Food Sources May Affect the Symptom Rates of COVID-19, an Epidemiological Analysis Based on the Public Data in Gansu Province, China, During the Summer Epidemic Cycle in 2022

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Abstract

According to the public data collected from the Health Commission of Gansu Province, China, regarding the COVID-19 pandemic during the summer epidemic cycle in 2022, the epidemiological analysis showed that the pandemic spread stability and the symptom rate (the number of confirmed cases divided by the sum of the number of asymptomatic cases and the number of confirmed cases) of COVID-19 were different among 3 main epidemic regions, Lanzhou, Linxia, and Gannan; both the symptom rate and the daily instantaneous symptom rate (daily number of confirmed cases divided by the sum of daily number of asymptomatic cases and daily number of confirmed cases) in Lanzhou were substantially higher than those in Linxia and Gannan. The difference in the food sources due to the high difference of the population ethnic composition in the 3 regions was probably the main driver for the difference of the symptom rates among the 3 regions. This work provides potential values for prevention and control of COVID-19 in different regions.

Coronavirus disease 2019 (COVID-19) is an acute respiratory infection caused by acute respiratory syndrome coronavirus 2 (SARS-CoV-2).[1] The confirmed symptoms of COVID-19 are fever, cough, dyspnea,[2] and most of the confirmed cases were aged 30-79 y.[1] It poses a great threat to public health worldwide and has a great impact on economy development and social stability.[3,4] Statistics showed that the number of confirmed cases was 602,621,970 and the number of deaths was 6,476,509 worldwide by August 24, 2022. In China, the central government and local governments adopted strict prevention and control measures against COVID-19. China accounted for only 0.0399% of confirmed cases and only 0.0807% of death in the world.[5]

As the COVID-19 became a global pandemic, real-time analysis of epidemiological data is needed to better understand the outbreak and control the pandemic.[2] The concentrated outbreak of the COVID-19 pandemic occurred mainly in 3 regions (Lanzhou city, Linxia Hui Autonomous Prefecture, and Gannan Tibetan Autonomous Prefecture), Gansu province, China, in Summer, 2022. According to the announcement from the Health Commission of Gansu Province, China, the epidemic virus was COVID-19 Omicron variant BA.2.38 based on gene sequencing analysis, the average incubation period of this strain was 2 to 4 d, and the strain has stronger transmission power and occult nature, faster transmission speed, higher infection rate, and stronger immune escape ability.[6] In the current study, we collected data from the Health Commission of Gansu Province, China, regarding the COVID-19 pandemic in Lanzhou, Linxia, and Gannan and compared the symptom rate, dynamic changes of daily asymptomatic case, and confirmed case numbers, and the daily instantaneous symptom rate among 3 main epidemic regions. We found that the symptom rates of the COVID-19 pandemic in Linxia and Gannan were significantly lower than that in Lanzhou during the summer epidemic cycle in 2022.

Materials and Methods

Data Sources

In this study, the data were obtained from the Health Commission of Gansu Province, China[7] The data were reported directly and publicly, and no privacy information of patients was involved. According to the concentrated outbreak period of the COVID-19 pandemic, we

Table 1. Total numbers of COVID-19 asymptomatic case and confirmed cases and the symptom rate in Gansu province during the summer epidemic cycle in 2022

Region	Total no. of asymptomatic case	Total no. of confirmed case	Symptom rate (%)
Lanzhou city	1847	505	21.47
Linxia prefecture	1613	82	4.84
Gannan prefecture	520	38	6.81
Other regions	98	25	20.33
Gansu province (total)	**4078**	**650**	**13.75**

collected the data from July 8 to August 2, for Lanzhou city, and from July 13 to August 2, for both Linxia Hui Autonomous Prefecture and Gannan Tibetan Autonomous Prefecture. No confirmed case and only a few asymptomatic cases were announced after August 3 during the summer epidemic cycle in 2022.

Data Analysis and Visualization

The symptom rate of the COVID-19 pandemic was calculated with the total number of confirmed cases divided by the sum of the total number of asymptomatic cases and the total number of confirmed cases. The daily instantaneous symptom rate was calculated with the daily number of confirmed cases divided by the sum of daily number of asymptomatic cases and daily number of confirmed cases. One-way analysis of variance (ANOVA) was performed using Duncan test function in the agricolae package of R software (V4.1.2) (https://www.r-project.org/), and Duncan's multiple range test was used to identify the significant differences among means at $P < 0.05$ ($n \geq 21$). Data visualization was implemented using ggplot2 package of R Software.

Results

Overview of the Summer Epidemic Cycle

The summer epidemic cycle of the COVID-19 pandemic initiated in Gansu Province from July 8 to August 2, for Lanzhou, and from July 13 to August 2, for both Linxia and Gannan. There were 4078 asymptomatic cases and 650 confirmed cases totally in Gansu province with a symptom rate of 13.75% (Table 1). Among 3 main epidemic regions, there were 1847 asymptomatic cases and 505 confirmed cases in Lanzhou with a symptom rate of 21.47%, 1613 asymptomatic cases and 82 confirmed cases in Linxia with a symptom rate of 4.84%, and 520 asymptomatic cases and 38 confirmed cases in Gannan with a symptom rate of 6.81%. There were 98 asymptomatic cases and 25 confirmed cases in other regions with a symptom rate of 20.33%, very close to the symptom rate in Lanzhou. The symptom rate in Lanzhou was 3.4- and 2.2-fold higher than those in Linxia and Gannan, respectively. Lanzhou, Linxia, and Gannan accounted for 45.3%, 39.6%, and 12.8% of the total provincial asymptomatic cases, however, 77.7%, 12.6%, and 5.8% of the total provincial confirmed cases, respectively.

Dynamic Changes in Daily COVID-19 Asymptomatic Case and Confirmed Case Numbers

According to the epidemic data of the whole province of Gansu (Figure 1), the first 4 confirmed cases and the first asymptomatic case were reported on July 8, 2022. The highest number of confirmed cases was 53 on July 16 and declined after July 21 (52 cases); the number of asymptomatic cases increased from July 8 to 21 with the peak value of 517 on July 21, and then gradually declined. The first 4 confirmed cases and the first asymptomatic case in Lanzhou were reported on July 8, 2022, just the same as the whole province. The highest number of confirmed cases was 53 on July 16 and declined after July 21 (50 cases); the number of asymptomatic cases increased from July 8 to 21 with the peak value of 201 on July 21. The first 2 asymptomatic cases and the first confirmed case in Linxia were reported on July 13 and 14, 2022, respectively. The highest number of confirmed cases was 27 on July 30; the number of asymptomatic cases increased from July 13 to 21 with the peak value of 261 on July 21, and then declined gradually. The first 8 asymptomatic cases and the first 10 confirmed cases in Gannan were reported on July 13 and 19, 2022, respectively. The highest number of confirmed cases was 10 on July 19; the number of asymptomatic cases increased from July 13 to 19 with the peak value of 58 on July 19, and then gradually declined after July 24 (58 cases). Of interest, the peak value of confirmed cases was pinpointed on July 16, 5 d earlier than July 21 when the peak value of asymptomatic cases was reported in the whole province of Gansu. However, different trends were observed among Lanzhou, Linxia and Gannan. The peak value of confirmed cases was reported on July 16, 5 d earlier than July 21 when the peak value of asymptomatic cases was reported in Lanzhou, just the same as the whole province. The peak value of confirmed cases was reported on July 30, 9 d later than July 21 when the peak value of asymptomatic cases was reported in Linxia; The peak value of both confirmed cases and asymptomatic cases was reported in Gannan on July 19.

Daily Instantaneous Symptom Rate

Heat map analysis showed that the daily instantaneous symptom rates are different among the 3 regions (Figure 2). Further variance analysis showed that the daily instantaneous symptom rate of Lanzhou was significantly higher than those of Linxia and Gannan, and no significant difference in the daily instantaneous symptom rate between of Gannan and Linxia ($P < 0.05$) (Figure 3) was observed. The average daily instantaneous symptom rates of Lanzhou, Linxia, and Gannan were 27.8%, 6.0%, and 9.9%, respectively.

Discussion

COVID-19 is the most widespread pandemic threating human health worldwide since the end of 2019. Timely publication of government information relevant to the epidemic spread is 1 of the effective measures for prevention and control of the virus. According to the epidemic information published by the Health Commission of Gansu Province during the summer epidemic cycle, the concentrated outbreak of the COVID-19 pandemic occurred mainly in Lanzhou, and then in Linxia and Gannan.[6] The local epidemic prevention departments responded quickly and timely reported the case data, including age, gender, address, source of exposure, date of onset, date of treatment, date of diagnosis, date of discharge, clinical symptoms, clinical classification, epidemiology track after disease, and the number of virus nucleic
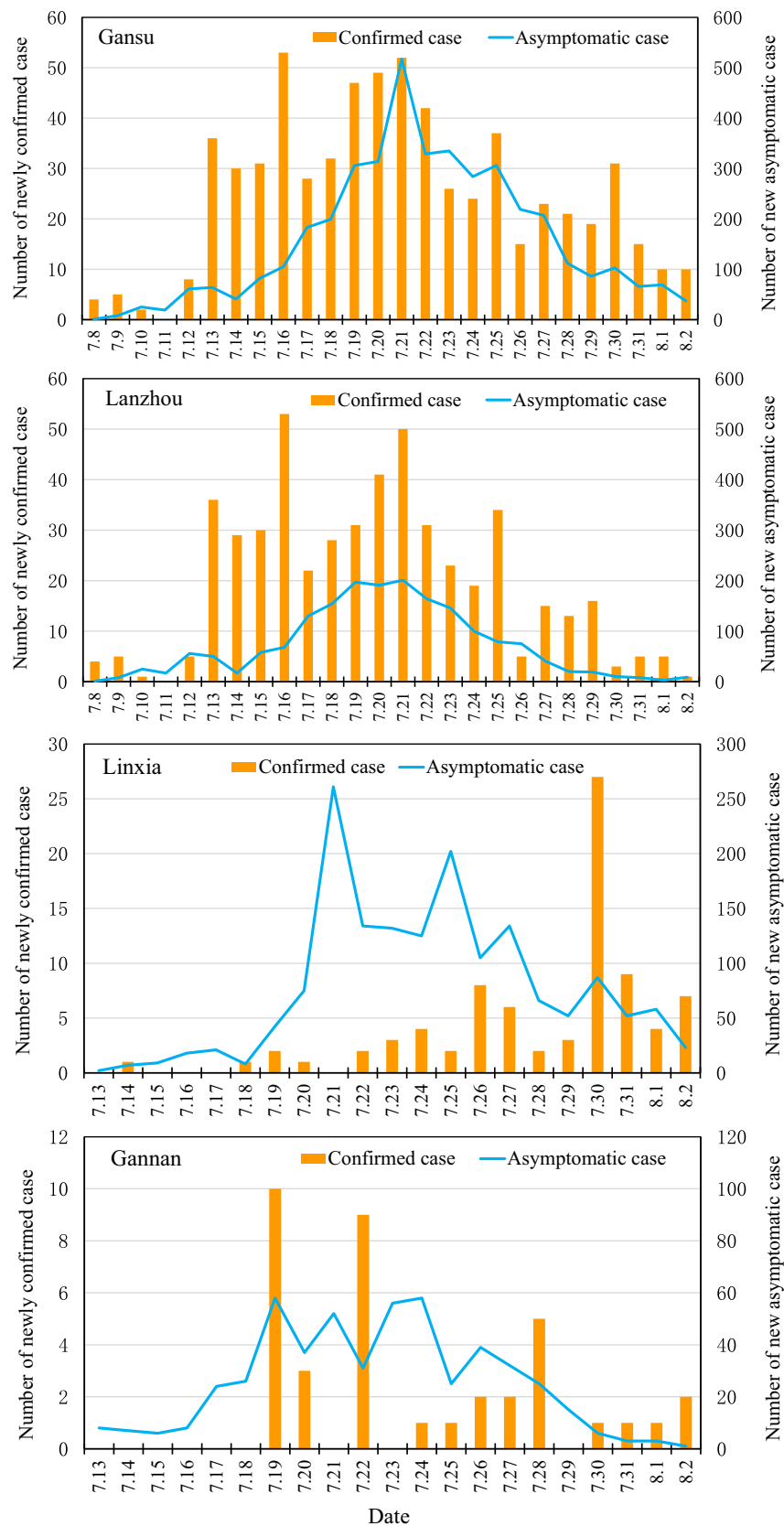
Figure 1. Dynamic changes of daily COVID-19 asymptomatic case and confirmed case numbers in main epidemic regions (Lanzhou, Linxia and Gannan) and the whole Gansu province during the summer epidemic cycle in 2022.
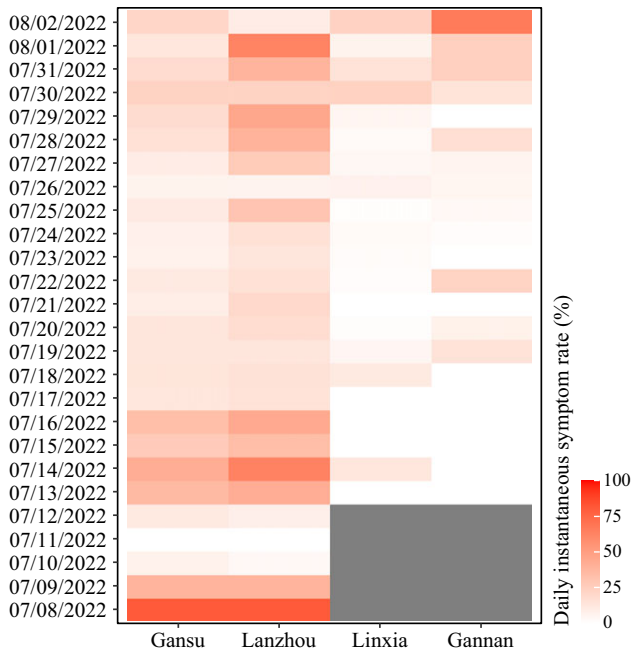
Figure 2. Heat map of the daily instantaneous symptom rate in main epidemic regions (Lanzhou, Linxia, and Gannan) and the whole Gansu province during the summer epidemic cycle in 2022.
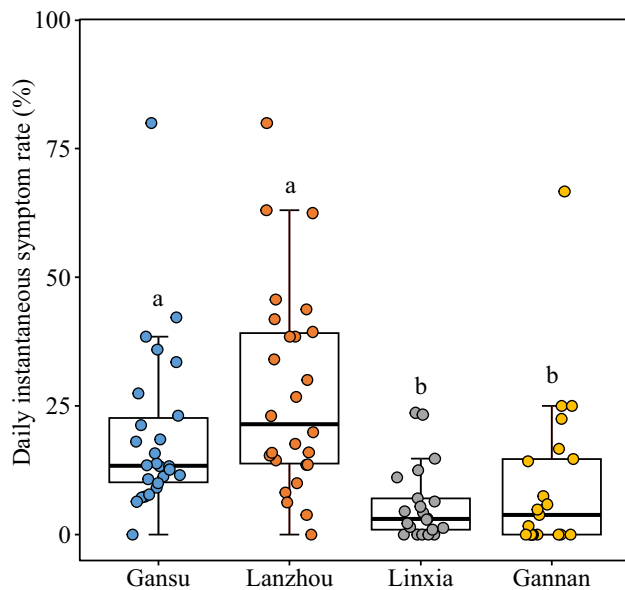

Figure 3. Variance analysis of the daily instantaneous symptom rate among main epidemic regions (Lanzhou, Linxia, and Gannan) and the whole Gansu province during the summer epidemic cycle in 2022.

acid tests.[8,9] Gansu provincial government efficiently and accurately evaluated the epidemic information, which enabled the public to have a real-time understanding of the epidemic situation. Due to the prompt response in Gansu Province and the effective prevention and control measures, the epidemic subsided in early August.

Asymptomatic cases were defined as those who had no relevant clinical symptoms and were positive in coronavirus pathogen testing of respiratory specimens.[10] With the implementation of the

national vaccination policy, people's immunity against COVID-19 has been continuously enhanced.[11,12] Although the omicron variant BA.2.38 was highly contagious, it was relatively less virulent and had relatively mild clinical symptoms, which might cause asymptomatic cases.[13,14] During the summer epidemic cycle in 2022, the number of asymptomatic cases of COVID-19 in Gansu Province was 5.3-fold higher than that of the confirmed cases. After July 21, 2022, the quantity of both asymptomatic cases and confirmed ones of COVID-19 in Gansu Province gradually declined.

Previous study showed that the stability of released information was disturbed by many scientific prevention and controlling measures.[9] Lanzhou is a provincial capital city with better epidemic prevention conditions than Linxia and Gannan, which laid a foundation for the stable and effective control of the COVID-19 epidemic. Numbers of both asymptomatic cases and confirmed ones in Lanzhou were more stable than those in Linxia and Gannan. Since the end of this summer epidemic cycle in 2022, Lanzhou began to conduct regular nucleic acid test for the residents, which had good guidance for the timely detection and control of the spread of the COVID-19 epidemic.

Several factors, including climate (eg, temperature, humidity, light, etc.) and food sources, might influence the symptom rate and severity of an epidemic.[15–17] The climate is different among Lanzhou, Linxia, and Gannan with Linxia and Gannan being cooler due to high altitude. More importantly, the ethnic composition of the population was greatly different among the 3 regions. Han people, Muslim people, and Tibetan people account for 95.59, 3.46, and 0.32% of the total population (3,616,163) in Lanzhou, respectively; 39.7, 57.58, and 0.40% of the total population (1,946,677) in Linxia, respectively; and 38.7, 6.26, and 54.64% of the total population (689,132) in Gannan, respectively.[18] The proportion of beef and mutton consumption for Muslim people and Tibetan people is greater than that for Han people, and the proportion of mutton consumption for Muslim people is greater than that for Tibetan people. Therefore, the food sources are different for people among the 3 regions; the proportion of beef and mutton consumption in Linxia and Gannan is greater than that in Lanzhou, and the proportion of mutton consumption in Linxia is greater than that in Gannan. During the summer epidemic cycle in 2022, the symptom rate of COVID-19 in Lanzhou was 3.4- and 2.2-fold higher than those in Linxia and Gannan, respectively (Table 1); the average daily instantaneous symptom rate in Lanzhou was 3.6- and 1.8-fold higher than those in Linxia and Gannan, respectively (Figure 3).

Conclusions

Based on the public information in Gansu province, China, during the summer epidemic cycle in 2022, the epidemiological analysis of COVID-19 showed that the pandemic spread stability and the symptom rate were different among the 3 main epidemic regions, Lanzhou, Linxia, and Gannan. Both the symptom rate and the daily instantaneous symptom rate in Lanzhou were much higher than those in Linxia and Gannan. The difference in food sources due to the high difference of the population ethnic composition was probably 1 of the main drivers for the difference of the symptom rates among these 3 regions. This study provided potential values for prevention and control of COVID-19 in different regions.

the manuscript. Q.W., X.-H.C., and J.-L.Z. revised the manuscript. All authors contributed to the manuscript and approved its submission for publication.

Conflict of interest. The authors have no conflicts of interest to declare.

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