings support the hypothesis that the pandemic serves as a “natural experiment” that modulates early-life exposures, microbial and viral ecology, and healthcare pathways, resulting in differential effects across allergic phenotypes and age groups. Birth cohort studies during the pandemic reinforce the importance of the *early life window*, with differences in atopic outcomes in infants born during the pandemic compared to before it, thought to be mediated by timing of infection exposure, indoor environment, and healthcare practices [56].

Therefore, interpretation of post-pandemic childhood allergy trends needs to be done carefully, with stratification based on diagnosis, age, service setting, and measurement method, and not simplified as a single increase or decrease due to COVID-19 alone [28, 37, 57].

Overall, post-pandemic changes in childhood allergic disease are better understood as changes in trigger and exposure patterns, not a general spike in allergies. Asthma is strongly affected by the return of viral infections and the resumption of school activities. Allergic rhinitis is influenced by the balance of indoor and outdoor exposure. Atopic dermatitis is influenced by stress, sleep disturbances, and access to services. Anaphylaxis is influenced by treatment behaviour and referral systems. Service visit-based indicators must always be read in conjunction with changes in service systems, such as telemedicine and shifts in community habits

CONCLUSION

The COVID-19 pandemic has served as *a natural experiment* that changes the patterns of exposure, environmental conditions, virus ecology, family behaviour, and access to health services for children, so that the post-pandemic trend in disease and allergies looks non-uniform and highly specific in diagnosis.

Asthma shows a decline in exacerbations during restrictions, with a rebound or shift pattern after school and social activities, especially influenced by the return of viral infections. Rhinitis allergies show the most heterogeneous response because of the balance between indoor and outdoor exposure and protective habits, while atopic dermatitis is relatively stable in terms of prevalence but prone to worsening severity under stress, disturbed sleep, and limitations in service. Food Allergy and anaphylaxis are strongly influenced by behavioural treatment and context, so the number of visits does not always reflect the true incidence. Therefore, the interpretation of post-pandemic trends needs to consider disease phenotype, age, change triggers, and dynamic service systems, with emphasis on preparedness for seasonal infections, management of exposure, monitoring severity, and strengthening service models for hybrid sustainability and maintenance of children.

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