



Letter to the Editor

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



Dear editor:

In this journal, we read with great interest the findings published by Li et al. and Zhou et al., which report a decline in *Streptococcus pneumoniae* and *Haemophilus influenzae* infections in children in response to the COVID-19 pandemic.^{1,2} In addition, Li et al. also found that COVID-19 had a greater impact on *Escherichia coli* isolated from children with respiratory tract infection than on children with digestive system infection.³ However, there are no data on changes in *Staphylococcus aureus* (*S. aureus*) infection in respiratory system and in non-respiratory system in children before and after the COVID-19 pandemic.

S. aureus is a gram-positive, non-motor, coagulase positive globular bacterium that has a nasal carrying rate of about 30% in the population.⁴ Meanwhile, *S. aureus* is also a ubiquitous human pathogen and the most common cause of skin and soft tissue infections and endocarditis.⁵ In particular, the emergence of community-acquired pneumonia (CAP) caused by methicillin-resistant *S. aureus*, which is the cause of severe pneumonia that leads to critical illness and death.⁶ In addition, nosocomial pneumonia caused by *S. aureus* often complicates hospitalization and can lead to serious consequences, especially when acquired in the intensive care unit.⁷ Bacterial vaccines have significantly reduced morbidity and mortality caused by several common pathogens, including *Haemophilus influenzae* type B, *Streptococcus pneumoniae*, *Neisseria meningitidis*, *Diphtheria*, *Pertussis* and *Tetanus*, however no vaccine has been developed to prevent *S. aureus* infections.⁸ After the outbreak of COVID-19, a series of countermeasures are mainly to block the route of respiratory transmission. Here we introduce the overall incidence of *S. aureus* and the incidence of respiratory system and non-respiratory system infection in children during the COVID-19 pandemic in Henan, China.

To assess the impact of the COVID-19 epidemic on the epidemiological characteristics of children with *S. aureus* infection, laboratory data of children's bacterial culture records from Henan Children's Hospital (National Children's Regional Medical Center, Henan Children's Medical Center, and Henan Pediatric Disease Clinical Medical Research Center) from January 1, 2016 to October 31, 2022 were analyzed. The total number of *S. aureus* culture cases, respiratory positivity and non-respiratory positivity were analyzed each month (Fig. 1). A total of 4838 children were included ($n = 742$ in 2016, $n = 783$ in 2017, $n = 719$ in 2018, $n = 805$ in 2019, $n = 650$ in 2020, $n = 690$ in 2021, $n = 449$ in 2022). In the two COVID-19 outbreaks in Henan, the positive number of *S. aureus* in respiratory system decreased significantly. However, in the two COVID-19 outbreaks in Henan, the positive number of the positive number of *S. aureus* in non-respiratory system have no ob-

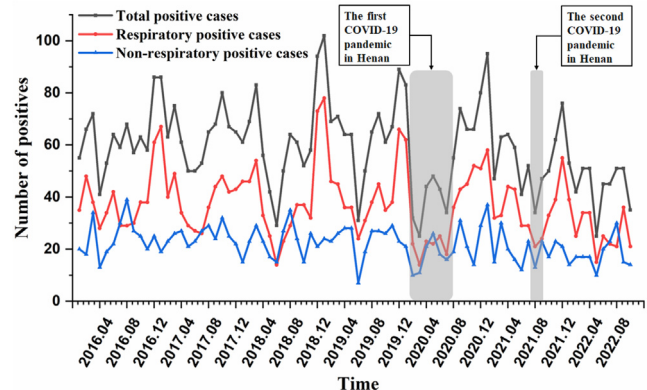


Fig. 1. General trend of *S. aureus* infection from January 1, 2016 to October 31, 2022.

vious changes. Despite a slight increase in the number of respiratory *S. aureus* positives in children recovering from the two COVID-19 pandemics, they are still lower than the same period before the pandemic. These results suggest that the COVID-19 pandemic has a significant impact on the epidemiological characteristics of *S. aureus* infections in respiratory system in children. While, the COVID-19 pandemic have no obvious influence on the epidemiological characteristics of *S. aureus* infections in non-respiratory system in children.

The number of *S. aureus* respiratory positives under 1 year of age accounted for 94% of the total *S. aureus* respiratory positives from 2016 to 2021 (Fig. 2A). While, non-respiratory positive *S. aureus* under 5 years of age accounted for 80% of the total number of non-respiratory positive *S. aureus*, especially under 3 years of age accounted for 71% of the total number of non-respiratory positive *S. aureus* between 2016 and 2021 (Fig. 2B). This also indicates that the population with *S. aureus* respiratory system infection is mainly under 1 year old, and the population with *S. aureus* non-respiratory system infection is mainly under 5 years old, especially under 3 years old.

In conclusion, the COVID-19 pandemic has changed the prevalence of respiratory *S. aureus* infections in children in Henan. While, the COVID-19 pandemic almost have no obvious changes the prevalence of non-respiratory *S. aureus* infections in children in Henan. Since the outbreak of COVID-19, countries around the world have implemented a series of strong control measures, increased awareness of personal protection, and effectively stopped the spread of the virus. Currently, COVID-19 continues to break out in some areas. With the normalization of epidemic prevention and control, it continues to affect people's living, traveling, learning, working and other ways, as well as the microbial community, especially the epidemiology of pathogens. Therefore, the long-term prevalence of *S. aureus* in children's deserves our continued attention. In addition, special attention should be paid to the risk of

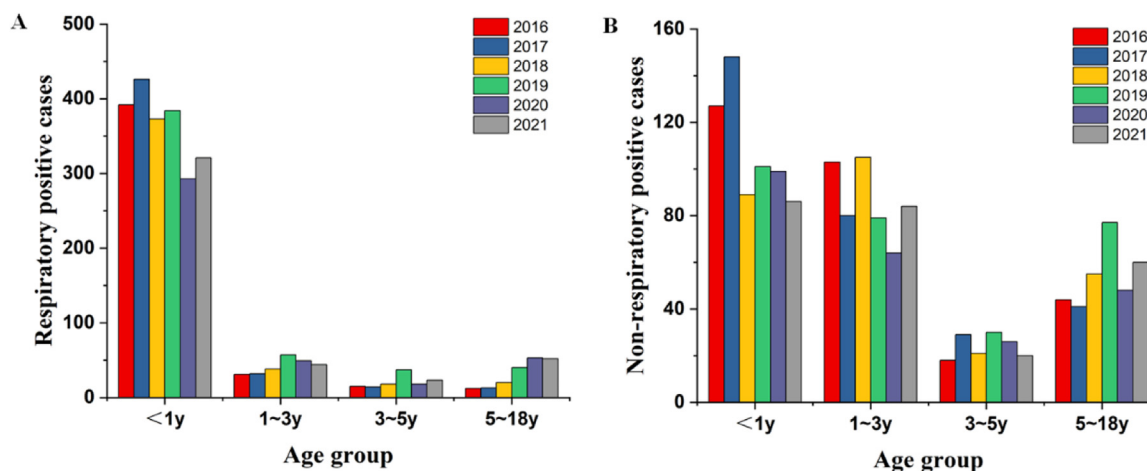


Fig. 2. (A) Cases of *S. aureus* positive infection in respiratory system from 2016 to 2021. (B) Cases of non-respiratory *S. aureus* positive infection in 2016–2021.

respiratory *S. aureus* infection in children under 1 year of age, and effective preventive measures should be taken promptly.

In summary, during the COVID-19 pandemic, there was a downward trend in children with respiratory *S. aureus* infections, apparently. While, the COVID-19 pandemic have no obvious changes non-respiratory *S. aureus* infections. Close monitoring of epidemiological trends can help prevent outbreaks of respiratory *S. aureus* infections in children, especially those under 1 year of age.

Declaration of Competing Interest

The authors declare no conflict of interests.

Acknowledgements

This work was funded by the National Natural Science Foundation of China (32201237), China Postdoctoral Science Foundation (2020M672301), Scientific and technological projects of Henan province (222102310270, 222102310109)

References

- Li Y, Guo Y, Duan Y. Changes in *Streptococcus pneumoniae* infection in children before and after the COVID-19 pandemic in Zhengzhou, China. *J Infect* 2022;**85**(3):e80–1. doi:10.1016/j.jinf.2022.05.040.
- Zhou J, Zhao P, Nie M, Gao K, Yang J, Sun J. Changes of *Haemophilus influenzae* infection in children before and after the COVID-19 pandemic, Henan, China. *J Infect* 2022. doi:10.1016/j.jinf.2022.10.019.
- Li L, Song C, Li P, Li Y. Changes of *Escherichia coli* infection in children before and after the COVID-19 pandemic in Zhengzhou, China. *J Infect* 2022. doi:10.1016/j.jinf.2022.11.017.
- Bhatty M, Ray P, Singh R, Jain S, Sharma M. Presence of virulence determinants amongst *Staphylococcus aureus* isolates from nasal colonization, superficial & invasive infections. *Indian J Med Res* 2013;**138**(1):143–6.

- Muenks CE, Hogan PG, Wang JW, Eisenstein KA, Burnham CD, Fritz SA. Diversity of *Staphylococcus aureus* strains colonizing various niches of the human body. *J Infect* 2016;**72**(6):698–705. doi:10.1016/j.jinf.2016.03.015.
- Self WH, Wunderink RG, Williams DJ, Zhu Y, Anderson EJ, Balk RA, et al. *Staphylococcus aureus* community-acquired pneumonia: prevalence, clinical characteristics, and outcomes. *Clin Infect Dis* 2016;**63**(3):300–9. doi:10.1093/cid/ciw300.
- Paling FP, Hazard D, Bonten MJM, Goossens H, Jafri HS, Malhotra-Kumar S, et al. Association of *Staphylococcus aureus* colonization and pneumonia in the intensive care unit. *JAMA Netw Open* 2020;**3**(9):e2012741. doi:10.1001/jamanetworkopen.2020.12741.
- Jahantigh HR, Faezi S, Habibi M, Mahdavi M, Stufano A, Lovreglio P, et al. The candidate antigens to achieving an effective vaccine against *Staphylococcus aureus*. *Vaccines* 2022;**10**(2). doi:10.3390/vaccines10020199.

Ying Liang
Henan Key Laboratory of Children's Genetics and Metabolic Diseases,
Children's Hospital Affiliated to Zhengzhou University, Henan
Children's Hospital, Zhengzhou Children's Hospital, Zhengzhou,
450018, China

Jieming Li
Henan University of Chinese Medicine, Zhengzhou, 450018, China

Ligong Hou, Xianwei Zhang*, Guangjun Hou*, Wancun Zhang*
Henan Key Laboratory of Children's Genetics and Metabolic Diseases,
Children's Hospital Affiliated to Zhengzhou University, Henan
Children's Hospital, Zhengzhou Children's Hospital, Zhengzhou,
450018, China

*Corresponding authors.

E-mail addresses: zhangxw956658@126.com (X. Zhang),
houguangjun2022@126.com (G. Hou), zhangwancun@126.com (W.
Zhang)