

## Trends of SARS-CoV-2 Infection Among Couriers in Risky Business After the Optimization of Prevention and Control Measures — China, December 2022 to January 2023

Yu Wu<sup>1,✉</sup>; Fan Ding<sup>2,✉</sup>; Jue Liu<sup>1</sup>; Wenzhan Jing<sup>3</sup>; Wenxin Yan<sup>1</sup>; Chenyuan Qin<sup>1</sup>; Fangyuan Li<sup>2</sup>; Yanping Zhang<sup>2</sup>; Guoqing Shi<sup>2</sup>; Wannian Liang<sup>3,✉</sup>; Qun Li<sup>2,✉</sup>; Min Liu<sup>1,✉</sup>

### ABSTRACT

**Introduction:** On December 7, 2022, China implemented “Ten New Measures” to optimize prevention and control measures for coronavirus disease 2019 (COVID-19). The purpose of this study was to evaluate the national and regional trends of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection among couriers in China from December 2022 to January 2023.

**Methods:** Data from the National Sentinel Community-based Surveillance in China was utilized, including participants from 31 provincial-level administrative divisions and Xinjiang Production and Construction Corps. Participants were tested for SARS-CoV-2 infection twice a week from December 16, 2022 to January 12, 2023. Infection was defined as a positive result for SARS-CoV-2 nucleic acid or antigen. The daily average newly positive rate of SARS-CoV-2 infection and the estimated daily percentage change (EDPC) were calculated.

**Results:** In this cohort, 8 rounds of data were collected. The daily average newly positive rate of SARS-CoV-2 infection decreased from 4.99% in Round 1 to 0.41% in Round 8, with an EDPC of -33.0%. Similar trends of the positive rate were also observed in the eastern (EDPC: -27.7%), central (EDPC: -38.0%) and western regions (EDPC: -25.5%). Couriers and community population showed a similar temporal trend, with the peak daily average newly positive rate of couriers being higher than that of community population. After Round 2, the daily average newly positive rate of couriers decreased sharply, becoming lower than that of community population in the same period.

**Conclusions:** The peak of SARS-CoV-2 infection among couriers in China has passed. As couriers are a key population for SARS-CoV-2 infection, they should be monitored continuously.

Since its outbreak in late 2019, coronavirus disease 2019 (COVID-19) caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has been spread globally and declared an epidemic by the World Health Organization (1). After experiencing the peak of the COVID-19 epidemic, China entered a normalization stage of prevention and control on April 29, 2020. During this stage, China effectively controlled the outbreak and spread of the epidemic by adopting the strategy of “preventing inbound cases and domestic resurgence”, and effectively reduced the occurrence of death cases (2). On December 7, 2022, China implemented the “Ten New Measures” to deeply improve the prevention and control of COVID-19 (3). These measures were introduced based on the latest epidemic situations and mutation of the virus to contain the epidemic in a more science-based and targeted manner. Couriers are a key population in the prevention and control of the epidemic, as they are in daily contact with numerous clients and coworkers, and may get infected at work and spread the disease to others (4). Studies have revealed that the demand for couriers has risen since the outbreak of COVID-19; a study in the Republic of Korea showed that the average number of times people used a courier service rose from 6.22 to 9.74 per month after the pandemic began (5), and reports from Russia indicated that the demand for couriers has grown 11 times over the past five years (6). However, the working hazards of couriers have rarely been studied. No study has evaluated the SARS-CoV-2 infection among couriers during the wide spread of Omicron variants BA.5.2.48 and BF.7.14 in China. To fill this gap, we aimed to evaluate the national and regional trends of SARS-CoV-2 infection among couriers using a community sentinel surveillance system in China between December 2022

and January 2023 to provide the latest data.

## METHODS

Using data from the National Sentinel Community-Based Surveillance (NSCS) in China, we assessed the trends of SARS-CoV-2 infection among couriers. The NSCS was a national community-based sentinel surveillance cohort from 31 provincial-level administrative divisions (PLADs) and Xinjiang Production and Construction Corps (XPCC). Multistage stratified cluster sampling was used to select participants. Each PLAD was required to select one provincial capital city and one large city, with at least 200 couriers sampled in each provincial capital city and at least 100 couriers sampled in each large city. Nucleic acid or antigen testing was conducted twice a week for each courier, as appropriate. The neighborhood committee (village committee) of each surveillance sentinel site was responsible for the specific implementation of the investigation and information reporting, while the district CDC of each surveillance sentinel site was responsible for collecting information and reporting at each level. All participants in the monitored communities were investigated twice a week (a total of eight surveillance rounds) from December 16, 2022 to January 12, 2023.

SARS-CoV-2 infection was defined as a positive test for SARS-CoV-2 nucleic acid or antigen. The daily average newly positive rate of SARS-CoV-2 infection and its 95% confidence interval (CI) (7) were calculated, which was defined as the percentage of the number of people with positive nucleic acid or antigen

detection of SARS-CoV-2 in the total number of surveyed people in a specific round of surveillance divided by the number of survey days.

The estimated daily percentage change (EDPC) was calculated, a widely used measure of the rate trend over a specified time interval globally. A regression line was fitted to the natural logarithm of the positive rate, i.e.,  $y = \alpha + \beta x$ , where  $y = \ln(\text{daily average newly positive rate})$  and  $x = \text{Rounds}$ . The EDPC was calculated as  $100 \times (e^{\beta} - 1)$  and its 95% CI was calculated as  $[(100 \times (e^{\beta_{lower\ bound}} - 1)), 100 \times (e^{\beta_{upper\ bound}} - 1)]$  to reflect the trends of daily average newly positive rate between different rounds. The trends of positive rate are downward (or upward) when the EDPC value and its 95% CI are below (or above) zero. R 4.1.3 (R Foundation for Statistical Computing, Vienna, Austria) and Excel 2010 (Microsoft Corp., Redmond, WA., USA) were used to analyze and generate statistical figures.

## RESULTS

As shown in Table 1, 21,000 couriers were recruited in the key population surveillance of NSCS. The daily average newly positive rate of SARS-CoV-2 infection decreased from 4.99% in Round 1 (December 16–19, 2022) to 0.41% in Round 8 (January 10–12, 2023), with an EDPC of -33.0% (95% CI: -40.2% to -25.0%,  $P < 0.001$ ). The daily average newly positive rate of SARS-CoV-2 infection for the eight surveillance rounds were 4.99%, 9.49%, 2.94%, 2.58%, 1.55%, 1.08%, 0.31%, and 0.41%, respectively. The epidemic peak occurred during Round 2 (December 20–22,

TABLE 1. Trends of SARS-CoV-2 infection among the couriers in sentinel community-based surveillance, China, December 2022 to January 2023.

Rounds (investigate date)	Number of investigated couriers	Number of newly positive cases	Daily average newly positive rate of SARS-CoV-2 infection (%; 95% CI)
Round 1	1,990*	397	4.99 (4.03, 5.94)
Round 2	9,960*	2,837	9.49 (8.92, 10.07)
Round 3	21,861	2,574	2.94 (2.72, 3.17)
Round 4	21,012	1,628	2.58 (2.37, 2.80)
Round 5	22,247	1,381	1.55 (1.39, 1.71)
Round 6	22,081	718	1.08 (0.95, 1.22)
Round 7	22,112	276	0.31 (0.24, 0.39)
Round 8.	23,009	280	0.41 (0.32, 0.49)

Note: Investigations in the study were conducted in 8 rounds, from December 16, 2022 to January 12, 2023. Round 1 was conducted December 16–19, 2022; Round 2 December 20–22, 2022; Round 3 December 23–26, 2022; Round 4 December 27–29, 2022; Round 5 December 30, 2022–January 2, 2023; Round 6 January 3–5, 2023; Round 7 January 6–9, 2023; and Round 8 January 10–12, 2023.

Abbreviation: SARS-CoV-2=severe acute respiratory syndrome coronavirus 2; CI=confidence interval.

\* Sample sizes for Rounds 1 and 2 of surveillance did not meet expectations due to the peak of SARS-CoV-2 infection from December 16 to 22, 2022, resulting in many couriers being unable to participate in the survey due to COVID-19 symptoms.

2022).

Table 2 presents the epidemic trends of SARS-CoV-2 in three regions. In eastern China, the daily average newly positive rate of SARS-CoV-2 infection among couriers decreased from 4.18% in Round 1 to 0.76% in Round 8, with an EDPC of  $-27.7%$  ( $P<0.001$ ). For central and western China, EDPCs were  $-38.0%$  (decreasing from 2.69% to 0.17%,  $P<0.001$ ) and  $-25.5%$  (decreasing from 5.68% to 0.60%,  $P<0.001$ ),

respectively. The daily average newly positive rates among couriers in eastern, central and western China all peaked at Round 2.

As Figure 1 shows, the daily average of newly positive rates in the eastern and western regions were generally higher than the national level, while the positive rate in the central region was lower than the national level. After Round 6 (January 3–5, 2023), the daily average of newly positive rates across regions

TABLE 2. Trends of SARS-CoV-2 infection among couriers in sentinel community-based surveillance by regions, China, December 2022 to January 2023.

Rounds	Number of investigate couriers	Number of newly positive cases	Daily average newly positive rate of SARS-CoV-2 infection (%; 95% CI)	EDPC (%; 95% CI)	P value
Eastern					
Round 1	658	110	4.18 (2.65, 5.71)		
Round 2	3,895	1,172	10.03 (9.09, 10.97)		
Round 3	6,274	1,306	5.20 (4.65, 5.75)		
Round 4	4,539	507	3.72 (3.17, 4.27)		
Round 5	5,732	377	1.64 (1.32, 1.97)	$-27.7$ ( $-34.4$ , $-20.4$ )	$<0.001$
Round 6	4,911	253	1.72 (1.35, 2.08)		
Round 7	5,685	78	0.34 (0.19, 0.49)		
Round 8	6,046	138	0.76 (0.54, 0.98)		
Central					
Round 1	130	14	2.69 ( $-0.09$ , 5.47)		
Round 2	2,881	929	10.75 (9.62, 11.88)		
Round 3	11,920	302	0.63 (0.49, 0.78)		
Round 4	12,190	432	1.18 (0.99, 1.37)		
Round 5	12,284	431	0.88 (0.71, 1.04)	$-38.0$ ( $-46.3$ , $-28.5$ )	$<0.001$
Round 6	12,285	239	0.65 (0.51, 0.79)		
Round 7	12,573	127	0.25 (0.16, 0.34)		
Round 8	12,607	63	0.17 (0.10, 0.24)		
Western					
Round 1	1,202	273	5.68 (4.37, 6.99)		
Round 2	3,184	736	7.71 (6.78, 8.63)		
Round 3	3,667	966	6.59 (5.78, 7.39)		
Round 4	4,283	689	5.36 (4.69, 6.04)		
Round 5	4,231	573	3.39 (2.84, 3.93)	$-25.5$ ( $-31.9$ , $-18.6$ )	$<0.001$
Round 6	4,885	226	1.54 (1.20, 1.89)		
Round 7	3,854	71	0.46 (0.25, 0.67)		
Round 8	4,356	79	0.60 (0.37, 0.83)		

Note: EDPC stands for estimated daily percentage change from Round 1 to Round 8 between December 16, 2022 and January 12, 2023. Round 1 was conducted December 16–19, 2022; Round 2 December 20–22, 2022; Round 3 December 23–26, 2022; Round 4 December 27–29, 2022; Round 5 December 30, 2022–January 2, 2023; Round 6 January 3–5, 2023; Round 7 January 6–9, 2023; and Round 8 January 10–12, 2023. The eastern region included Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan PLADs; the western region included Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Xizang (Tibet), Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang PLADs, and XPCC; the central region included Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan PLADs.

Abbreviation: SARS-CoV-2=severe acute respiratory syndrome coronavirus 2; EDPC=estimated daily percentage change; CI=confidence interval; PLAD=provincial-level administrative division; XPCC=Xinjiang Production and Construction Corps.

converged and the disparities between regional incidence were noticeably decreasing, with all rates falling below 1% in Round 8.

As shown in Figure 2, the daily average of newly positive cases among couriers varied across PLADs, but all showed a downward trend after reaching a peak in Round 2, and dropped below 5% in Round 8.

Figure 3 demonstrates that couriers and the community population had a similar temporal trend, with the peak daily average newly positive rate of couriers (9.49%) being higher than that of the community population (6.36%). Following Round 2, the daily average newly positive rate of couriers decreased significantly, becoming lower than that of the community population during the same period.

## DISCUSSION

Our findings showed that the peak of daily average newly positive rates of SARS-CoV-2 infection among couriers occurred between December 20–22, 2022 and

had decreased to 0.41% by January 10–12, 2023. In terms of the distribution of positive rates in different regions, the eastern, central, and western regions all reached their peak on December 20–22, 2022. The peak in the western region was relatively low and the disparities between regional incidence were shrinking, with all regions declining below 1% in Round 8. Data from different PLADs also showed a downward trend in newly positive SARS-CoV-2 infections among couriers.

Jue et al. (8) utilized data from the NSCS system in China to assess trends of SARS-CoV-2 infection among community population. In this national cohort, the daily average newly positive rate of SARS-CoV-2 infection decreased from 4.13% in Round 1 (December 16–19, 2022) to 0.69% in Round 8 (January 10–12, 2023). The time trend of the positive rate of couriers in our study was consistent with that of community population, which showed that the epidemic in China has reached a steady transition after the optimization of prevention and control measures.

The express delivery business in China is

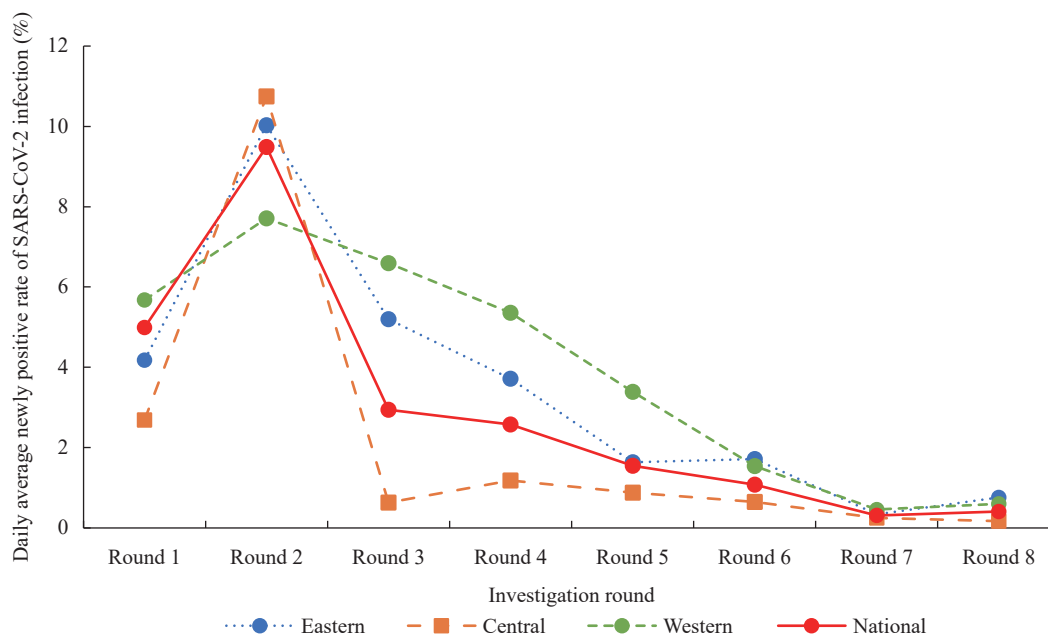


FIGURE 1. Trends of SARS-CoV-2 infection among couriers in the sentinel community-based surveillance, China, December 2022–January 2023, stratified by regions.

Note: Investigations in the study were conducted in 8 rounds, from December 16, 2022 to January 12, 2023. Round 1 was conducted December 16–19, 2022; Round 2 December 20–22, 2022; Round 3 December 23–26, 2022; Round 4 December 27–29, 2022; Round 5 December 30, 2022–January 2, 2023; Round 6 January 3–5, 2023; Round 7 January 6–9, 2023; and Round 8 January 10–12, 2023. The eastern region included Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan PLADs; the western region included Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Xizang (Tibet), Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang PLADs, and XPCC; the central region included Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan PLAD.

Abbreviation: SARS-CoV-2=severe acute respiratory syndrome coronavirus 2; PLAD=provincial-level administrative division; XPCC=Xinjiang Production and Construction Corps.

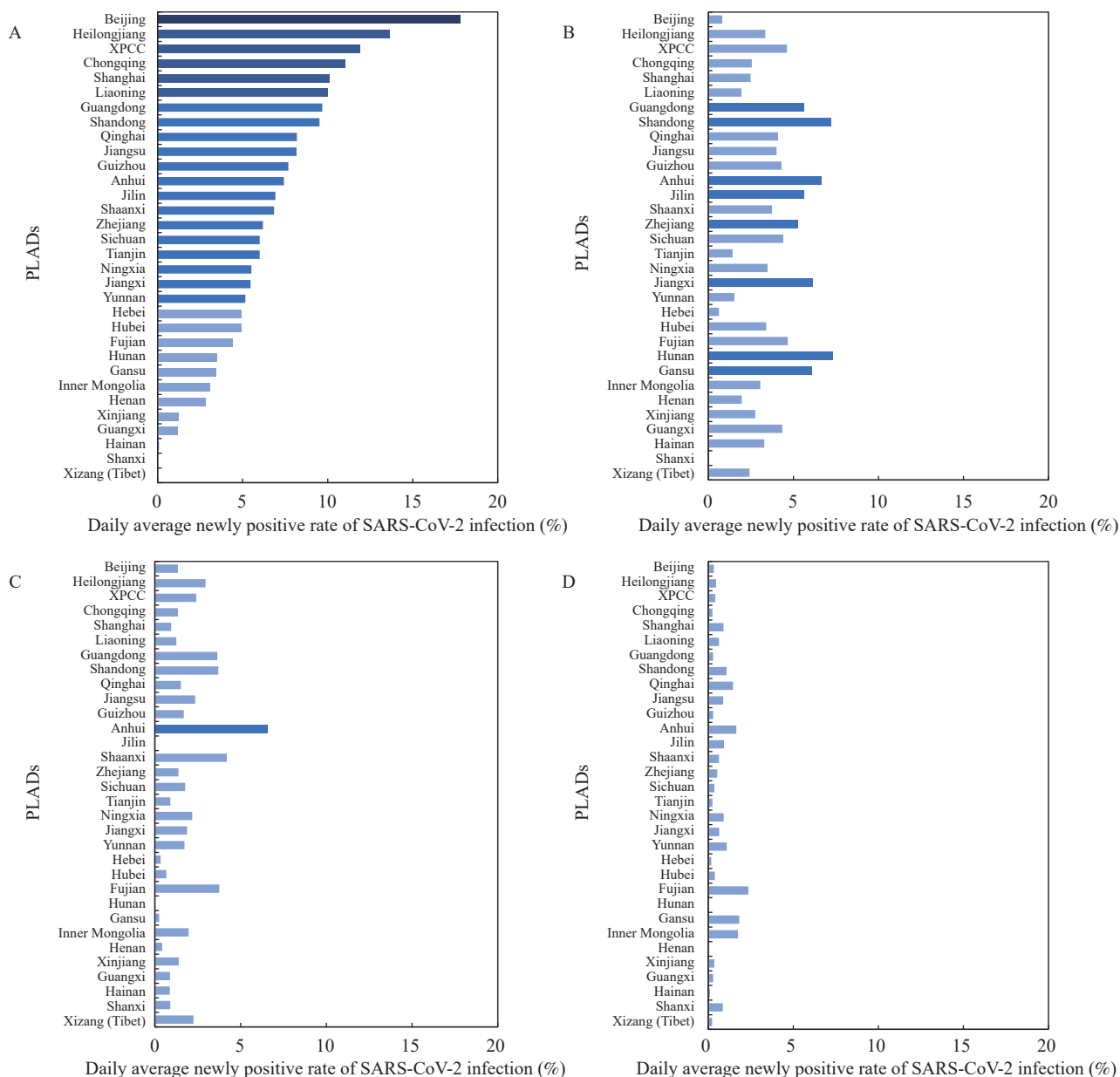


FIGURE 2. Average daily rate of newly positive couriers in the sentinel community-based surveillance in China, December 2022 to January 2023, stratified by PLAD and XPCX. (A) Round 2; (B) Round 4; (C) Round 6; (D) Round 8.

Note: Round 2 was conducted December 20–22, 2022; Round 4 December 27–29, 2022; Round 6 January 3–5, 2023; and Round 8 January 10–12, 2023.

Abbreviation: SARS-CoV-2=severe acute respiratory syndrome coronavirus 2; PLAD=provincial-level administrative division; XPCX=Xinjiang Production and Construction Corps.

burgeoning, increasing job opportunities at express delivery enterprises, resulting in a growing need for delivery personnel. Statistically, the number of couriers in China increases by 150,000–200,000 every year (9). Chinese couriers are generally young and poorly educated. They work long hours on consecutive days in a challenging environment with little to no downtime.

Since the outbreak of COVID-19, the demand for

couriers has risen (4). The virus is transmitted when an infected person comes in close contact with another person. Couriers, as they have many customers, suppliers, and coworkers, are at higher risk of transmission (10). In the study by Egozi et al. (4), the couriers reported their self-compliance with regulations to prevent infection: 35% reported full compliance, 38% reported partial compliance, and 27% reported no compliance. The combination of potential safety

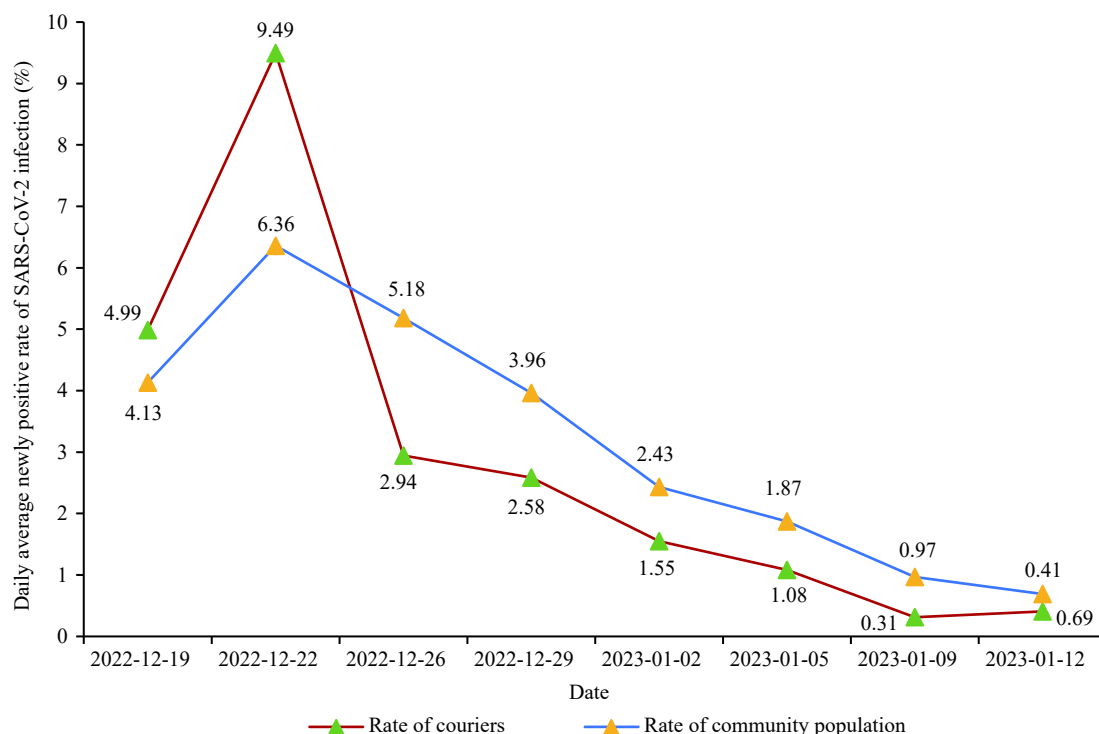


FIGURE 3. Time trends of SARS-CoV-2 infection among couriers and community population in the sentinel community-based surveillance, China, December 2022 to January 2023. Abbreviation: SARS-CoV-2=severe acute respiratory syndrome coronavirus 2.

and health risks with varied terms of employment puts this population at risk of inadequate health and safety at work in general and during the COVID-19 pandemic in particular. The likelihood that delivery workers have direct contact with SARS-CoV-2-infected customers without ever experiencing symptoms and may subsequently act as a presymptomatic transmitter unwittingly passing the novel coronavirus to their healthy customers, coworkers, or families should be taken into consideration (11).

SARS-CoV-2 is primarily spread through respiratory droplets during close face-to-face contact (12). The risk of transmission via fomites is low, but the Omicron variant currently circulating around the world is more infectious. According to Hirose et al. (13), the median survival times of the Wuhan strain, Alpha variant, Beta variant, Gamma variant, Delta variant, Omicron BA.1 variant, and Omicron BA.2 variant on plastic surfaces were 56.0 h, 191.3 h, 156.6 h, 59.3 h, 114.0 h, 193.5 h, and 199.7 h, respectively. The Omicron BA.1 and BA.2 variants had the longest survival time, indicating that couriers are at a higher risk of Omicron infection. Our study found that the peak daily average newly positive rate of couriers (9.49%) was higher than that of the community population (6.36%). After the

second round, the daily average newly positive rate of couriers decreased, lower than that of the community population in the same period. Couriers are generally highly mobile, thus increasing their risk of contracting SARS-CoV-2. Additionally, since couriers are usually young and healthy, the symptoms after infection are generally mild and they recover quickly, leading to a rapid decrease in the peak of the daily average newly positive rate. As a key population for SARS-CoV-2 infection, couriers should be continuously monitored. The couriers' cohort has effectively filled the current research gap, providing the most up-to-date data information and technical support for the assessment of the epidemic situations and the estimation of medical treatment requests at national, regional, and provincial levels.

This study has several strengths. First, we selected a large sample size of couriers in provincial capitals and larger cities in all 31 PLADs and XPCC. Second, the NSCS conducted regular and frequent laboratory testing of participants at the peak of the epidemic. However, several potential limitations of this study should be noted. First, since this is an emergency surveillance project supported by the National Bureau of Disease Control and Prevention, the sampling methods varied from province to province, including



PPS random sampling and convenience sampling, which may have impacted the daily positive rate. Second, we only selected couriers in urban areas as participants, and there was a lack of relevant data on rural couriers. The couriers' cohort was unstable and there was a high turnover of couriers, which may have affected the positive rate. Third, we analyzed aggregated NSCS data without individual-level data and therefore could not analyze the differences in the average daily incidence rate of SARS-CoV-2 infection among people with different characteristics (such as age, gender, and presence of underlying chronic diseases).

In conclusion, after the optimization of prevention and control measures, sentinel surveillance data of the community population indicate that the peak of SARS-CoV-2 infection in China has passed. Currently, SARS-CoV-2 infection among couriers in China is at a low epidemic level. To ensure continued control of the virus, it is necessary to maintain monitoring of the positive rate of couriers in the future.

**Conflicts of interest:** No conflicts of interest.

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# Corresponding authors: Min Liu, liumin@bjmu.edu.cn; Qun Li, liquan@chinacdc.cn; Wannian Liang, liangwn@tsinghua.edu.cn.

<sup>1</sup> School of Public Health, Peking University, Beijing, China; <sup>2</sup> Chinese Center for Disease Control and Prevention, Beijing, China; <sup>3</sup> Vanke School of Public Health, Tsinghua University, Beijing, China; Institute for Healthy China, Tsinghua University, Beijing, China.

⊗ Joint first authors.

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