

# *Epidemiology and Clinical Characteristics of Influenza A and B in Children of Different Age Groups*

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**Abstract:** To analyze the epidemic characteristics of influenza A (influenza A) and influenza B (influenza B) in Hohhot from October 2022 to December 2023 and the clinical manifestations of children with influenza A and influenza B in different age groups, so as to provide evidence for the prevention and control of influenza in this region. A retrospective analysis was performed on 8042 children (aged 0-18 years) suspected to have influenza A and influenza B from October 2022 to December 2023 in the Maternal and Child Health Hospital of Inner Mongolia Autonomous Region. The epidemic characteristics and clinical manifestations of children with influenza A and influenza B were analyzed with statistical analysis. From October 2022 to December 2023, the positive detection rate of influenza A was 6.0% (484/8042) and that of influenza B was 3.2% (261/8042). The main clinical manifestations of children with H1N1 influenza are upper respiratory tract infection, pneumonia, fever, cough, bronchitis. The main clinical manifestations were upper respiratory tract infection, pneumonia, cough, bronchitis and fever. The positive rate was 6.9% (250/3615) in males and 5.3% (234/4427) in females. The positive rate was 3.9% (141/3615) in males and 2.7% (120/4427) in females. The positive detection rate of influenza A was higher in 6-12 years old [9.0% (103/1149)], and the positive rate of influenza B was higher in 3-6 years old [4.9% (133/2741)]. The positive rate of influenza A and B in 1-3 years old, 3-6 years old and 6-12 years old was significantly different from that in 0-1 years old ( $P < 0.01$ ). The positive detection rate of influenza A was higher in February-March and November-December. After March 2023, the positive detection rate of influenza A decreased significantly, and no positive influenza B was detected from April to September. The positive rate of B current was mainly concentrated in February-March and November-December. In the second half of 2023, the positive detection rate of influenza B increased month by month, and the positive detection rate of influenza B remained at a high level from November to December. The positive detection rates of A and B influenza were higher in Hohhot area from 1 to 12 years old. The positive detection rates of A and B were compared among all age groups and genders,  $P < 0.05$ , and the difference was statistically significant. The main clinical manifestations were upper respiratory tract infection, pneumonia and fever. Attention should be paid to strengthening preventive measures for different groups and major seasons.

## 1. Introduction

Influenza (flu) is a respiratory illness caused by influenza viruses, which are negative-strand RNA viruses of the Orthomyxoviridae family. Based on the antigenic differences of the viral nucleoprotein and matrix protein, influenza viruses are classified into types A, B, and C [1]. Influenza causes significant morbidity and mortality worldwide, with approximately 500,000 deaths annually; currently, influenza A virus (influenza A virus, IAV) and influenza B virus (influenza B virus, IBV) primarily infect humans and cause epidemics globally. Influenza A virus undergoes the most variation and has caused multiple major pandemics worldwide; outbreaks of influenza B virus are more localized and exhibit seasonality and regionality [2].

Children are a high-risk group for influenza infection. According to the World Health Organization (WHO), 20-30% of children worldwide contract seasonal influenza each year. About 30% of children with influenza develop complications, which have become a major cause of hospitalization. Due to the weaker immunity of infants and young children compared to adults, their onset is more acute and progresses faster. In severe cases, it can develop into acute respiratory distress syndrome, septic shock, sepsis, and even death. Therefore, analyzing its epidemiological trends and characteristics is of great importance for the prevention of influenza [3-4].

Since the outbreak of the COVID-19 pandemic at the end of 2019, due to strict control policies, the use of masks, and social distancing, there has been no large-scale outbreak of Influenza A and B in Hohhot from 2020 to 2022. On December 5, 2022, the lockdown was fully lifted, and in January 2023, Hohhot experienced another outbreak of influenza [5].

This paper conducts an epidemiological analysis and clinical case analysis of Influenza A (H1N1) and Influenza B in children under 18 years old in the Hohhot area from October 2022 to December 2023. The aim is to understand the clinical characteristics of Influenza A infection in children of different age groups, provide data support for the clinical diagnosis and treatment of Influenza A and B, and early detection of severe cases. This also provides a reference for future risk assessment and prevention of Influenza A and B mutations, as well as ideas for early intervention and treatment.

## 2. Data and Methods

### 2.1. Clinical Data

From October 2022 to December 2023, 8042 suspected cases of Influenza A and B under the age of 18 were treated at the Maternal and Child Health Hospital of Inner Mongolia Autonomous Region, including 3615 males and 4427 females.

Inclusion criteria: meeting the diagnostic criteria for Influenza A as outlined in the 'Expert Consensus on Diagnosis and Treatment of Influenza in Children (2020 Edition)', and testing positive for Influenza A or B virus antigens. Exclusion criteria: patients with autoimmune diseases, nephrotic syndrome, or other systemic underlying diseases; those who have used immunosuppressants or have immune deficiency diseases in the past 3 months; those co-infected with Influenza B, respiratory syncytial virus, EB virus, or other viral infections. According to the age of the children, they were divided into the following groups: 0-1 year group (excluding 1 year); 1-3 years group (including 1 year, excluding 3 years); 3-6 years group (including 3 years, excluding 6 years); 6-12 years group (including 6 years, excluding 12 years); 12-18 years group (including 12 years, excluding 18 years).

### 2.2. Instruments and Reagents

The instruments used were the domestic Shanghai Hongshi fully automatic gene amplification

instrument SLAN-96P, and the reagents were the adenovirus nucleic acid detection kit (PCR-fluorescent probe method) from Guangdong Hexin Health Technology Co., Ltd.

### 2.3. Methods

**Specimen Collection:** Collect pharyngeal swab specimens from children. The examiner uses a tongue depressor to assist, passing the swab over the root of the tongue to the posterior pharyngeal wall and tonsillar crypts, lateral walls, etc., repeatedly wiping 3 to 5 times to collect mucosal cells, avoiding contact with the tongue, oral mucosa, and saliva.

**Nucleic Acid Testing:** Add 2ml of saline to the throat swab, extract DNA using nucleic acid extraction and purification techniques, strictly follow the steps in the reagent kit manual, and then amplify using a real-time fluorescent PCR instrument.

**Interpretation Criteria:** After the reaction is complete, according to the analysis results of the Shanghai Hongshi Fully Automated Medical PCR Analysis System, if there is a significant increase in the fluorescent signal under FAM fluorophore, showing a typical S-shaped curve, and  $Ct \leq 35.00$ , it is determined to be positive; if there is no significant increase in the fluorescent signal under FAM fluorophore, and  $Ct > 35.00$ , it is determined to be negative.

This study adopts a retrospective approach, utilizing the hospital information system for statistical analysis of relevant data.

### 2.4. Statistical Methods

SPSS 22.0 statistical software was used. Count data were described by frequency. The chi-square test, corrected chi-square test, or Fisher's exact probability method was used for intergroup comparisons, while variance analysis and t-tests were used for intergroup comparisons; count data were expressed as case numbers (percentages).  $P < 0.05$  was considered statistically significant.  $\chi^2$

## 3. Results

### 3.1. Detection of Influenza A and B in Different Months

Table 1: Detection of Influenza A and B in Different Months from October 2022 to December 2023 [Cases (%)]

Month	Number of Cases	Influenza A Positive	Influenza B Positive
10	99	3(3.0)	9(9.0)
11	21	0	0
12	157	1(0.6)	2(1.2)
1	167	1(0.5)	1(0.5)
2	529	113(21.4)	115(21.7)
3	905	229(25.3)	88(9.7)
4	619	18(2.9)	0
5	746	4(0.5)	0
6	689	0	0
7	710	0	0
8	657	0	0
9	660	1(0.1)	0
10	667	9(1.3)	6(0.8)
11	693	68(9.8)	22(3.1)
12	723	37(5.1)	18(2.5)

From October 2022 to December 2023, a total of 8042 pediatric cases were tested, with an overall detection rate of 6.0% (484/8042) for Influenza A and 3.2% (261/8042) for Influenza B. No cases of Influenza A or B were detected in November 2022, and no positive cases of Influenza A were detected from June to August 2023, while no positive cases of Influenza B were detected from April to September. The highest detection rate for Influenza A was in March at 25.3% (229/905), and the highest detection rate for Influenza B was in February at 21.7% (115/529). Influenza A mainly peaked in spring with a positive detection rate of 11.1% (251/2270); Influenza B mainly peaked in winter with a positive detection rate of 13.8% (118/853). See Table 1 for details, and the trend chart is shown in Figure 1.

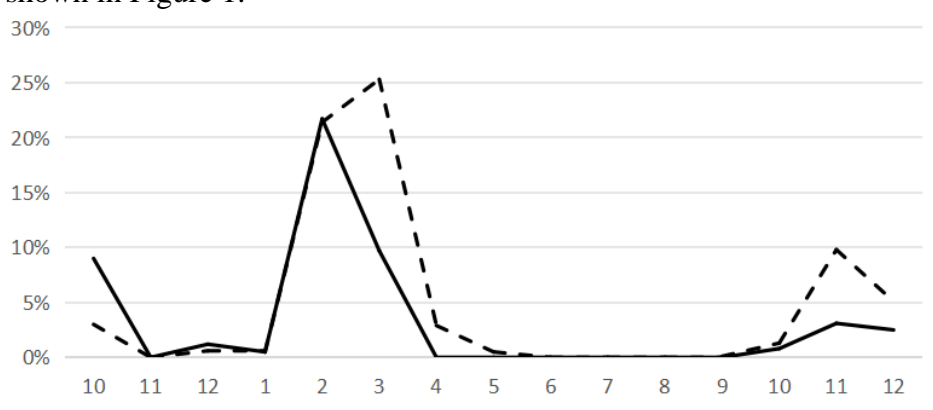


Figure 1: Trend Chart of Influenza Infection Rate from October 2022 to December 2023

### 3.2. Influenza A and B Positivity in Different Age Groups

The highest detection rate of Influenza A positivity is in the 6-12 years age group, at 7.8% (98/1249). The lowest detection rate of Influenza A positivity is in newborns aged 0-1 years, at 3.2% (51/1618). The highest detection rate of Influenza B positivity is in the 1-3 years age group, at 4.3% (77/1785); the lowest is in the 0-1 years age group, at 1.0% (16/1618). Overall, the detection rate of Influenza A positivity is higher in the 1-12 years age group, while the detection rate of Influenza B positivity is higher in the 1-6 years age group. See Table 2 for details.

Table 2: Distribution of Influenza A and B Positive Cases by Age Group from October 2022 to December 2023 [Cases (%)]

Age Group	Number of Cases	Influenza A Positive	Influenza B Positive
0 ~ 1	1618	51(3.2)	16(1.0)
1 ~ 3	1785	124(6.9)	77(4.3)
3 ~ 6	3241	206(6.4)	133(4.1)
6 ~ 12	1249	98(7.8)	33(2.6)
12 ~ 18	149	5(3.4)	2(1.3)

### 3.3. Influenza A and B Positivity Rates by Gender

Influenza A positivity rate: Male 6.9% (250/3615), Female 5.3% (234/4427). Influenza B positivity rate: Male 3.9% (141/3615), Female 2.7% (120/4427).

### 3.4. Distribution of Influenza A and B by Gender and Age Group

There are differences in the detection rates of Influenza A and B positivity between genders, with higher detection rates in males ( $P < 0.05$ ). Comparing the other four groups with the 0-1 year group, it was found that the detection rates of Influenza A and B positivity in the 1-3 years, 3-6 years, and 6-12 years age groups were statistically significant ( $P < 0.001$ ). See Table 3 for details.

Table 3: Comparison of Positive Detection Rates of Influenza A and B by Age and Gender

Grouping	Category	Number of People	Influenza A (n=480)	Detection Rate/%	$\chi^2$ Value	P Value	Influenza B (n=250)	Detection Rate/%	$\chi^2$ Value	P Value
Gender	Male	3615	250	6.9	8.273	0.004	141	3.9	8.397	0.004
	Female	4427	234	5.3			120	2.7		
Age Group *	0 ~ 1	1618	51	3.2	-	-	16	1.0	-	-
	1 ~ 3	1785	124	6.9	22.650	<0.001	77	4.3	33.479	<0.001
	3 ~ 6	3241	206	6.4	20.103	<0.001	133	4.1	33.474	<0.001
	6 ~ 12	1249	98	7.8	28.262	<0.001	33	2.6	11.061	<0.001
	12 ~ 18	149	5	3.4	0.017	0.895	2	1.3	0.165	0.684

\*Note: The comparison between age groups is between the 0 ~ 1 year group and the other four groups respectively.  $P < 0.05$  indicates a statistically significant difference.

### 3.5. Distribution of Different Clinical Manifestations

The distribution of clinical manifestations in children with Influenza A is as follows: upper respiratory tract infection 49.8% (241/484), pneumonia 19.6% (95/484), bronchitis 11.8% (57/484), cough 5.6% (27/484), fever 4.5% (22/484), febrile convulsion 3.5% (17/484), laryngitis 3.5% (17/484), and others 1.7% (8/484). The distribution of clinical manifestations in children with Influenza B is as follows: upper respiratory tract infection 28.0% (73/261), pneumonia 26.4% (69/261), bronchitis 11.1% (29/261), cough 10.7% (28/261), febrile convulsion 9.6% (25/261), fever 7.3% (19/261), laryngitis 4.2% (11/261), and others 2.7% (7/261). See Table 4 for details.

Table 4: Distribution of Clinical Manifestations of Influenza A and B Positive Patients from January to December 2023 [cases (%)]

Clinical Manifestations	Influenza A	Influenza B
Upper Respiratory Tract Infection	241(49.8)	73(28.0)
Pneumonia	95(19.6)	69(26.4)
Bronchitis	57(11.8)	29(11.1)
Cough	27(5.6)	28(10.7)
Fever	22(4.5)	25(9.6)
Febrile Seizure	17(3.5)	19(7.3)
Laryngitis	17(3.5)	11(4.2)
Others	8(1.7)	7(2.7)

## 4. Discussion

Influenza A virus (IAV) frequently mutates and is the main cause of human influenza. It usually

occurs seasonally, with early symptoms including headache, chills, and cough, similar to a cold. However, its onset is very rapid, typically causing fever with body temperature reaching above 39 °C. In severe cases, it can lead to respiratory failure, multiple organ failure, and even death.

Influenza B virus (IVB) has only one type of neuraminidase and one type of hemagglutinin, so its variability is much lower than that of influenza A virus. In recent years, influenza has been at a high level of prevalence globally, with the positive detection rates of both influenza A and B significantly higher than the same period a few years ago [6-7].

Season is an important factor affecting the transmission and infection of diseases. In temperate regions, influenza is very common throughout the winter; in tropical and subtropical regions, influenza occurs year-round, mostly during the rainy season, and often peaks in the summer and autumn. The results of this study show that influenza A and B viruses in Hohhot are mainly prevalent in the winter and spring seasons. During the period from October 2022 to December 2023, influenza A and B mainly broke out in February and March. With the rise in temperature and the arrival of summer, no positive cases of influenza A or B were detected in June, July, and August. In October, as the temperature in Hohhot gradually decreased, the positive detection rates of influenza A and B also gradually increased [8].

The positive detection rates of Influenza A and B viruses also have characteristics in age and gender distribution. The results of this study indicate that there are statistically significant differences in the age distribution of people under 18 years old in Hohhot ( $P < 0.05$ ). Influenza A and B are mainly distributed among children aged 1-12 years, with the positive rate of Influenza A generally higher than that of Influenza B across all age groups. The positive rates of Influenza A and B in newborns aged 0-1 year are generally lower than in other age groups. Due to the low immunity of infants and young children, and the increased awareness of influenza prevention since the outbreak of the COVID-19 pandemic, parents have become more cautious about the viral prevention in the environment of newborns, resulting in lower influenza positive rates. This is also related to the fact that during the COVID-19 pandemic, infants and young children's relatives wore masks, maintained social distancing, and avoided crowd gatherings, reducing the chances of Influenza A infection. Additionally, infants and young children mostly stay at home, with less exposure to public places. Preschool and school-age children live in groups in kindergartens and schools, with a larger range of activities, making it easy for the virus to spread once a classmate is infected. Children over 12 years old have more developed immune systems and are less likely to get viral infections as they age. In Hohhot, there are differences in the positive detection rates of Influenza A and B between genders, with higher detection rates in males. The positive detection rate of Influenza A is higher in children aged 6-12 years, while the positive detection rate of Influenza B is higher in children aged 1-3 years. Influenza A and B infections are more common in children under 12 years old. The positive detection rate of Influenza A in male children is higher than in female children ( $P < 0.05$ ), consistent with the findings of Lan Xiaoying et al., possibly due to the higher variability of Influenza A. Children with Influenza A have a longer course of illness, more severe clinical symptoms, and are more prone to bacterial infections and neurological damage. Therefore, early prediction and prevention of Influenza A in male children can be strengthened. The results of this study show that the infection rate of Influenza B is statistically significantly higher in males than in females ( $P < 0.05$ ), which is inconsistent with the findings of Zhang Yitong et al., possibly due to the subtype of the prevalent influenza virus and the geographical location of the study. Further research is needed to determine the specific reasons [9-12].

The results of this study show that Influenza A and B mainly cause upper respiratory tract infections, bronchopneumonia, bronchitis, and other respiratory diseases, with symptoms such as cough and fever being the main manifestations. Due to the small sample size in this study, there are inevitably limitations, so further analysis through large sample surveys is needed.

Since the global outbreak of COVID-19 at the end of 2019, due to the strict control policies in our country, such as the widespread promotion of mask-wearing, social distancing, and avoiding crowd gatherings, there has been no large-scale influenza epidemic from 2020 to 2022. Because the Influenza A virus is prone to mutation, flu vaccines cannot effectively prevent infections from mutated strains, and infants and young children have immature natural immune systems, children are a high-risk group for influenza and severe influenza. During flu epidemics, there can be a significant number of school-aged children missing classes and kindergartens closing. Influenza, as a major public health issue, requires solutions to prevent the disease from worsening into severe cases. Children are a high-risk group for severe influenza, with high infection rates, and infected children can become sources of transmission in schools, spreading the virus to other children. Influenza in children also affects the work and life of parents. Primary school students aged 6-12, as well as teachers and students, should wear masks when going out, pay attention to hand hygiene and maintain social distancing, actively participate in physical exercise to improve body resistance, and avoid close contact with people who have respiratory symptoms as much as possible. Additionally, eligible teachers and students should receive the flu vaccine every autumn to reduce the chance of influenza infection and the occurrence of severe and critical influenza. Schools should strengthen leadership, raise requirements for influenza prevention and control work, and make plans in advance [13-14].

In short, understanding the epidemiological characteristics of influenza viruses in people under 18 years old in Hohhot helps in prevention and vigilance, reducing the prevalence, minimizing complications, and curbing the spread of the influenza virus. Gaining knowledge about influenza viruses and their epidemiological features in advance, and getting vaccinated against influenza, are important measures to prevent viral infectious diseases. During the influenza epidemic period, children should maintain good hygiene habits and lifestyles when going out, reduce outdoor activities, or avoid participating in activities in densely populated areas. In enclosed environments such as schools or homes, maintaining air circulation can reduce the risk of cross-infection [15].

## 5. Conclusions

This study, conducted by Jiali Lian and colleagues at Baotou Medical College and Inner Mongolia Maternal and Child Health Hospital, analyzes the epidemiology and clinical characteristics of Influenza A and B in children of different age groups in Hohhot from October 2022 to December 2023. A total of 8042 children aged 0-18 years, suspected of having influenza A or B, and were retrospectively analyzed to understand the epidemic characteristics and clinical manifestations, providing evidence for the prevention and control of influenza in this region.

The overall detection rate was 6.0% for influenza A and 3.2% for influenza B. The data showed a higher detection rate of influenza A among children aged 6-12 years and a higher detection rate of influenza B among children aged 3-6 years. Seasonal trends indicated that influenza A peaked in February-March and November-December, while influenza B was primarily detected in February-March and increased month by month in the latter half of 2023, peaking in November-December. Gender differences were observed, with higher detection rates in males for both influenza A (6.9%) and B (3.9%) compared to females (5.3% and 2.7%, respectively). The clinical manifestations of influenza A included upper respiratory tract infections, pneumonia, bronchitis, cough, and fever, while influenza B presented with similar symptoms but had a higher prevalence of pneumonia and febrile seizures.

The study highlights the importance of targeted preventive measures for different age groups and seasons. The findings suggest that enhanced awareness and preventive strategies, such as vaccination and public health interventions, are crucial in reducing the incidence and severity of

influenza among children. This research provides valuable data for the clinical diagnosis, treatment, and early detection of severe influenza cases, and offers a reference for future risk assessments and preventive measures against influenza mutations.

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