Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Letter to the Editor

Changes of *Haemophilus influenzae* infection in children before and after the COVID-19 pandemic, Henan, China

Dear editor:

In this journal, Yuan et al. demonstrated *Streptococcus pneumoniae* infections among children are on a decreasing trend during the COVID-19 pandemic in Zhengzhou, China,[1] as well as carbapenemase-producing *Enterobacteriaceae* and extended-spectrum beta-lactamase *E. coli* in France.[2,3] However, no data is available regarding *Haemophilus influenzae* (*H.influenzae*) infection.

H. influenzae is a gram-negative, nonmotile, facultatively coccobacillus pathogen for human, and transmitted through respiratory secretion droplets and direct close contact.[4] *H. influenzae* mainly causes respiratory disease, bacteremia and central nervous system diseases.[5] In particular for children, it is a leading cause of children meningitis in worldwide,[6] and has been listed as one of priority pathogens by WHO. Vaccination against *H. influenzae* serotypes b (Hib) prevented the onward communication transmission of Hib, and consequently incidence of Hib infections drops considerably in many countries including China. However, archived studies showed increasing incidences of *H. influenzae* serotypes a (Hia) and non-typeable *H. influenzae* (NTHi) annually by 13% and 3%, respectively.[7] With the changing epidemiology of *H. influenza* infection, it is important to monitor the dynamic of *H. influenzae* among children during the COVID-19 pandemic. Here we evaluated the change of *H. influenzae* infection and clinical characteristics in children before and after the COVID-19 pandemic, which may help to inform the implementation of prevention strategies in clinic.

Laboratory-based surveillance of *H. influenzae* was conducted from January 1, 2018, to December 31, 2021, at Henan Children's Hospital, an affiliated hospital of Zhengzhou University with 95,000 inpatients per year, 2,200 beds in total, and located in Zhengzhou, capital of Henan province, China. We present the number positive of *H. influenzae* infection among Children and young people aged 0–18 years, as well as comparisons of different age groups (0–28d, 29d-1y, 1–3y, and 3–18y).The groups are based on the traditional living habits of Chinese children and young people aged 0–18 years. Group 1 (0–28d), the baby and mom are supposed to stay at home,and avoid contact with other people except families during the first month after delivery. Group 2 (29d-1y), preschool age group at home. Group 3 (1–3y), preschool age group at home or within private nursery affiliations. Group 4 (3–18y), children and young people in kindergarten or school.

We observed that the number of positive *H. influenzae* infection in children were declined over the past four years (Fig. 1). Most likely because the government carried out a home quarantine through lockdown of the entire society from Jan 24 2020 to May 15 2020, in Zhengzhou. In particular, the decrease of *H. influenzae* infection has been sustained for five months after a lockdown strategy in Zhengzhou, which ended on May 15, 2020. Moreover, although the number positive and positive rate of *H. influenzae* infection in children began to increase since November 2020, it is still lower than that in the same period in 2018 and 2019. The positive rate of *H. influenzae* among children with respiratory disease in 2020 (6.21%) was lower than that in 2018 (11.28%) and 2019 (10.16%) ($p<0.05$), raised again in 2021 (7.37%) ($p<0.05$) and still lower than that in 2018 and 2019 ($p<0.05$). No change was

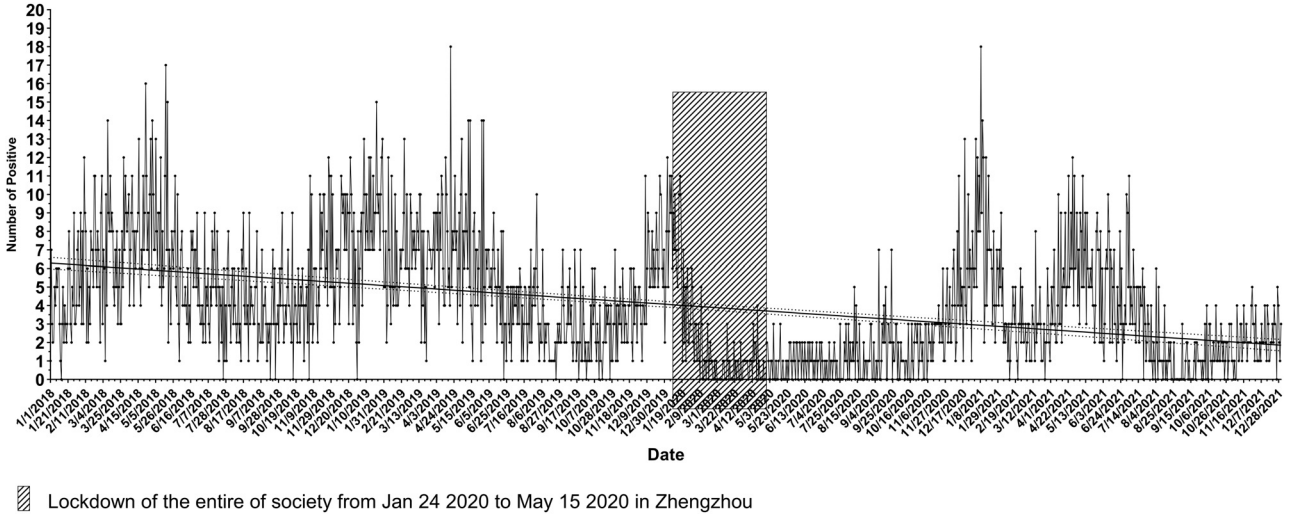

Fig. 1. The number of*H. influenzae* among Children and young people aged 0–18 years by day during2018 to 2021.

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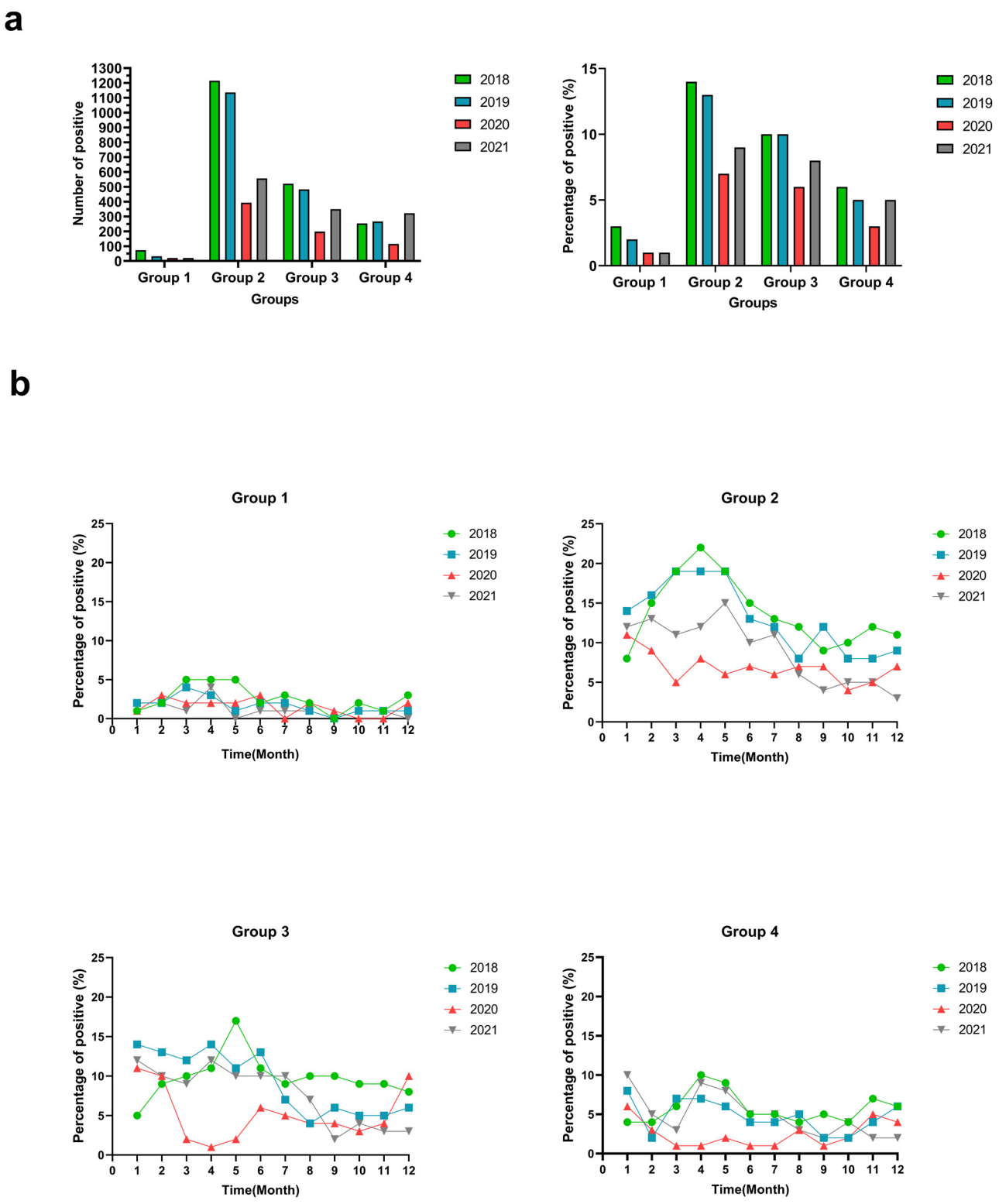

Fig. 2. a The number of positive and positive rates of *H.influenzae* infection in children by age group during 2018 to 2021. **b** The positive rate of *H.influenzae* detected in specimens by month in each age group during 2018 to 2021.

observed in children with bacteremia and central nervous system diseases. Therefore the lockdown may have affected *H. influenzae* infection with respiratory disease, but not other diseases caused by *H. influenzae*. We also found that the positive rate of *H. influenzae* decreased in group 2-4 (Fig. 2), which indicated the lockdown may only contained the community based transmission of *H. influenzae*. The proportion of *H. influenzae* infection was more than 45% in group 1–2, while reach to 70% in group 1–3. It indicated that the population of *H. influenzae* infection was mainly under 3 years old (children at home), especially for those under 1 year.

In addtition, the age composition of the children with *H. influenzae* infection under 3 years old changed during the COVID-19 pandemic. The median age of children under 3 years old with *H. influenzae* infection in 2020 (8.2 months, IR 4.27–15) was older than that in 2018 (7.5 months, IR 3.8–14) and 2019 (7.5 months, IR 3.77–14) ($p<0.05$). However the median age of the hospitalized children under 3 years old in 2020 (6.1 months, IR1.77–15) was younger than that in 2018 (6.8 months, IR1.87–15) and 2019 (6.17 months, IR 1.93–15). These results way be correlated with the delay of Hib vaccinations in these years. In China, Hib vaccine should be administered starting at 2 months and completed within 1.5 years old, completed the whole inoculation in 3 doses. However, vaccinations for many children were delayed because of the 113-day lockdown during Jan 2020 to May 2020 in Henan, including Hib vaccine.

Finally, this study showed that the COVID-19 pandemic changed the epidemiological trend of *H. influenzae* infection in children in Henan, China. Several factors may have contributed to the change: the lessening of children-to-children contact during the COVID-19 pandemic (closed schools and kindergartens), hand hygiene, masks, and the limitation of travel in children. What's more, the *H. influenzae* vaccination was also delayed, which may be related to the older median age of children with *H. influenzae* infection.

In conclusion, we found a decreased tendency of *H. influenzae* infection among children during the COVID-19 pandemic. Keeping effective and continuous surveillance is of great significance to prevent endemic of *H. influenzae* infection among children under 3 years old.

Declaration of competing interest

None.

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Juanjuan Zhou, Peipei Zhao, Manjie Nie, Kaijie Gao, Junmei Yang*
Zhengzhou Key Laboratory of Children's Infection and Immunity, Children's Hospital Affiliated to Zhengzhou University, Henan Children's Hospital, Zhengzhou 450018, P.R. China

Jiufeng Sun**
Guangdong Provincial Center for Disease Control and Prevention, Guangzhou, China

*Corresponding authors: Junmei Yang, Zhengzhou Key Laboratory of Children's Infection and Immunity, Children's Hospital Affiliated to Zhengzhou University, Henan Children's Hospital, Zhengzhou 450018, P.R. China.
**Corresponding authors: Jiufeng Sun, Guangdong Provincial Center for Disease Control and Prevention, Guangzhou 510300, P.R.China.
E-mail addresses: yangjunmei7683@163.com (J. Yang), sunjiuf@163.com (J. Sun)