Original Article

Laboratory analysis of positive rate of *Mycoplasma pneumoniae* antibody among 53,273 children with respiratory tract infections in Xi'an from 2017 to 2020

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Background: *Mycoplasma pneumoniae* (*Mp*) is an important pathogen that causes respiratory tract infections in children. Data on epidemiology of paediatric *Mp* infection in China are little known. The aim of this study was to investigate the infection of children with respiratory tract infection in Xi'an from 2017 to 2020, and to explore the epidemiological features of paediatric *Mp* infection in Northwest China during the past 4 years.

Methods: A total of 53,273 paediatric patients diagnosed with respiratory tract infection as the first diagnosis were enrolled. *Mp* antibody was detected using passive agglutination method. Statistical analysis and epidemiological investigation were carried out on the test results according to different years, seasons, ages and genders. The differences among rates were analyzed by the χ^2 test. The trends among the rates were analyzed by the Poisson regression.

Results: A total of 14,375 *Mp* antibody positive patients were detected, with a total positive rate of 26.98%. The rate of *Mp* infection in 2017 was significantly higher than other years (χ^2=431.700; P=0.000), and the rate showed a downward trend year by year [incidence rate ratios (IRR) =0.906; 95% CI: 0.892–0.921; P=0.000]. The rate of *Mp* infection increased gradually in the order of spring, summer, autumn and winter (IRR =1.078; 95% CI: 1.060–1.097; P=0.000), and peaked in winter (29.08%). As age increased, the positive rate of *Mp* infection also gradually increased (IRR =1.138; 95% CI: 1.134–1.143; P=0.000). The peak age of *Mp* infection was between 6 and 12 years, accounting for 51.71%, significantly more compared with other age groups (χ^2=4203.000, P=0.000). Female children had significantly higher positive rates than male children (χ^2=527.000; P=0.000).

Conclusions: *Mp* infection mainly occurs related to year, season, age and gender. Understanding the epidemiological characteristics of paediatric *Mp* infection can contribute to timely treatment and diagnosis, and may improve the prognosis of children with *Mp* infection.

Keywords: *Mycoplasma pneumoniae* (*Mp*); antibody titer; child

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Introduction

Mycoplasma pneumoniae (*Mp*) is a common pathogenic microorganism that can cause respiratory tract infections in children (1). Additionally, *Mp* is a major cause of community-acquired pneumonia (CAP) in children, and accounts for 10–30% of the pediatric population (2). *Mp* can cause respiratory diseases such as acute and chronic respiratory infections, bronchitis and asthma (3,4). It can also cause extrapulmonary diseases including encephalitis, nephritis, myocarditis and other complications in severe cases (5,6). *Mp* epidemic is cyclical, with an epidemic peak every 3–7 years, and each epidemic lasts for 1–2 years (7). The prevalence of infection is related to season, age, gender, geography and other factors (8,9). However, there have been few studies with large numbers of paediatric patients with Mp infection to explore the epidemiology and dynamic characteristics in Northwest China.

In order to find out the epidemic situation of *Mp* infection in Xi'an, to provide the basis for clinical diagnosis, treatment, corresponding prevention and control strategies for children in the local region, we retrospectively analyzed the antibody titers to *Mp* in 53,273 children with respiratory tract infection as the first diagnosis from the Respiratory Medicine Clinic from 2017 to 2020 and a comprehensive statistical analysis was conducted in accordance with the different years, seasons, ages, and genders. We present the following article in accordance with the STROBE reporting checklist (available at https://tp.amegroups.com/article/view/10.21037/tp-22-127/rc).

Methods

Sample collection

The Northwest Women's and Children's Hospital is a women and children specialist hospital located in Xi'an, China. We retrospectively analyzed the antibody titer results of *Mp* in 53,273 paediatric patients (24,459 girls and 28,814 boys) with respiratory tract infenction as the first diagnosis, aged from 1 month to 12 years old, who had visited in the Respiratory Medicine Clinic from January 2017 to December 2020. Paediatric patients were all living in Xi'an city. All patients were independent, data of the same individual child during the research period only inclusion of the first visit. This study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was reviewed and approved by the Ethics Committee of the Northwest Women's and Children's Hospital (No. 21–16). Individual consent for this retrospective study was waived. The children were divided into the following 4 age groups: (I) 0–1 year old (infant group); (II) 1–3 years old (toddler group); 3–6 years old (preschool group); and 6–12 years old (school-age group). The data were also divided into the following 4 seasonal groups: (I) March–May (spring group); (II) June–August (summer group); (III) September–November (autumn group); and (IV) December–February (winter group).

Detection of Mp antibody titers

Peripheral blood samples (80 μL) were collected from children and kept at room temperature for at least 20 min. The serum was collected by centrifugation at 3,000 rpm for 10 min. The *Mp* antibody titer detection was performed using an *Mp* antibody detection kit (passive agglutination method; Fuji Ruibai Co., Ltd., Japan). All the operations were performed strictly in accordance with the manufacturer's instructions. Mp infection is defined as single titres of serum Mp antibody ≥1:160 measured by the particle agglutination test (10).

Statistical methods

The data analysis was conducted with the statistical software SPSS 18.0 (IBM Corp., Chicago, IL, USA). The enumeration data were expressed as the number of cases. The differences among rates were analyzed by the χ^2 test. The trends among the rates were analyzed by the Poisson regression. A two-sided P value <0.05 was considered statistically significant.

Results

Distribution of Mp infection positive rates in different years

The positive rate of *Mp* infection in children had the highest positive rate in 2017 (37.27%) and the lowest rate in 2019 (24.13%), and the difference between the different years was statistically significant (χ^2=431.700; P=0.000) (*Table 1*). Additionally, the positive rate of the *Mp* infection in the children tended to decrease over consecutive years (IRR =0.906; 95% CI: 0.892–0.921; P=0.000) (*Table 2*).

Distribution of Mp infection positive rates in different seasons

The children had the highest positive *Mp* infection rate in

Table 1 Distribution of positive rates of *Mp* infection in different years

Year	Cases (n)	Positive cases (n)	Positive rate (%)	χ^2	P value
2017	6,061	2,259	37.27		
2018	16,490	4,257	25.82		
2019	20,261	4,888	24.13		
2020	10,461	2,971	28.40		
Total	53,273	14,375	26.98	431.700	0.000

Mp, *Mycoplasma pneumoniae*.

Table 2 The trend of positive rates of *Mp* infection in different years, seasons and ages

Gender	Cases (n)	Positive cases (n)	IRR	95% CI	P value
Year	28,814	6,603	0.906	0.892–0.921	0.000
Season	24,459	7,772	1.078	1.060–1.097	0.000
Age	53,273	14,375	1.138	1.134–1.143	0.000

IRR and their 95% CI were calculated using a Poisson regression model. *Mp*, *Mycoplasma pneumonia*; IRR, incidence rate ratios; CI, confidence interval.

Table 3 Distribution of positive rates of *Mp* infection in different seasons

Season	Cases (n)	Positive cases (n)	Positive rate (%)	χ^2	P value
Spring	10,592	2,472	23.34		
Summer	8,593	2,178	25.35		
Autumn	17,592	4,928	28.01		
Winter	16,496	4,797	29.08		
Total	53,273	14,375	26.98	129.400	0.000

Mp, *Mycoplasma pneumoniae*.

winter (29.08%) and the lowest in spring (23.34%), and the difference between the different seasons was significant (χ^2=129.400; P=0.000) (*Table 3*). Further, the positive rate of *Mp* infection in children tended to gradually increase in the order of spring, summer, autumn, and winter (IRR =1.078; 95% CI: 1.060–1.097; P=0.000) (*Table 2*).

Distribution of Mp infection positive rates at different ages

Children in the school-age group had the highest positive *Mp* infection rate (51.71%); and children in the infant group had the lowest rate (5.95%), and the difference between age groups was significant (χ^2=4,203.000; P=0.000) (*Table 4*). The positive rate of the *Mp* infection gradually increased in children as age increased (IRR =1.138; 95% CI: 1.134–1.143; P=0.000) (*Table 2*).

Distribution of Mp infection positive rates by gender

The positive rate of *Mp* infection in girls (31.78%) was significantly higher than that in boys (22.92%), and there was a significant difference between the genders (χ^2=527.000; P=0.000) (*Table 5*).

Discussion

The *Mp* pathogen is common in the population, especially in children. Studies have shown that there are significant differences in the positive rate of *Mp* infection in different countries and regions, populations, years, and seasons

Table 4 Distribution of positive rates of *Mp* infection in different age groups

Age (years)	Cases (n)	Positive cases (n)	Positive rate (%)	χ^2	P value
0–1	7,513	447	5.95		
1–3	15,608	3,394	21.75		
3–6	23,038	6,855	29.76		
6–12	7,114	3,679	51.71		
Total	53,273	14,375	26.98	4,203.000	0.000

Mp, *Mycoplasma pneumoniae*.

Table 5 Distribution of positive rates of *Mp* infection in different genders

Gender	Cases (n)	Positive cases (n)	Positive rate (%)	χ^2	P value
Male	28,814	6,603	22.92		
Female	24,459	7,772	31.78		
Total	53,273	14,375	26.98	527.000	0.000

Mp, *Mycoplasma pneumoniae*.

(6,7,11). The prevalence of *Mp* infection varies widely from 8.7–37.5% in different countries worldwide (9,12-14). Gao *et al.* (9) found that the *Mp* infection rate was 37.5% in children with respiratory symptoms in northern China. Conversely, Jiang *et al.* (12) found that the *Mp* infection rate was only 12.2% in children with respiratory symptoms in southern China. The results of this study showed that the *Mp* infection rate in children with respiratory symptoms in Xi'an from 2015 to 2020 was 26.98%, which falls somewhere between the 2 above-mentioned rates. Eun *et al.* (15) found that the epidemic peaks were separated by 3–4 years for *Mp* in Korea. Our study showed that the *Mp* infection rate in children in the Xi'an region was the highest in 2017 (37.27%), decreased in 2018 and 2019 (25.82% and 24.13%), but increased again in 2020 (28.40%). Due to the global epidemic situation of the coronavirus disease of 2019 (COVID-2019) in early 2020, the use of masks and disinfectants or other factors may have reduced the *Mp* infection rate in children in the region in 2020. It appears that the *Mp* epidemic in Xi'an tends to peak every 3–4 years.

Infection with *Mp* occurs in children year-round; however, there are differences across the seasons. A study from northern China found that the *Mp* infection rate was the highest in autumn (9); a study from southern China (Zhejiang) and another from Australia found that the *Mp* infection rate was the highest in summer (July) (12,16); a study in Korea found that the *Mp* infection rate was the highest in autumn or winter (15); and a study from the United States found that the *Mp* infection rate was the highest from August to November (17). The results of our study showed that the *Mp* infection rate in children in the Xi'an area were 23.34%, 25.35%, 28.01%, and 29.08% for spring, summer, autumn, and winter, respectively, and that the trend showed a significant increase. Notably, the highest *Mp* infection rate was in winter (29.08%), followed by autumn. Thus, the prevention and control of *Mp* infection in autumn and winter should be strengthened in Xi'an, especially in winters in endemic years. As the annual infection rate of *Mp* is >20%, the prevention and control of *Mp* in spring and summer should also be emphasized.

There are gender differences in the prevalence of *Mp* infection (9,12). Gao *et al.* (9), Jiang *et al.* (12), and Kung *et al.* (18) showed that the prevalence of *Mp* infection is higher in women than men, which suggested that women may be more susceptible to MP than men. Similarly, we found that there was gender difference in the prevalence of Mp infection in our study, the morbidity rate of girls (31.78%) was significantly higher than that of boys (22.92%).

Children may be infected with *Mp* at any age, especially in preschool and school-age children (19). In Japan, the highest incidence of *Mp* infection was among the 7–10 age group (20), while in Australia, it was 5–9 years old (16). The results of the present study had revealed that the infection rates of *Mp* in the infant group, toddler group, preschool, and school-age groups were 5.95%, 21.75%, 29.76%, and

51.71%, respectively. The infection rate of *Mp* in children showed a significantly increasing trend with age. School-age children aged 6–12 years old were more likely to experience *Mp* infection, which is consistent with most studies (9,16,19,20). However, the *Mp* infection rate in the infant group (0–1 year old) was the lowest, being only 5.95%, which may be related to the simple living environment and dietary structure (mainly breast milk) of children in that age group. One study has shown that breast milk contains a variety of immunomodulatory and antibacterial substances, which can significantly reduce the risk of respiratory tract infection in children. Breastfeeding is a protective factor for respiratory tract infection (21). Thus, the prevention and control of *Mp* infection in preschool and school-age children, especially school-age children, should be strengthened in Xi'an. This study was a single center retrospective study, which had some limitations: the included samples had a certain selection bias.

Based on our retrospective analysis, this study revealed that *Mp* infection in children in Xi'an from 2017 to 2020 was characterized by a high infection rate throughout the year, especially in autumn and winter. The prevalence of *Mp* infection was significantly higher in girls than in boys. The infection rate of *Mp* in children increased significantly with age, especially in school-age (6–12 years) children. Thus, effective prevention and control measures should be implemented in autumn and winter to reduce the prevalence of Mp infection among school-age children.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://tp.amegroups.com/article/view/10.21037/tp-22-127/rc

Data Sharing Statement: Available at https://tp.amegroups.com/article/view/10.21037/tp-22-127/dss

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://tp.amegroups.com/article/view/10.21037/tp-22-127/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was reviewed and approved by the Ethics Committee of the Northwest Women's and Children's Hospital (No. 21–16). Individual consent for this retrospective study was waived.

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