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Original Article

Epidemiological characteristics of Mycoplasma pneumoniae and viral infections in hospitalized children with recurrent lower respiratory tract infections

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Abstract: Objective: To investigate the epidemiological characteristics of Mycoplasma pneumoniae and common viral infections in hospitalized children with recurrent lower respiratory tract infections in Chengdu from 2019 to 2023, and to provide scientific evidence to support clinical diagnosis, treatment, and public health prevention. Methods: A retrospective analysis was conducted on pathogen detection results from 10,580 children hospitalized with recurrent lower respiratory tract infections at a hospital in Chengdu between January 2019 and December 2023. Results: Among the 10,580 hospitalized children, the pathogen detection rate was 28.01%, with Mycoplasma pneumoniae showing the highest positivity rate (17.49%). The detection rates of influenza B virus and Mycoplasma pneumoniae were significantly higher in female children compared to males (all $P < 0.05$). The positivity rates for adenovirus, respiratory syncytial virus, influenza A virus, and human rhinovirus in 2023 were significantly elevated compared to other years (all $P < 0.05$). In children under 1 year of age, detection rates for influenza A virus, influenza B virus, and Mycoplasma pneumoniae were lower. The co-detection rate of viral infections and Mycoplasma pneumoniae was low (all $P < 0.05$). A higher detection rate of Mycoplasma pneumoniae was observed in 3-year-olds, along with a higher co-detection rate of two pathogens (all $P < 0.05$). Conclusion: Mycoplasma pneumoniae is the predominant pathogen in hospitalized children with recurrent lower respiratory tract infections. Gender, age and season significantly influence pathogen positivity rates. Notably, in 2023, the positivity rates of many pathogens increased significantly, potentially related to changes in COVID-19 prevention and control measures.

Keywords: Recurrent lower respiratory tract infections, children, epidemiological characteristics, Mycoplasma pneumoniae

Introduction

Acute lower respiratory tract infections (LRTIs) are among the most common and severe infectious diseases affecting children, posing significant threats to pediatric health and imposing substantial burdens on families and society [1-3]. Global statistics indicate that approximately 156 million children suffer from pneumonia each year, with 7%-13% progressing to

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Table 1. Diagnostic criteria for recurrent lower respiratory tract infections (times/year)

Age Group (Years)	Bronchitis (Episodes/Year)	Pneumonia (Episodes/Year)
0-2	≥ 3	≥ 2
> 2-5	≥ 2	≥ 2
> 5-14	≥ 2	≥ 2

severe pneumonia. Annually, around 2 million children die from severe pneumonia, with the majority of fatalities occurring in those under five years of age [4-7]. The etiological spectrum of LRTIs is diverse, encompassing bacteria, viruses, mycoplasma, chlamydia, and fungi, with viruses and Mycoplasma pneumoniae (MP) identified as the primary causative agents [8, 9]. Common respiratory viruses include respiratory syncytial virus (RSV), influenza viruses A and B (IFV-A and IFV-B), parainfluenza virus (PIV), adenovirus (ADV), and human rhinovirus (HRV) [10].

The distribution of respiratory pathogens varies considerably across regional and environmental contexts, influenced by factors such as seasonal epidemics and the COVID-19 pandemic. Changes in pathogen types and infection patterns may have become particularly notable during the COVID-19 era. Chengdu, a major city in southwest China with a dense and mobile population, reports a high incidence of pediatric respiratory infections. Children with recurrent lower respiratory tract infections are at increased risk of co-infection with multiple pathogens, complicating clinical diagnosis and treatment, and contributing to excessive antibiotic use and the emergence of antibiotic resistance. These patients often experience more severe complications and a greater healthcare burden [10]. Since the onset of the COVID-19 pandemic, increased attention has been paid to viral and MP-related lower respiratory infections. However, existing studies have primarily focused on general LRTIs, with limited research specifically addressing the pathogen distribution characteristics in children with recurrent LRTIs. In particular, there is a lack of systematic analyses examining temporal trends and regional variations in pathogen profiles. In this study, we retrospectively analyzed hospitalized children with recurrent LRTIs at a hospital in Chengdu from 2019 to 2023. We characterized the epidemic characteristic patterns of MP and common viruses in this population and explored the impact of gender, age, and seasonal factors on pathogen detection rates. Additionally, we investigated changes in pathogen distribution trends after the COVID-19 pandemic. Our findings aim to provide scientific evidence for improving clinical diagnosis, treatment strategies, and public health prevention targeting recurrent LRTIs in children.

Materials and methods

Clinical data

This study was a retrospective analysis involving 10,580 children hospitalized with recurrent LRTIs at Chengdu Women's and Children's Central Hospital from January 2019 to December 2023. Inclusion criteria were as follows: 1. Children who met the diagnostic criteria for recurrent LRTIs as defined by the 1987 National Pediatric Respiratory Conference (**Table 1**); 2. Age range between 0 and 16 years; 3. Availability of complete medical records, including demographic information, pathogen detection results and other relevant clinical information [11]. Exclusion criteria were as follows: 1. Children with rickets; 2. Children with congenital heart disease; 3. Children with malnutrition; 4. Children with anemia; 5. Children with allergic diseases (e.g., allergic asthma, allergic rhinitis); 6. Children with immunodeficiency disorders; 7. Children with malignant tumors. Children with other serious complications (e.g., severe underlying pulmonary diseases, hepatic or renal failure). This study was approved by the Ethics Committee of Chengdu Women's and Children's Central Hospital (Approval No. 2025 (41)).

Specimen collection and detection methods

Antibody detection for MP, IFV-A, IFV-B, RSV, PIV, and ADV: Three milliliters of venous blood were collected from each child to isolate the serum samples. MP antibodies were detected using the passive agglutination method. IgM antibodies for MP, IFV-A, IFV-B, RSV, PIV, and ADV were detected using a chemiluminescent immunoassay. The detection kits were purchased from Antu Bioengineering Co., Ltd.

Nucleic acid detection for MP, IFV-A, IFV-B, RSV, ADV, and HRV: Throat swab specimens were collected and subjected to real-time fluorescence quantitative PCR to detect nucleic acids of MP, IFV-A, IFV-B, RSV, ADV, and HRV. The detection kits were purchased from Shengxiang Bio-Tech Co., Ltd.

Quality control: All tests were conducted by the hospital's laboratory, strictly following the reagent instructions.

Interpretation of detection results: The results were primarily based on laboratory nucleic acid testing. In the absence of nucleic acid testing results, antibody detection results were used. Additional case information, including patient gender, age, and consultation time, was retrieved from the hospital's medical record system.

Statistical methods

Data were processed using SPSS 22.0 software. Count data were expressed as (n, %), and measurement data were presented as ($\overline{x}\pm s$). Comparisons of count data among multiple groups were performed using the chi-square (χ^2) test. A *P*-value < 0.05 was considered statistically significant. When significant differences were detected in the overall chi-square test, pairwise comparisons were conducted using the Bonferroni correction method. Specifically, statistical significance was set at P < 0.017 for three-group comparisons, P < 0.008 for four-group comparisons, and P < 0.005 for five-group comparisons.

Results

Basic characteristics of the study population

A total of 10,580 hospitalized children with recurrent LRTIs were included in this study, comprising 4,218 females and 6,362 males. The ages of the participants ranged from 0 to 16 years, with an average age of (1.88 ± 1.92) years. The average duration of hospitalization was (6.83 ± 3.40) days. The distribution of cases by age group was as follows: ~1 year: 6,054 cases, ~3 years: 2,990 cases, ~6 years: 1,201 cases, ~16 years: 335 cases.

Pathogen detection and epidemiological features of recurrent LRTIs in children

Detection of common respiratory pathogens: Among the 10,580 hospitalized children with LRTIs, 2,963 cases tested positive for at least one pathogen, resulting in an overall detection rate of 28.01%. MP exhibited the highest detection rate at 17.49% (1,850/10,580). Other detected pathogens included HRV with a positivity rate of 4.74% (501/10,580), RSV at 4.48% (474/10,580), IFV-B at 1.54% (163/10,580), ADV at 1.44% (152/10,580), PIV at 0.90% (95/10,580), and IFV-A at 0.89% (94/10,580). The differences in detection rates among these seven pathogens were statistically significant (χ^2=754.125, P < 0.001), as shown in **Figure 1**.

Detection rates by gender, year, and age group: The detection rates of IFV-B and MP were significantly higher in female children compared to males (all P < 0.05). Pathogen positivity rates varied significantly across different years. In 2023, the detection rates of several pathogens (ADV, RSV, IFV-A, HRV) were significantly higher than in other years (all P < 0.05). Significant differences in pathogen detection rates were also observed among different age groups (P < 0.05). The ~3-year-old group had the highest detection rate of RSV, while the ~3, ~6, and ~16-year-old groups showed higher detection rates of HRV and MP. The detection rate of IFV-A, IFV-B, HRV, and MP was lowest in the ~1-year-old group, and RSV had the lowest detection rate in the ~16-year-old group (all P < 0.05). The detailed results are presented in **Table 2**.

Monthly and seasonal detection rates: The detection rate of ADV showed a significant increase across all seasons in 2023, especially in the autumn (all P < 0.05). The detection rate of RSV was significantly elevated during the spring and autumn of 2023 (all P < 0.05). IFV-B exhibited a higher detection rate in 2019, followed by a gradual decrease, with a slight resurgence in 2023 (all P < 0.05). IFV-A demonstrated increased detection rates during the winter and spring of 2023 (all P < 0.05). HRV had higher detection rates across all seasons in 2023, particularly in autumn (all P < 0.05). The detection rate of MP peaked during the autumn season in each study year (all P < 0.05). Detailed results are presented in **Table 3** and **Figure 2**.

Detection of multiple pathogens

Among the 2,963 positive cases, single-pathogen infections accounted for the majority, representing 88.69% (2,628 cases). The detection

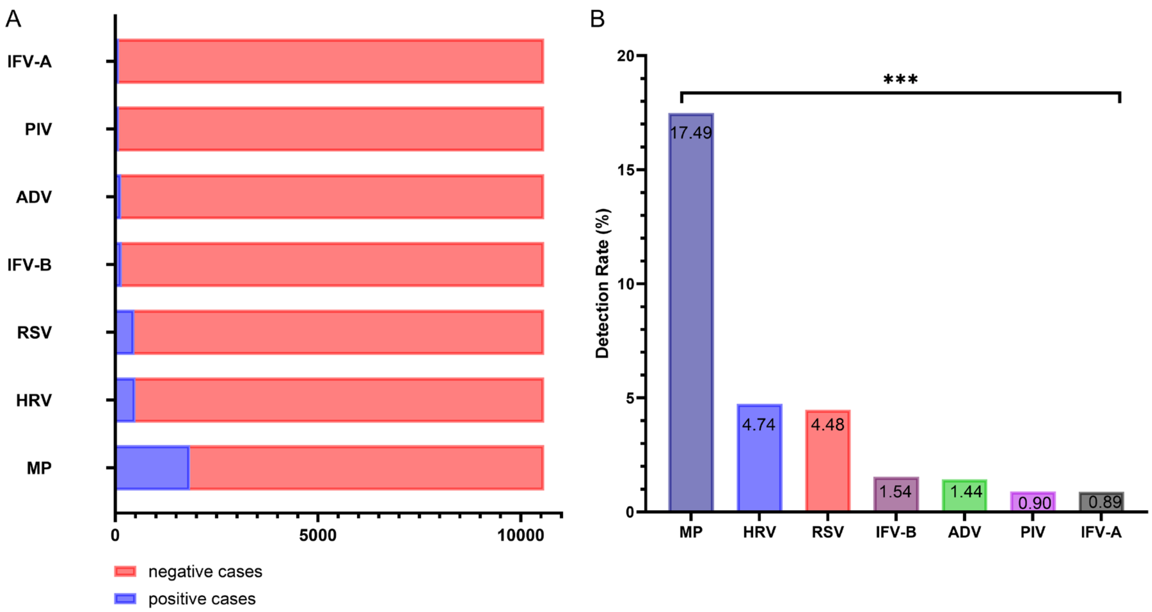

Figure 1. Detection of seven common respiratory pathogens. A: Number of cases in which each of the seven pathogens was detected; B: Positive detection rate of each of the seven pathogens. Note: HRV: Human_Rhinovirus; RSV: Respiratory_Syncytial_Virus; ADV: Adenovirus; PIV: Parainfluenza Virus; IFV-B: Influenza_B_Virus; IFV-A: Influenza_A_Virus; MP: Mycoplasma_Pneumoniae.

Table 2. Detection of common respiratory pathogens in children with respiratory infections by gender, year, and age group [cases (%)]

Index	HRV (n=501)	RSV (n=474)	ADV (n=152)	PIV (n=95)	IFV-B (n=163)	IFV-A (n=94)	MP (n=1850)
Gender							
Female (n=4218)	189 (4.48)	196 (4.65)	63 (1.49)	46 (1.09)	83 (1.97)	32 (0.76)	942 (22.33)
Male (n=6362)	312 (4.9)	278 (4.37)	89 (1.4)	49 (0.77)	80 (1.26)	62 (0.97)	908 (14.27)
χ^2	1.008	0.455	0.161	2.925	8.436	1.342	114.219
p	0.316	0.500	0.689	0.087	0.004	0.247	< 0.001
Year							
2019 (n=2500)	0 (0.00)	98 (3.92)	18 (0.72)	40 (1.6)	134 (5.36)	18 (0.72)	406 (16.24)
2020 (n=1277)	0 (0.00)	2 (0.16)	1 (0.08)	15 (1.17)	13 (1.02)	1 (0.08)	149 (11.67)
2021 (n=1948)	0 (0.00)	1 (0.05)	8 (0.41)	20 (1.03)	0 (0.00)	0 (0.00)	377 (19.35)
2022 (n=1642)	8 (0.49)	3 (0.18)	6 (0.37)	9 (0.55)	2 (0.12)	1 (0.06)	315 (19.18)
2023 (n=3213)	493 (15.34)	370 (11.52)	119 (3.7)	11 (0.34)	14 (0.44)	74 (2.3)	603 (18.77)
χ^2	1151.830	589.400	170.111	28.712	320.846	113.580	44.294
p	< 0.001	< 0.001	< 0.001	0.003	< 0.001	< 0.001	< 0.001
Age							
~1 year group (n=6054)	231 (3.82)	286 (4.72)	70 (1.16)	46 (0.76)	64 (1.06)	42 (0.69)	543 (8.97)
~3 year group (n=2990)	186 (6.22)	148 (4.95)	61 (2.04)	36 (1.2)	59 (1.97)	29 (0.97)	859 (28.73)
~6 year group (n=1201)	63 (5.25)	35 (2.91)	14 (1.17)	11 (0.92)	31 (2.58)	18 (1.5)	337 (28.06)
~16 year group (n=335)	21 (6.27)	5 (1.49)	7 (2.09)	2 (0.6)	9 (2.69)	5 (1.49)	111 (33.13)
χ^2	28.414	16.253	12.682	4.791	24.491	9.300	716.229
p	< 0.001	< 0.001	< 0.005	0.188	< 0.001	0.026	< 0.001

Table 3. Detection of respiratory pathogens in different seasons [cases (%)]

Season	HRV (n=501)	RSV (n=474)	ADV (n=152)	PIV (n=95)	IFV-B (n=163)	IFV-A (n=94)	MP (n=1850)
2019 Winter (n=620)	0 (0.00)	25 (4.03)	5 (0.81)	4 (0.65)	11 (1.77)	0 (0.00)	80 (12.9)
2019 Summer (n=571)	0 (0.00)	25 (4.38)	7 (1.23)	22 (3.85)	54 (9.46)	4 (0.70)	91 (15.94)
2019 Spring (n=655)	0 (0.00)	47 (7.18)	5 (0.76)	8 (1.22)	32 (4.89)	2 (0.31)	117 (17.86)
2019 Autumn (n=654)	0 (0.00)	1 (0.15)	1 (0.15)	6 (0.92)	37 (5.66)	12 (1.83)	118 (18.04)
2020 Winter (n=398)	0 (0.00)	2 (0.50)	1 (0.25)	6 (1.51)	5 (1.26)	0 (0.00)	44 (11.06)
2020 Summer (n=233)	0 (0.00)	0 (0.00)	0 (0.00)	2 (0.86)	5 (2.15)	0 (0.00)	31 (13.3)
2020 Spring (n=202)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.5)	0 (0.00)	18 (8.91)
2020 Autumn (n=444)	0 (0.00)	0 (0.00)	0 (0.00)	7 (1.58)	2 (0.45)	1 (0.23)	56 (12.61)
2021 Winter (n=428)	0 (0.00)	1 (0.23)	2 (0.47)	4 (0.93)	0 (0.00)	0 (0.00)	80 (18.69)
2021 Summer (n=450)	0 (0.00)	0 (0.00)	0 (0.00)	4 (0.89)	0 (0.00)	0 (0.00)	72 (16)
2021 Spring (n=494)	0 (0.00)	0 (0.00)	4 (0.81)	6 (1.21)	0 (0.00)	0 (0.00)	75 (15.18)
2021 Autumn (n=576)	0 (0.00)	0 (0.00)	2 (0.35)	6 (1.04)	0 (0.00)	0 (0.00)	150 (26.04)
2022 Winter (n=463)	2 (0.43)	2 (0.43)	3 (0.65)	6 (1.3)	1 (0.22)	0 (0.00)	77 (16.63)
2022 Summer (n=421)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.24)	1 (0.24)	0 (0.00)	86 (20.43)
2022 Spring (n=523)	0 (0.00)	1 (0.19)	1 (0.19)	1 (0.19)	0 (0.00)	0 (0.00)	82 (15.68)
2022 Autumn (n=235)	6 (2.55)	0 (0)	2 (0.85)	1 (0.43)	0 (0.00)	1 (0.43)	70 (29.79)
2023 Winter (n=345)	26 (7.54)	25 (7.25)	9 (2.61)	1 (0.29)	7 (2.03)	15 (4.35)	83 (24.06)
2023 Summer (n=962)	150 (15.59)	38 (3.95)	33 (3.43)	6 (0.62)	1 (0.10)	6 (0.62)	135 (14.03)
2023 Spring (n=972)	116 (11.93)	176 (18.11)	23 (2.37)	2 (0.21)	2 (0.21)	46 (4.73)	71 (7.3)
2023 Autumn (n=934)	201 (21.52)	131 (14.03)	54 (5.78)	2 (0.21)	4 (0.43)	7 (0.75)	314 (33.62)
χ^2	786.739	632.056	134.466	67.386	303.475	171.630	248.356
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	< 0.001

Note: According to the meteorological classification method, March to May is considered spring, June to August is summer, September to November is autumn, and December to February of the following year is winter.

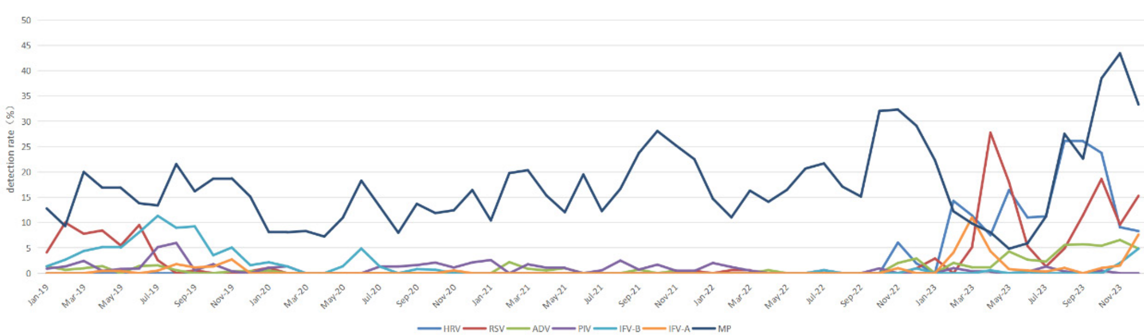

Figure 2. Monthly detection of respiratory pathogens.

rate of single pathogens was significantly higher in female patients compared to male patients (P < 0.05). The highest detection rates for single infections, dual infections, and viral co-infections with MP were all recorded in 2023 (all P < 0.05). There were significant differences in the detection rates of multiple pathogens among different age groups. Single-pathogen detection rates were highest in the ~3, ~6, and ~16-year-old groups, and lowest in the ~1-year-old group. The detection rate of dual-pathogen infections was highest in the ~3-year-old group and lowest in the ~1-year-old group (all P < 0.05). Additionally, the detection rate of viral co-infection with MP was significantly lower in patients aged ≤ 1 year compared to other age groups (P < 0.05). The detailed results are shown in **Table 4**.

Table 4. Detection of multiple pathogens [cases (%)]

Item	Single Pathogen (n=2628)	Two Pathogens (n=304)	Three or More Pathogens (n=31)	Virus Combined with Mycoplasma Pneumoniae (n=200)
Gender				
Female (n=4218)	1257 (29.8)	120 (2.84)	18 (0.43)	88 (2.09)
Male (n=6362)	1371 (21.55)	184 (2.89)	13 (0.2)	112 (1.76)
χ^2	92.491	0.020	4.294	1.452
p	< 0.001	0.887	0.038	0.228
Year				
2019 (n=2500)	504 (20.16)	84 (3.36)	14 (0.56)	77 (3.08)
2020 (n=1277)	161 (12.61)	10 (0.78)	0 (0.00)	6 (0.47)
2021 (n=1948)	392 (20.12)	7 (0.36)	0 (0.00)	6 (0.31)
2022 (n=1642)	338 (20.58)	3 (0.18)	0 (0.00)	2 (0.12)
2023 (n=3213)	1233 (38.38)	200 (6.22)	17 (0.53)	109 (3.39)
χ^2	486.114	238.134	26.533	126.051
p	< 0.001	0.001	< 0.001	0.001
Age				
~1 year group (n=6054)	1013 (16.73)	118 (1.95)	11 (0.18)	62 (1.02)
~3 year group (n=2990)	1077 (36.02)	134 (4.48)	11 (0.37)	89 (2.98)
~6 year group (n=1201)	414 (34.47)	43 (3.58)	3 (0.25)	36 (3)
~16 year group (n=335)	124 (37.01)	9 (2.69)	6 (1.79)	13 (3.88)
χ^2	499.593	48.434	28.951	58.610
p	< 0.001	< 0.001	< 0.001	< 0.001
Severity of Pneumonia				
Non-severe Pneumonia (n=8645)	2201 (25.46)	254 (2.94)	25 (0.29)	162 (1.87)
Severe Pneumonia (n=1935)	427 (22.07)	50 (2.58)	6 (0.31)	38 (1.96)
χ^2	9.748	0.711	0.024	0.069
p	0.002	0.399	0.878	0.793

Note: Single pathogen: Detection of a single pathogen during the same illness episode. Two pathogens: Detection of two pathogens simultaneously during the same illness episode. Three or more pathogens: Detection of three or more pathogens simultaneously during the same illness episode.

Discussion

Accurate pathogen identification is critical for guiding the clinical management of children with recurrent LRTIs [12]. Previous studies have shown that approximately 85% of cases of recurrent LRTIs in children are caused by viral infections, whereas bacterial infections account for only about 15% [13]. Early, comprehensive, rapid, and precise pathogen detection is essential not only for accurate clinical diagnosis and effective treatment but also for promoting rational antimicrobial use [14, 15]. Furthermore, timely identification and targeted management of key pathogens can significantly reduce the recurrence rate and the risk of complications, thereby improving the quality of life for affected children and reducing the healthcare and economic burden on families and society [16].

The literature indicates that the detection rates and epidemiological characteristics of pathogens in children with acute LRTIs vary across regions, likely due to differences in study time, populations, detection methods, and climatic conditions. In this study, the total detection rate of seven non-bacterial pathogens among children with recurrent LRTIs in Chengdu from 2019 to 2023 was 28.01%, aligning broadly with the findings reported by Jun-e Ma et al. in Wuhan, Hubei Province, China [17]. However, a study conducted by Wang Shuang et al. at Shenyang Children's Hospital, which utilized multiplex RT-PCR to test 1,788 cases of community-acquired pneumonia, reported a viral positivity rate of 59.7%, which is higher than that observed in our cohort. Such differences reflect the significant regional variability in pathogen distribution patterns [18]. In this study, MP was the most frequently detected pathogen, with a positivity rate of 17.49%, which is slightly higher than that reported by Jun-e Ma, but lower than the rate observed by Wang et al. [19]. These variations may be attributed to various factors, including geographic location, climatic differences, population density, healthcare resource distribution, and differences in study populations and diagnostic techniques.

For instance, the subtropical monsoon climate, high population mobility, and medical infrastructure in Chengdu may have influenced the transmission dynamics and infection rates of MP compared to other regions. Furthermore, variations in research periods and inclusion criteria, along with the sensitivity and specificity of detection methods used, could also contribute to the observed discrepancies.

This observation is well-supported by previous studies, including those by Nardi and Kang, which highlight gender differences in the prevalence of IFV-B and MP in children [20, 21]. Physiological factors, such as gender-specific immune responses and hormonal influences, likely contribute to the increased susceptibility of female children to these pathogens. Additionally, behavioral and social factors, including gender-based differences in activity patterns, may lead to greater exposure to infectious agents in group settings, further supporting these findings. This multifactorial perspective helps explain the higher detection rates observed in female children, underscoring the importance of considering gender-specific preventive strategies in clinical practice. Furthermore, girls may exhibit different hygiene practices and healthcare-seeking behaviors, which could influence pathogen transmission and infection risks. For instance, females may be more likely to seek medical attention at the onset of symptoms, thereby increasing the likelihood of pathogen detection. Environmental factors also warrant attention; differences in exposure within the home and social environments, as well as variations in seasonal activity patterns, may further elevate the risk of infections such as IFV-B and MP in girls during certain seasons.

The study by Jun-e Ma et al. showed a significant decline in the detection rates of various respiratory pathogens during the COVID-19 pandemic (2020-2021) [17]. Our study also found a significant reduction in pathogens such as HRV, ADV, RSV, PIV, IFV-A, and IFV-B in 2020, 2021, and 2022, further supporting these findings. This decline underscores the impact of public health measures, including social distancing, mask-wearing, and school closures, in reducing children's exposure to these pathogens. Research by Mingyu Tang et al. indicated an increase in the positivity rate for respiratory pathogens following the relaxation of COVID-19 control measures in 2023 [22]. Our study aligns with this observation, as we observed a notable rise in the detection rates of ADV, RSV, IFV-A, and HRV in 2023. This increase likely reflects the resumption of school and social activities, which facilitated greater pathogen transmission and contributed to the observed spike in detection rates.

Significant differences in susceptibility to various respiratory pathogens have been observed across different age groups in children. Studies by Huang et al. and Salim et al. on pediatric acute respiratory infections have shown notable differences in pathogen detection rates among age groups, particularly with higher viral detection rates in children aged 1 to 3 years and lower rates in those under 1 year old [23, 24]. Our findings align with these observations, as the 1-3-year age group showed higher detection rates for ADV, RSV, HRV, and MP. This may be due to the increased activity levels of children aged 1 to 3 years, which heightens their exposure to pathogens, combined with their still-developing immune systems, thereby increasing the likelihood of infections. Conversely, in our study, the detection rates for IFV-A, IFV-B, HRV, and MP were lower in children under 1 year of age, consistent with prior research. Despite having an immature immune system and weaker resistance to pathogens, infants limited outdoor activities lead to reduced exposure and consequently lower infection rates. These findings are important for the development of targeted prevention and treatment strategies for respiratory infections in children across different age groups.

This study examined the seasonal distribution patterns of recurrent LRTIs in children in Chengdu from 2019 to 2023, revealing a significant increase in RSV detection rates during the spring and autumn of 2023. These findings align with those reported by Shah et al., suggesting that the seasonal trends of certain pathogens may be similar across different regions [25]. Ren et al. observed that HRV detection peaked in autumn, while IFV showed higher detection rates in winter and spring. Our results align with these observations, further confirming the seasonal patterns of these pathogens [26]. Notably, the detection rate of IFV-B was higher in 2019, followed by a gradual decline, with a slight resurgence in 2023, whereas IFV-A had higher detection rates in the winter and spring of 2023. These findings highlight the significant seasonal differences in the detection rates of respiratory pathogens, emphasizing the critical need to understand the seasonal epidemiology of different pathogens for the development of effective public health strategies.

This study shows that 88.69% of patients exhibited a single non-bacterial pathogen detected during their illness, underscoring the predominance of single pathogen infections in children with recurrent LRTIs. In line with this, research by Li et al. found that mixed infections, particularly those involving MP and ADV, significantly increased the incidence of severe community-acquired pneumonia [27]. This study observed the highest proportion of dual infections in 2023, predominantly within the ~3-year-old group. This suggests that children in this age range may have a higher susceptibility to multiple pathogens, potentially reflecting the epidemic characteristics of specific pathogens within this demographic. These findings highlight the need for targeted health interventions for children in this age group, particularly in the post-epidemic period, where shifts in pathogen dynamics following changes in epidemic control measures may warrant enhanced monitoring and public health strategies.

This study has a few limitations. First, the study sample was limited to hospitalized children from a single hospital in Chengdu, which may limit the generalizability of the findings to the broader population of children across Chengdu or other regions. Second, despite the use of multiple detection methods, variations in the sensitivity and specificity of these methods may have affected the detection rates of pathogens. Finally, the focus on hospitalized children with recurrent LRTIs may have overlooked non-hospitalized cases, whose pathogen distribution could differ from those requiring hospitalization, thus affecting the representativeness of the results.

In conclusion, from 2019 to 2023, MP was the most predominant pathogen among hospitalized children with recurrent LRTIs in Chengdu. The positivity rates of pathogens were significantly influenced by factors such as gender, age, and season. Notably, in 2023, there was a marked increase in the positivity rates of various pathogens, likely reflecting the impact of changes in COVID-19 prevention and control measures. A comprehensive understanding of the epidemiological characteristics of these pathogens can assist pediatricians in developing targeted prevention and treatment strategies, thereby improving therapeutic outcomes and alleviating the disease burden.

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Disclosure of conflict of interest

None.

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