

Postprint: Analysis of the Proportion and Trends of Outpatient Visits for Pediatric Allergic Diseases in Beijing, 2014-2021

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Date: 2024-04-01T00:00:00+00:00

Abstract

Background The prevalence of allergic diseases has risen sharply in the global population, currently affecting 10%~40% of the world's population. These conditions typically begin in childhood; however, there remains a paucity of data in China on trend analysis of allergic disease incidence in children within 10 years. This study seeks to provide epidemiological support for the prevention and management of allergic diseases domestically by mining single-center electronic medical record data.

Objective To analyze the annual constituent ratio and temporal trends of outpatient visits for allergic diseases among children aged 0~18 years at Beijing Children's Hospital, Capital Medical University from 2014 to 2021.

Methods A retrospective analysis was conducted on outpatient electronic medical record data from the hospital information system of Beijing Children's Hospital, Capital Medical University from 2014 to 2021 to analyze the annual constituent ratio and temporal trends of allergic disease visits. The annual constituent ratios of allergic diseases—including eczema, urticaria, allergic rhinitis, bronchial asthma, allergic cough, allergic conjunctivitis, food allergy, drug allergy, pollinosis, and anaphylaxis—were calculated across different genders and age groups. The temporal trends of constituent ratios were further analyzed for allergic diseases that consistently ranked in the top 10 in annual constituent ratio.

Results From 2014 to 2021, a total of 1,231,890 outpatient visits for allergic diseases were recorded among children, with 1,231,863 visits included after exclusion of missing data, comprising 727,082 visits by boys (59.0%) and 504,781 visits by girls (41.0%). The age of children presenting for allergic diseases was predominantly under 3 years (46.9%). Differences in gender and age among

children visiting for allergic diseases were statistically significant ($P < 0.05$). After excluding non-IgE-mediated allergic diseases such as anaphylactoid purpura, bronchitis, and respiratory tract infections, 1,208,265 cases were included in the disease spectrum analysis. From 2014 to 2017, the top 5 allergic diseases in terms of outpatient visit constituent ratio were eczema, urticaria, allergic rhinitis, bronchial asthma, and allergic cough; from 2018 to 2021, the top 5 were allergic rhinitis, eczema, urticaria, allergic conjunctivitis, and bronchial asthma. Analysis of annual constituent ratio trends revealed that from 2014 to 2021, the constituent ratios of allergic rhinitis, allergic conjunctivitis, and food allergy among all allergic diseases demonstrated an upward trend year by year, with peak constituent ratios reaching 45.4%, 11.1%, and 2.8%, respectively; the constituent ratios of eczema, urticaria, and bronchial asthma showed a downward trend, with peak constituent ratios of 46.5%, 24.9%, and 11.3%, respectively.

Conclusion From 2016 to 2021, the proportion of outpatient visits for allergic diseases among children at Beijing Children's Hospital, Capital Medical University showed an upward trend relative to total hospital outpatient visits; from 2014 to 2021, the annual constituent ratios of allergic rhinitis, allergic conjunctivitis, and food allergy showed an upward trend, while those of eczema, urticaria, and bronchial asthma showed a downward trend.

Full Text

Analysis of the Proportion and Trend of Outpatient Visits for Pediatric Allergic Diseases in Beijing from 2014 to 2021

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Abstract

Background: The prevalence of allergic diseases is increasing dramatically worldwide, affecting 10%-40% of the global population. These diseases often begin in childhood, yet China lacks data on incidence trends in pediatric allergic diseases over the past decade. This study aims to provide epidemiological

support for national allergy prevention and management efforts by mining electronic medical record data from a single center.

Objective: To analyze the annual proportion and trend of outpatient visits for allergic diseases among children aged 0-18 years at Beijing Children's Hospital, Capital Medical University from 2014 to 2021.

Methods: We conducted a retrospective analysis of outpatient electronic medical record data from the hospital information system of Beijing Children's Hospital, Capital Medical University between 2014 and 2021. The annual proportional composition and trends of allergic diseases were analyzed. Gender- and age-specific proportions were calculated for various allergic diseases including eczema, urticaria, allergic rhinitis, bronchial asthma, allergic cough, allergic conjunctivitis, food allergy, drug allergy, pollen allergy, and anaphylaxis. We further analyzed trends in diseases that consistently ranked among the top 10 in annual proportion.

Results: From 2014 to 2021, there were 1,231,890 outpatient visits for pediatric allergic diseases. After excluding missing data, 1,231,863 eligible cases were included, comprising 727,082 boys (59.0%) and 504,781 girls (41.0%). The majority of children were under 3 years of age (46.9%). Gender and age differences among children visiting for allergic diseases were statistically significant ($P < 0.05$). Non-IgE-mediated allergic diseases such as Henoch-Schönlein purpura, bronchitis, and respiratory tract infections were excluded, leaving 1,208,265 cases for disease spectrum analysis. From 2014-2017, the top 5 allergic diseases were eczema, urticaria, allergic rhinitis, bronchial asthma, and allergic cough. From 2018-2021, the top 5 were allergic rhinitis, eczema, urticaria, allergic conjunctivitis, and bronchial asthma. Trend analysis revealed that from 2014-2021, the proportions of allergic rhinitis, allergic conjunctivitis, and food allergy showed an upward trend, with peak proportions reaching 45.4%, 11.1%, and 2.8% respectively. Conversely, the proportions of eczema, urticaria, and bronchial asthma showed a downward trend, with peak proportions of 46.5%, 24.9%, and 11.3% respectively.

Conclusion: From 2016-2021, the proportion of outpatient visits for pediatric allergic diseases at Beijing Children's Hospital showed an upward trend. Between 2014-2021, the annual proportions of allergic rhinitis, allergic conjunctivitis, and food allergy increased, while those of eczema, urticaria, and bronchial asthma decreased.

Key Words: Anaphylaxis; Allergic diseases; Child; Ambulatory care; Proportion; Trend analysis; Beijing

Allergic diseases are common conditions affecting children's health and quality of life, with severity ranging from self-limiting mild symptoms to severe anaphylaxis. Recent studies demonstrate a rising prevalence among children. Data from the U.S. Centers for Disease Control and Prevention (1988-2011) show

self-reported pediatric food allergy prevalence increasing by 1.2% per decade. In China, the prevalence of asthma among children aged 0-14 years shows an overall upward trend, reaching as high as 9.82%. Pediatric allergic rhinitis prevalence is approximately 18.46% with significant regional variation. The prevalence of atopic dermatitis in children aged 1-7 years reaches 12.94%, while 40.9% of infants aged 0-24 months have experienced or are experiencing allergic symptoms, with a current prevalence of 12.3%. Different allergic diseases frequently co-occur in asthma and allergy patients, with multimorbidity common across all age groups. However, China currently lacks epidemiological data on the disease spectrum and changing trends of pediatric allergic diseases. This study analyzes the disease spectrum and trends among outpatients at Beijing Children's Hospital to provide data reference for hospital and specialty allergy disease management.

1.1 Data Sources

Original data were extracted from the outpatient electronic medical record system of the hospital information system (HIS) at Beijing Children's Hospital, Capital Medical University from 2014-2021. This study was approved by the Ethics Committee of Beijing Children's Hospital (Approval No.: [2022]-E-006-Y).

1.2 Research Methods

We employed a keyword search strategy using terms including "allergy," "eczema," "urticaria," "asthma," "allergic," "wheezing," "atopic," "pollinosis," "cough variant," and "cough variant asthma." Case data for patients whose diagnoses contained these keywords were transferred to the Pediatric Asthma Data Analysis Platform by hospital information center staff. Diagnoses were classified according to International Classification of Diseases-10 (ICD-10) principles. Multiple visits by the same patient for the same disease within a year were counted as one case, while visits for different diseases were counted separately. Following consensus among research team members, non-IgE-mediated allergic diseases including Henoch-Schönlein purpura, bronchitis, respiratory tract infections, upper respiratory infections, pharyngitis, sinusitis, infantile wheezing, eosinophilia, hyper-IgE syndrome, and bronchiolitis obliterans were excluded. We calculated the proportional composition of the top 10 allergic diseases by visit frequency and analyzed trends in annual composition ratios.

1.3 Statistical Methods

Source data were cleaned and normalized using R language methods. Data engineers then performed batch processing. Disease characteristics were described using constituent ratios, and chi-square tests were used for statistical analysis of disease trends. $P < 0.05$ was considered statistically significant.

2.1 General Information

From 2014-2021, there were 1,231,890 outpatient visits for pediatric allergic diseases. After excluding 5 cases with missing gender information and 22 cases with missing age information, 1,231,863 eligible cases were included. Boys accounted for 727,082 visits (59.0%) and girls for 504,781 visits (41.0%). The majority of children were under 3 years of age (577,589 cases, 46.9%), followed by preschool children aged 3-6 years (382,197 cases, 31.0%), school-age children aged 6-12 years (252,230 cases, 20.5%), and adolescents aged 12-18 years (19,847 cases, 1.6%). Gender and age differences were statistically significant ($P < 0.05$) (Table 1).

After excluding non-IgE-mediated allergic diseases, 1,208,265 cases were included in the disease spectrum analysis. The proportion of outpatient visits for pediatric allergic diseases among total hospital outpatient visits at Beijing Children's Hospital showed an upward trend from 2016-2021 [Figure 1: see original paper].

2.2 Outpatient Visits and Composition of Pediatric Allergic Diseases, 2014-2021

From 2014-2017, the top 5 allergic diseases by outpatient visit proportion were eczema (35.4%-46.5%), urticaria (17.1%-24.9%), allergic rhinitis (11.4%-27.0%), bronchial asthma (8.6%-11.3%), and allergic cough (2.0%-4.0%). From 2018-2021, the top 5 were allergic rhinitis (39.2%-45.4%), eczema (18.3%-23.1%), urticaria (10.4%-12.4%), allergic conjunctivitis (8.5%-11.1%), and bronchial asthma (6.8%-8.2%). Table 2 shows the outpatient visit numbers and proportional rankings for pediatric allergic diseases from 2014-2021.

2.3 Trends in Annual Proportional Composition, 2014-2021

Further trend analysis of the 8 allergic diseases consistently ranking in the top 10 revealed that from 2014-2021, the annual proportions of allergic rhinitis, allergic conjunctivitis, and food allergy showed an upward trend, with peak proportions reaching 45.4%, 11.1%, and 2.8% respectively. Conversely, the proportions of eczema, urticaria, and bronchial asthma showed a downward trend, with peak proportions of 46.5%, 24.9%, and 11.3% respectively [Figure 2: see original paper].

Discussion

Our findings show that from 2014-2021, the annual proportions of allergic rhinitis, allergic conjunctivitis, and food allergy showed an upward trend, consistent with previous international epidemiological studies. The Japanese Guidelines for Allergic Rhinitis 2020 indicate that allergic rhinitis can be perennial or seasonal, with seasonal allergic rhinitis often associated with pollinosis. Pollinosis is a seasonal allergic rhinitis caused by pollen antigens, frequently complicated

by allergic conjunctivitis. From 1960-2008, the number of patients with allergic rhinitis increased, with pollinosis becoming more common and increasing among middle-aged individuals. Our study included cases of children ≥ 18 years and found that allergic rhinitis, allergic conjunctivitis, and food allergy all increased from 2014-2021, particularly with a marked upward trend in allergic rhinitis patients after 2018.

Regarding food allergy, 6%-8% of children in industrialized countries such as Europe and the United States suffer from food allergy. The prevalence of food allergy in infancy is increasing and may affect up to 15%-20% of infants. The most common food allergens are milk, eggs, peanuts, tree nuts, shellfish, and fish. Milk and egg allergies often resolve naturally with age, while peanut and tree nut allergies tend to persist. In our study, the number of children diagnosed with food allergy at our hospital increased 28-fold from 2014 to 2021, far exceeding current international trends in food allergy prevalence. This increase may be related to improved awareness of food allergy among caregivers and physicians. However, due to the non-specific clinical manifestations of food allergy and the limited availability of oral food challenge tests in China, both underdiagnosis and overdiagnosis coexist. Additionally, the diverse dietary patterns in China further complicate diagnosis, necessitating further research to improve diagnostic accuracy.

International studies show that since 1970, the incidence of eczema in industrialized countries has increased 2-3 fold, with prevalence among children and adolescents ranging from 5%-20%. From 1993-2020, eczema prevalence in children aged 1-13 years increased by 14% per decade, though significant regional variation exists. Eczema has not continued to increase in low-income countries or the Americas but has risen in some regions of Africa, the Eastern Mediterranean, and high-income areas. For urticaria, international research is limited, with acute and chronic forms often not distinguished. A meta-analysis of chronic urticaria prevalence in children and adults worldwide showed substantial regional variation, with Asian prevalence estimated at 1.40% and chronic urticaria prevalence increasing over time, ranging from 0.14%-2.40% in children. Our study found that the annual proportion of pediatric urticaria ranged from 10.4%-24.9% from 2014-2021, with a decreasing trend after 2017. This discrepancy with previous research may be due to our exclusion of non-allergic disease patients and lack of disease duration stratification.

IgE-mediated allergic diseases manifest clinically as urticaria, angioedema, allergic rhinitis, allergic conjunctivitis, asthma, oral allergy syndrome, gastrointestinal symptoms, and systemic anaphylaxis. Bronchial asthma is a common chronic airway allergic disease in childhood. Asthma prevalence trends vary by region, with global asthma incidence continuing to rise in low- and middle-income countries while appearing to plateau in some developed countries. In 2017, the overall asthma prevalence in the United States was 7.9%. Three national epidemiological surveys of urban children in China (1990, 2000, and 2010) showed cumulative prevalence rates of 1.00%, 1.97%, and 3.02% respectively,

indicating a clear upward trend. Currently, China lacks multicenter epidemiological data on childhood asthma after 2010. Our study shows a downward trend in the annual proportion of pediatric bronchial asthma since 2017, though this may be relative due to the increasing disease spectrum and marked rise in food allergy patients. Multicenter studies including healthy controls are needed to verify whether childhood asthma prevalence in China has truly plateaued.

Individuals often have two or more coexisting allergic diseases. Anaphylaxis is a multisystem allergic emergency that is frequently misdiagnosed as asthma or urticaria in up to 80% of cases. The lifetime prevalence of systemic anaphylaxis is estimated at 0.3% in Europe and 1.6%-5.1% in the United States. Hospital admissions due to anaphylaxis are increasing in many countries, particularly among young children, with drug and food triggers being especially notable. Young people with asthma or known food allergies (especially peanut/tree nut) are at higher risk for fatal anaphylaxis.

In summary, from 2016-2021, the proportion of outpatient visits for pediatric allergic diseases at Beijing Children's Hospital showed an upward trend. From 2014-2021, the annual proportions of allergic rhinitis, allergic conjunctivitis, and food allergy increased, while those of eczema, urticaria, and bronchial asthma decreased. The proportional composition of different pediatric allergic diseases is continuously changing, likely related to industrialization, pollen concentrations, and economic development. Multicenter, multidimensional studies are needed for further verification. Although this is a single-center study, the large sample size and long time span still provide representative insights into the growing trend and potential patterns of allergic diseases in the Beijing region. Prevention and control of pediatric allergic diseases should focus not only on acute severe conditions like asthma and anaphylaxis but also on health management and patient education for common and frequent conditions.

Author Contributions: HOU Xiaoling, HUANG Huijie, JIANG Nannan, LI Ang, and WEI Mian were responsible for data cleaning, statistical analysis, and figure preparation. KONG Qin was responsible for patient information extraction and retrieval. XIANG Li was responsible for final manuscript revision, overall supervision, and project management.

Conflict of Interest: The authors declare no conflict of interest.

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(Received: January 17, 2024; Revised: March 20, 2024) (Edited by: KANG Yanhui)

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