

Data analysis and research reveal the reasons why China still adheres to its “dynamic zero-COVID policy”

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Data analysis and research reveal the reasons why China still adheres to its “dynamic zero-COVID policy”

Yeyu Freddie Dai, Bingxi Gabriel Dai

Abstract

China has been attacked by its largest outbreaks of COVID-19 since March. Pervasive arguments about prevention policy arose among people in China and around the world. Complete and accurate statistical analyzes of cases of contraction with SARS-CoV-2 in China are given under the conditions of strict mandatory quarantine and isolation, and of a high rate of full vaccination⁽¹⁾. This study reveals the essential reasons why China has been and will be adhering to its “dynamic zero-COVID policy” which stands in contrast to a global trend towards easing restrictions and attempting to co-exist with the circulating virus⁽²⁾, including choice uniqueness, difference of case symptomatic rates, unpredictability of transmission, worries of burden to medical system, successful reducing to zero the number of each active chain of transmission, and outstanding economy achievements, etc. This study may bring new thoughts for correction of present epidemiological theory and mathematical models, as well as new theoretical supports for the prevention policy making. It may also give other countries time to be better prepared for the coming 6th wave driven by Omicron variant.

Methods

We analyzed daily domestic cases (cases of infection between domestic travelers, as called indigenous cases in China) of COVID-19 in mainland China from 21 February 2022 to 14 May 2022 (hereafter also called the March outbreaks) from publicly released data provided by the National Health Commission of the People’s Republic of China (NHC), which are accessible through its News Daily Briefings ([Http://en.nhc.gov.cn](http://en.nhc.gov.cn)). NHC of China released daily updates on the number of “confirmed” (here meaning symptomatic) and asymptomatic new cases, with a breakdown by provinces, and severe cases, deaths and recoveries nationwide. Sources of more information were COVID-19 epidemiological reports published daily by Provincial/Territorial branches of NHC (including CDC) and press conferences held by Provincial/Territorial governments (CDC is a department of NHC in China and the same was for its Provincial/Territorial branches). All data had been updated to 14 May 2022.

There were sudden surges of numbers of cases in some days during the March outbreaks due to test deficiency in some jurisdictions in a few days. A sudden surge of cases might indicate a belated report but did not necessarily indicate a skew or underestimation of the total COVID-19 cases because all belated cases were reported later when tests and doctors were sufficient. We applied normalization of data or curves according to the need of appearance of figures or charts, with the original data stated in dataset in the supplementary files.

The same Criteria had been followed all over China for all COVID-19 related work including prevention measures, testing, diagnosing, and classification of cases of infection. This analysis used the word “symptomatic” instead of “confirmed” (as NHC called) and the word “confirmed” instead of “infected”, as shown in the following, including other definitions and explanations:

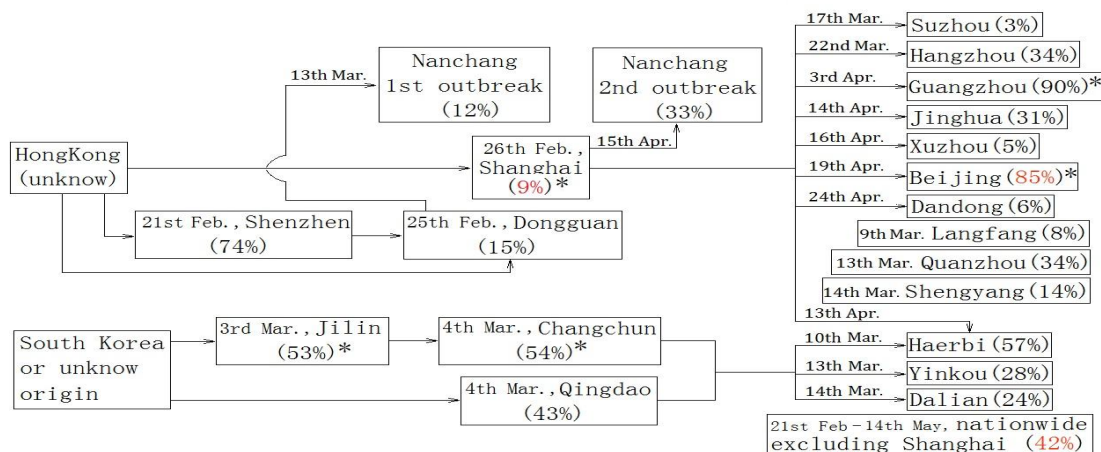
1. Confirmed cases are laboratory confirmed (SARS-CoV-2 PCR-positive) cases of infection by double samplings (nasal and pharyngeal swab specimens) and tests. Confirmed cases are composed of asymptomatic cases, symptomatic cases, and deaths.
2. Asymptomatic cases are cases of infection without symptom or symptoms. Symptomatic cases are cases with symptom or symptoms, and are composed of mild cases, moderate cases, and severe cases (including critical cases).
3. Case symptomatic rate (also stated as “morbidity rate” in some figures of this article) is the percentage of symptomatic cases in confirmed cases.
4. Case fatality rate is the percentage of deaths in confirmed cases, unless specifically stated.
5. Case severity rate is the ratio of severe cases, either in symptomatic cases or in confirmed cases in percentage. It is usually stated specifically as in symptomatic or in confirmed cases.

Converting of confirmed cases from asymptomatic to symptomatic might happen at any time. The daily numbers of such conversion were reported in some jurisdictions and nationwide, but not reported in other jurisdictions. The actual ratios of daily converting cases from asymptomatic to symptomatic reported in some jurisdictions and nationwide, which are shown in the section “Asymptomatic case conversion” of this study for estimation of impact to the related actual numbers or ratios in jurisdictions with conversion not reported, had been deducted by daily numbers of such conversion.

Main

China had been struggling with its largest COVID-19 outbreaks, driven by the SARS-CoV-2 Omicron BA.2 subvariant since 21 February 2022. The virus swept rapidly across 100 cities in 30 provinces of the country, causing a total of 738,944 people infected during the March Outbreaks till 14 May 2022⁽¹⁾, as shown in Figure 1.

Figure 1. Transmission chain of the largest outbreaks of COVID-19 in mainland China with display of the morbidity rates in major cities



The date ahead is the onset date of the outbreak in each city. The percentage in bracket is the final morbidity rate of the city to date. *indicates that morbidity rate is the actual percentage of symptomatic cases in the confirmed cases, with converted cases excluded. Percentage in red indicates the epidemic in the city has not ended yet.

China's "dynamic zero-COVID policy" had been working well and had successfully reached its goal of reducing to zero the number of each active chain of transmission, even during the period of the 5th wave driven by Omicron in the world⁽¹⁾, until the March outbreaks. The outbreaks in Shanghai were considered as a failure of "dynamic zero-COVID policy". The rapid epidemic expansion of the March outbreaks have plunged tens of millions of people into lockdown (Lewis, 2022) though all cities except Shenzhen did not implement the whole territory lockdown for one week. President Xi Jinping announced on 19th March 2022 that China would stick to its "dynamic zero-COVID policy". This policy now stands in contrast to a global trend towards easing restrictions and attempting to co-exist with the circulating virus (Lewis, 2022).

But pervasive doubts about the present policy arose reasonably across the world including China's own people. People were shocked by the fast climbing of the number of daily confirmed new cases as well as the extremely high percentage of asymptomatic cases, meaning the huge drop of the harmfulness of the virus in comparison with variants and subvariants before. Nationwide daily percentage of mild cases and severe cases were not openly published except Jilin Province. In Jilin, among all the confirmed cases, 99.56% were asymptomatic or mild, while 0.42% were moderate and 0.07% were severe or critical. The nationwide number of severe cases remained in hospital were from 50 to 75 from 23th March to 5rd April 2022 indicating a very low percentage of the severe cases too. The percentage of the remained severe cases in the remained symptomatic cases was 0.31% on 5rd April. Fatality rate was extremely low and 2 deaths were reported by Jilin on 18th March 2022, indicating case fatality rate of 0.0011%. The above-mentioned data told why people began to doubt about the present policy.

Facing such a low severity rate or fatality rate, why China still adheres to its "dynamic zero-COVID policy"? Although vaccines could not protect people from contracting the SARS-CoV-2 virus, but scientists said that full vaccination could protect against severe disease and death, with higher effectiveness among adults ≥ 60 years⁽¹⁾. There were sayings of low rates of full vaccination of elderly people in China, but that was not true. As press conferences of the Department of State reported, over 87% of the population was fully vaccinated by mid-February 2022. The full vaccination rate is 87.45% overall by 05 February and 87.77% by 14 March 2022. This rate of full vaccination is 88.01% in the overall population by 24 March 2022, with 84.36% or 222.72 million of those aged 60 and above. A total of 138.24 million (or 52.36% of) people over 60 years old received boost shots. China's 7th census published its population as 1.412 billion, among them 264 million or 18.70% aged 60 or above⁽¹⁾.

Thus we wished to know the reasons why China had been and would be adhering to its "dynamic zero-COVID policy". And our recent studies found some interesting results which we believe to have relations with the reasons, including the choice uniqueness, morbidity differences in different cities, unpredictability, worries of sudden impact to medical system, successful zero clearing in some of the main cities, and outstanding economy growth, etc.

Uniqueness of having a choice

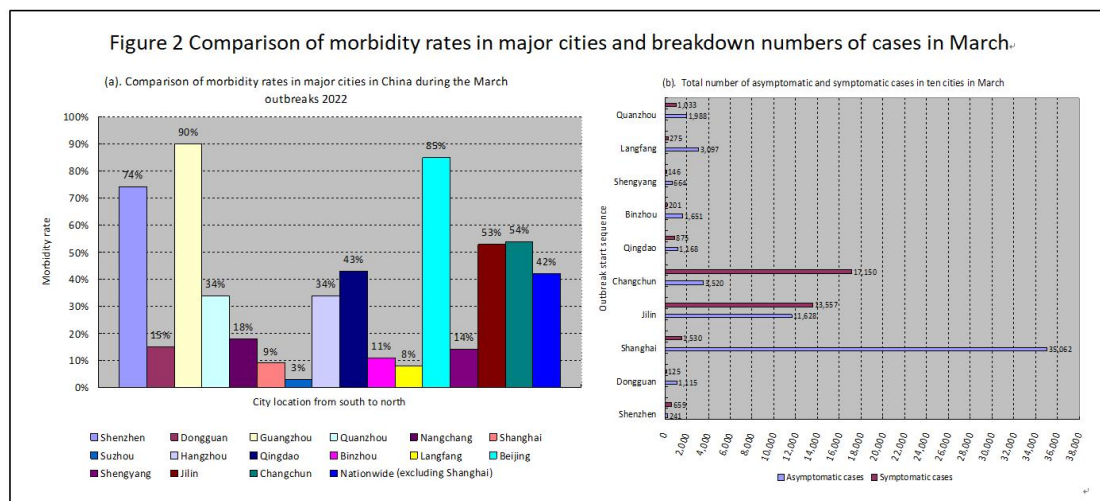
Before March, Hong Kong had just recorded the most critical epidemics of in February with close

to 900 cases of COVID-19 per 100,000 residents in Hong Kong, the highest level recorded anywhere in the world during the pandemic⁽²⁾. When its medical system was lashed breakdown by the epidemics, Hong Kong was unable to admit all COVID-19 patients who needed hospitalization. According to the press conference of HK SAR government, Hong Kong finally gave up mandatory PCR testing on 21st March 2022. It had no choice other than joining the global trend towards easing restrictions and attempting to co-exist with the circulating virus, at least in long period of time in the future.

But China still has a Choice other than joining the global trend. Basically, it is a common sense for people to make their best choice when they have some different choices. So does a country. China is the only large economy who had controlled all transmissions of the SARS-CoV-2 virus before 21 February 2022. 155,729, the number of people of infection from 1st March to 3rd April 2022, is a tiny portion of the population, specifically as 1/9,000, indicating that the past month is still a very early stage of the March outbreaks.

Case symptomatic rate and its unpredictability

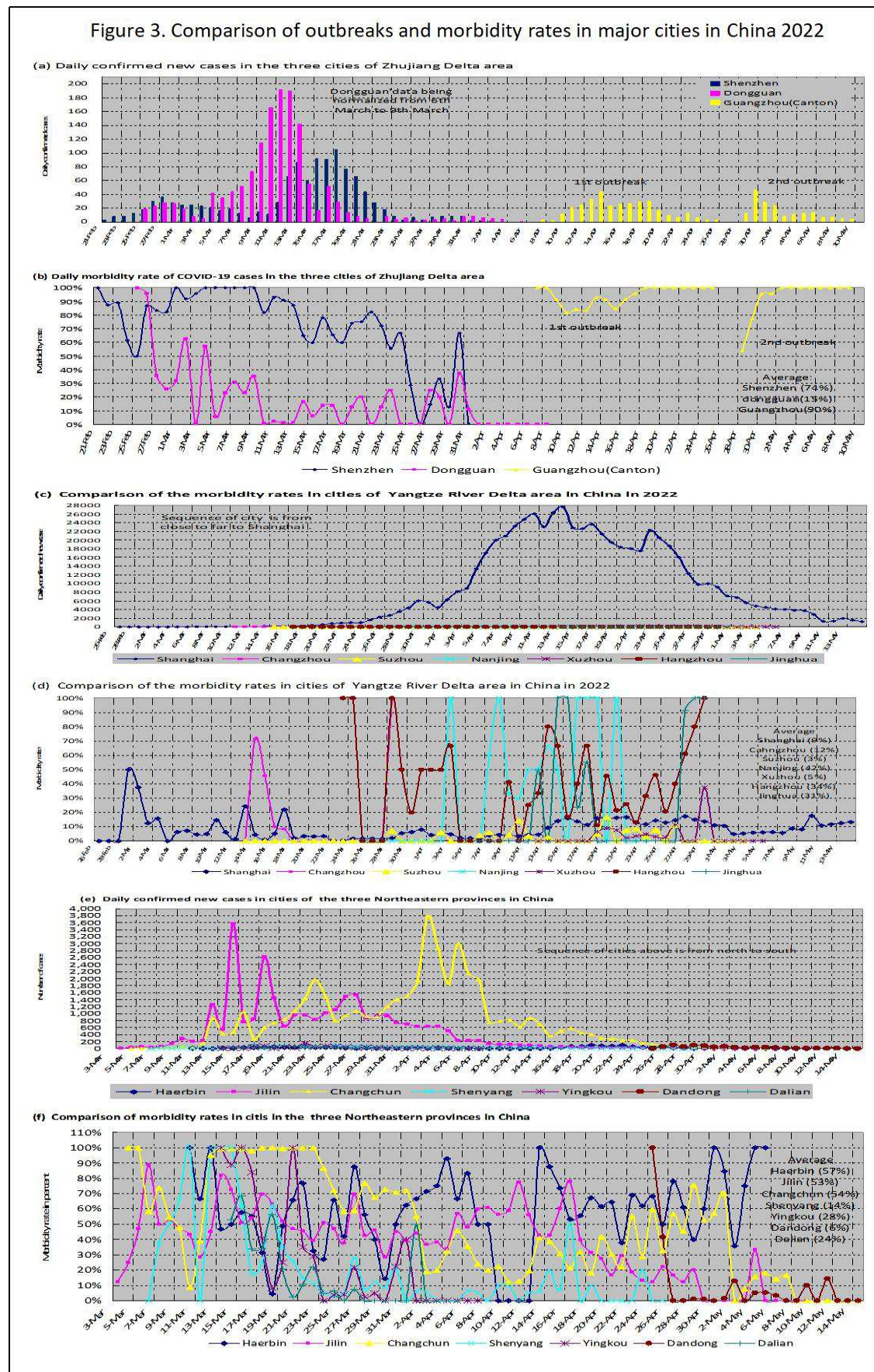
There existed cities thirty-fold differences in case symptomatic rates during the March outbreaks. Omicron BA.2 subvariant is unpredictable of neither its transmission nor its case symptomatic rate and its virulence 9th(3). There had been enormous differences in case symptomatic rates between the ten cities since the start of the March outbreaks. Their case symptomatic rates varied from 3% (in Suzhou) to 90% (in Guangzhou), with an average of 42% nationwide excluding Shanghai, as shown in Figure 2a.



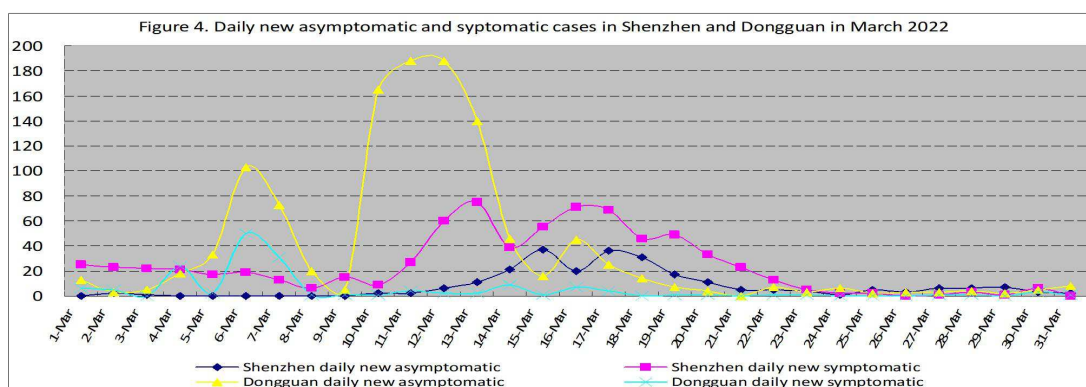
Such enormous differences of case symptomatic rates indicated difficulties in predicting the outcome of new outbreaks. Take Shanghai as an example, since the onset of the outbreak on February 26, rapid expansion of numbers of daily new confirmed cases appeared and daily cases reached over 20,000 within a period of 23 days, and a total of 90,352 people were infected in 34 days. The case symptomatic rates in Shanghai ranged from 8% to 0% in 29 of the 36 days. The up-to-date case symptomatic rate in Shanghai was 4% by 4 April 2022 and the final case

symptomatic rate in Shanghai was 9% by 14 May 2022 (Fig. 3(c)).

Figure 3. Comparison of outbreaks and morbidity rates in major cities in China 2022



The reason why there were such differences is unrelated to any of the factors contributing to incidence of infectious diseases known today. There are groups of cities to be compared for the features of the outbreaks because the cities of each group are close or very close with each other and are similar in climate, population density and characteristics, diet and living habits, religious background, educational background, medical resources, etc. The first group of similar cities are Shenzhen, Dongguan and Guangzhou in Zhujiang Delta area, which are three of the southernmost cities in mainland China. Shenzhen and Dongguan, both adjacent to Hong Kong, are also adjacent. Both of them are located on the eastern bank of the Zhujiang Delta, with a very high population density of 11 to 18 million people on approximately 960-770 square miles of land each^(3,4,5). Both being immigration cities (portion of domestic immigrants being 50% and above in the population), the average ages of their population are relatively young, Shenzhen at 32.5 years and Dongguan at 34 years on 1st November 2020^(4,5). Shenzhen and Dongguan have contradictory case symptomatic rates during the early stages of outbreaks, from 100% to 92% in Shenzhen and 63% to 0% in Dongguan. Dongguan’s trend of outbreaks doesn’t follow the trend of its neighbor Shenzhen and had two extraordinary surges of asymptomatic cases (Fig. 4, the yellow triangle line). The final average case symptomatic rates of Shenzhen, Dongguan, and Guangzhou (with late outbreaks of Shanghai origin) are obviously different too, as 74%, 15%, and 90% respectively (Fig. 1 and Fig. 3(b)).



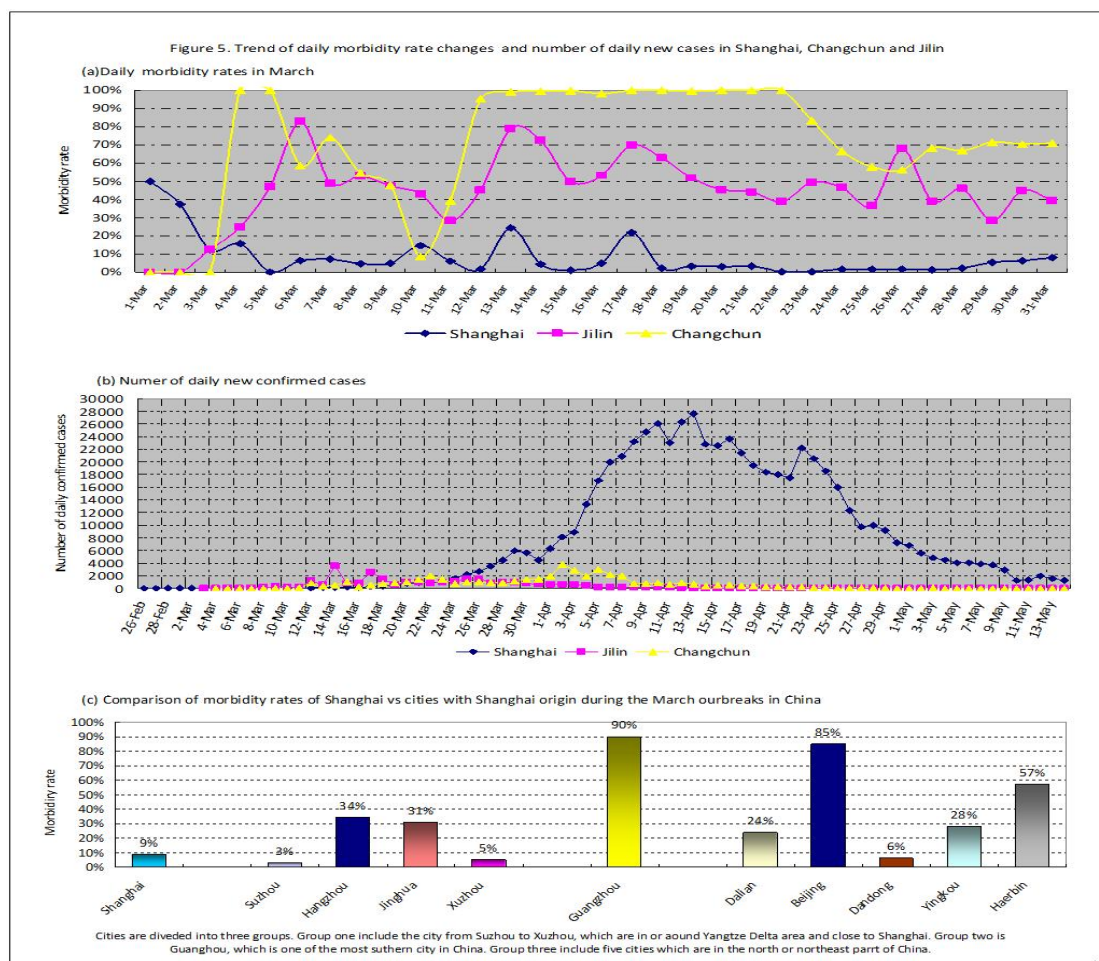
The second group of similar cities are Shanghai, Changzhou, Suzhou, Nanjing, Xuzhou, Hangzhou, and Jinghua (with location from close to far with Shanghai), which are the largest cities in or around the Yangtze River Delta area in eastern China. Among them, Suzhou and Shanghai are adjacent.

With origin from Hong Kong, Shanghai’s outbreaks had a relatively slow start with one or two cases daily from 26 February to 01 March 2022. Rapid expansion of numbers of daily confirmed new cases appeared after 13 March 2022, and the number reached nearly 6,000 per day within a period of 17 days (Fig. 3(c)). Daily new cases kept growing fast to 27,605 by 13 April 2022 and reached to a total of 619,259 confirmed cases on 14 May 2022. The outbreaks in the other six cities were all originated from Shanghai. By the end of the outbreaks (by 14 May 2022 for Shanghai), the final average case symptomatic rates in the second group of cities were 9%, 12%, 3%, 42%, 5%, 34%, and 31% respectively (Fig. 3(c) & 3(d)), showing major differences too.

The third group of similar cities are Haerbin, Jilin, Changchun, Shenyang, Yingkou, Dandong, and Dalian from north to south, which are the large cities in the three northeastern provinces in China, with Jilin and Changchun only 111 kilometers apart.

The outbreaks started in Jilin on 03 March 2022 with unknown sources of origin, though being later reported by local media as from South Korea. Changchun's outbreaks followed one day after Jilin. Changchun and Jilin were the most affected among the seven cities of the third group. The case symptomatic rates in Jilin and Changchun were also different from each other at the beginning, with Changchun's 85% (yellow line in Figure 3(f)) and Jilin's 50% pink line in Figure 3(f)). And their levels seemed steady in the early stage of outbreaks too. By the end of the outbreaks in these seven cities, the final average case symptomatic rates were 57%, 53%, 54%, 14%, 28%, 6%, and 24% in Haerbin, Jilin, Changchun, Shenyang, Yingkou, Dandong, and Dalian respectively (Fig. 3(e) & 3(f)), showing major differences too.

Shanghai, Changchun and Jilin were the most affected cities during the March outbreaks, with 619,259, 46,255 and 28,955 people infected respectively. Shanghai its peak on 13 April Jilin's number of daily new cases of Jilin, Changchun and Shanghai declined from its peak on 26 March, 2 April and 13 April of 2022 respectively (Fig. 5(b)). The case symptomatic rates of these three cities were apparently different too, either in March (Fig. 5(a)) or in their whole period of outbreaks (Fig.3).



The case symptomatic rates in the cities with the same origin (Shanghai origin) in the middle and late stages of the March outbreaks also varied much, with the highest of 90% in Guangzhou and the lowest of 3% in Suzhou (Fig. 1 & Fig. 5(c)). Cities were grouped together in close columns in Figure 5(c), by distances from Shanghai, for comparison. Such large differences of case symptomatic rates were not related to the locations of cities which are greatly different in distances from Shanghai, with some in the far north while some in the far south in China.

Omicron BA.2 transmission unpredictable

Case symptomatic rate of Omicron BA.2 in a specific area is unpredictable, nor its transmission. Chinese cities are more like isolated islands than those of other countries because of strict prevention measures. Omicron BA.2 subvariant seems to have developed a different pattern of virulence in these isolated cities of China. Among the ten mostly attacked cities in March, half of them have very low case symptomatic rate, including Shanghai (4%), Langfang (8%), Binzhou (10%), Dongguan (12%), and Shengyang (18%). On the other hand, these five cities have a very high percentage of asymptomatic cases, including Shanghai (96%), Langfang (92%), Binzhou (90%), Dongguan (88%) and Shengyang (82%) by the end of March. Additionally, two of the cities have high case symptomatic rates, including Shenzhen (75%) and Changchun (83%), by the end of March.

Omicron BA.2 subvariant seems to have developed a different pattern of transmission in these isolated cities of China too. Patterns of epidemic expansions in different cities are apparently different as shown in Figure 3(a), 3(c) and 3(e), Figure 4, and Figure 5(b), showing that the transmission is unpredictable.

Worries of sudden impact to medical system

The data in Jilin Province showed 0.49% of the confirmed cases needed hospitalization (following guidance of the national Diagnosis and Treatment Protocol for COVID-19 Patients)⁽⁶⁾, including 0.07% of severe or critical cases. The Chinese version of the national Diagnosis and Treatment Protocol for COVID-19 Patients (Tentative 9th Edition) was published on 19th March 2022, but not its English version. Symptomatic mild cases would not be treated in designated hospitals according to the protocol in “Chapter XI Treatment” of the 9th edition, which is different to the 8th Edition⁽⁷⁾.

According to the data published by press conferences of the government of China and Hong Kong Administrative Region, there were 6.4 hospital beds per 1,000 persons in China and 5.5 in Hong Kong. The medical system of Hong Kong was lashed breakdown by the outbreak of Omicron BA.2 in February. There would be no reason to be believed that China can avoid the breakdown of its medical system.

Scientists said the ratio of the critical patients in total number of the severe patients was as high as 35 to 50 in Jilin Province by the mid of May. Since there were only estimated basic reproduction number (R0) of Omicron BA.2 (which might be up to 10 as some scientists

indicted), the estimation of the need of hospital beds relied on the support of the sample survey in HK which indicated a minimum of 60% of the population to be infected in 50 days. According to such data and the data in this article, China might need 4,150,000 hospital beds in 50 days starting from the day of easing of restrictions, under the circumstances that Omicron BA.2 keeps steady in case symptomatic rate with the present trend stated in this study. And a total number of 620,800 patients might be severe or up, including 434,600 of critical patients, if nationwide outbreaks follow the trend in Jilin Province. It would definitely thump the medical system into breakdown.

Successful containment of outbreaks in main cities

Among the ten cities of rapid expansion during the March outbreaks, five of them had successfully contained the outbreaks and reduced to zero the number of daily new confirmed case by 4 April 2022, as shown in Figure 6, including Shenzhen, Dongguan, Qindao, Binzhou, and Langfang. Their successful experiences gave confidence to the nation as well as to other affected cities, such as Shanghai, Changchun and Jilin.

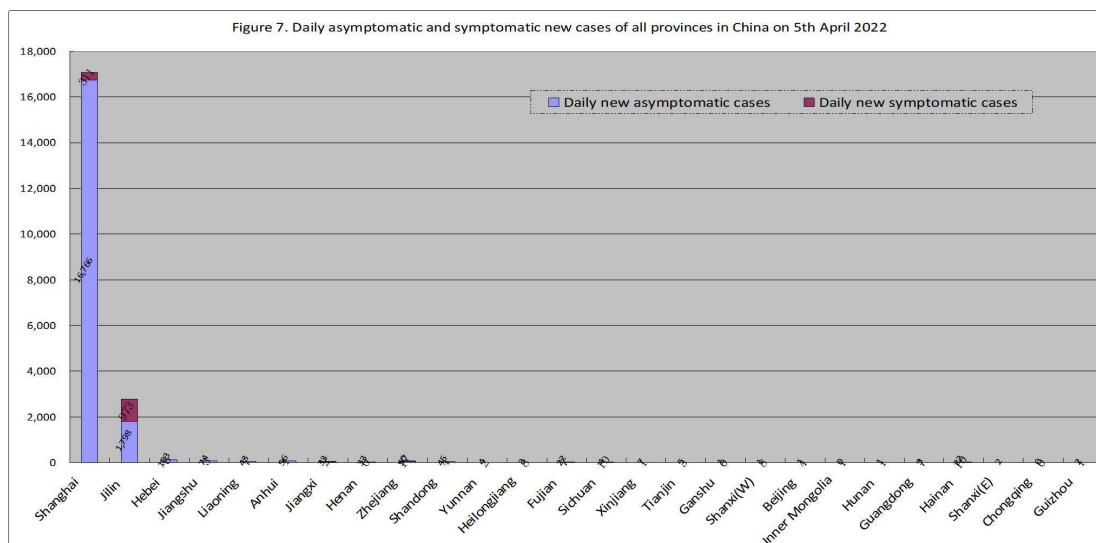
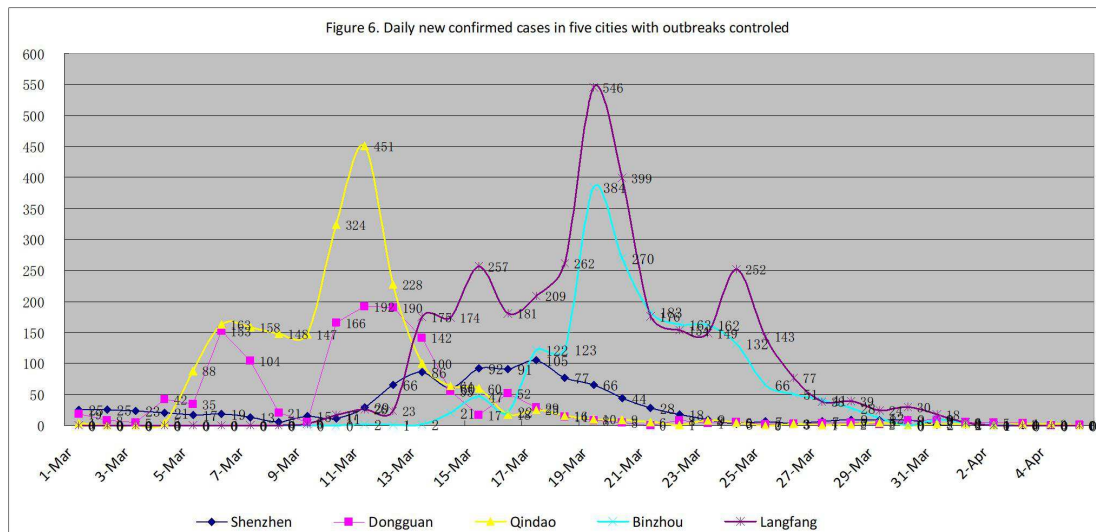


Figure 7 shows all the provinces (a total of 26) that had daily new cases on 4 April 2022. We can clearly see Shanghai and Jilin Province are the two provinces that had been mostly stressed in their battle with the outbreaks, with Shanghai reported 16,766 asymptomatic cases and 311 symptomatic cases whereas Jilin Province reported 1,798 and 973 accordingly, and no other provinces reported daily cases more than 109.

Outstanding economy growth

It's easy for people to get a conclusion that China's "dynamic zero-COVID policy" is tremendously costly. Such conclusion is lack of support by data. Data shows that the better a country minimized its COVID-19 epidemics, the better economy growth they could achieve. The GDP growth rate of USA in 2020 is -3.5% (in 2021, 5.7%) while that of China is 2.3% (in 2021, 7.9%)⁽⁸⁾. USA's CPI in 2020 is 4.8% (in 2021, 7%) while China's, 2.5% (in 2021, 0.9%), meaning a much higher inflation in USA.

In March, the Bureau of Statistics of China announced that China's economy recovered better than expectation in the first two months of 2022⁽⁹⁾. It seems that China does not see the reason why it should give up its "dynamic zero-COVID policy".

Calculation of economy lost

There could not be many people who did not agree that all provinces could contain their outbreaks except Shanghai and Jilin, since no province other than Shanghai and Jilin reported more than 109 confirmed cases on 4 April 2022, a situation which could be considered to be easy to contain the outbreaks.

The national portions of economy of Shanghai, Changchun and Jilin are 3.78%, 0.62% and 0.14% in 2021, according the data published by the press conference of the National Bureau of China. Suppose that the production in Shanghai, Changchun and Jilin are zero, based on a presumed calculation with the worst scenario of full lockdown of these three cities for twenty days, during the lockdown. And the economy loss of Shanghai, Changchun and Jilin will be 1.8 billion, 0.3 billion and 0.066 billion US dollars (at an exchange rate of 1 dollar to 6.4 RMB). The total loss of the three cities will be 130 billion dollars during their lockdowns, which is 0.07275% of China's GDP in 2021. Thus maximum national GDP loss may be 0.7275% directly caused by lockdowns of the three cities, based on an estimation of multiplier effect of ten times, which China thinks it can afford.

Limitation

Our study did not take political factors into consideration of the reasons why China has been adhering to its "dynamic zero-COVID policy", nor did we evaluate the national GDP loss including all lockdowns during the outbreaks in China in 2022.

Conclusion

The SARS-CoV-2 Omicron BA.2 subvariant can transmit rapidly even under the conditions of very strict mandatory measures. Its transmission and case symptomatic rate in a specific area are unpredictable. Enormous differences in case symptomatic rates may appear in different areas and may not be related to any of the influencing factors known. Fifty-eight percent of the confirmed cases are asymptomatic in China during the March outbreaks (bias free of Shanghai) in 2022, and the percentage of mild cases in symptomatic cases may be as high as 98.72%. China still has a choice better than the choice of co-existing with the SARS-CoV-2. The worries of the breakdown of the medical system, the successful experience of containment of outbreaks in some cities, and the outstanding economy achievements during COVID-19 Pandemic are also essential reasons why China has been and will be adhering to its “dynamic zero-COVID policy”. Although all know China will ease its prevention restrictions finally, China will definitely adhere to its “dynamic zero-COVID policy” for a long time before ending it.

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Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Cov2221Feb14MayforRS1.xls](#)