Should we keep hope? Key 8 weeks - Spatiotemporal epidemic characteristics of COVID-19 in Sichuan Province and its comparative analysis with other provinces in China and global epidemic trend

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Abstract
Background: To compare the epidemiological characteristics of Sichuan Province, other provinces in China and the world epidemic trends by analyzing the prevalence and length of epidemic time, in order to provide a basis for responding to imported cases abroad and to formulate prevention and control strategies in areas that are still rapidly circulating.

Methods: The number of confirmed cases, daily growth, incidence and the length of time from the first reported case to the end of local case (non-overseas imported cases) were compared by spatial and temporal (geographical, temporal) classification. Visualizing the development and changes of epidemic situation by layer through maps.

Results: In the first wave, total of 539 cases were reported in Sichuan Province, with the incidence rate of 0.6462 / 100,000. The closer to Hubei, the heavier the epidemic. The peak of Sichuan Province came earlier and the value was lower. Eight weeks after Wuhan lockdown, all became better. The longest epidemic length in city level of China was 53 days, median 23 days. It was released quickly in the 1st month, and accelerated in the 2ed month (three times of 1st month). Most countries outside China began to rise rapidly 4 weeks after their first case. Some European countries was earlier than USA. Germany, Spain, Italy, and China cost 28, 29, 34, and 18 days to reached the peak of daily increment, after their daily increase up to 20 cases. Countries in African Region and South-East Asia Region were at the early stage, in Eastern Mediterranean Region and Region of the Americas were at rapid growth phase, in European presented an inflection point or at a plateau period but falling slowly.

Conclusions: Adopting appropriate isolation and control measures is necessary to actively respond to the epidemic situation. If effective measures were implemented at the 8 key weeks, the peak value of the confirmed cases will be lower and decrease quickly. Some countries with improved epidemic situations also need to develop a continuous "local strategy at entry checkpoints" to respond to a possible second local epidemic.

Background
Faced with unknown infectious diseases, policy makers are always looking for the best point of prevention and control between underestimating and overestimating the risk. In December 2019,
there were reports of unexplained pneumonia infections in Wuhan, China.\textsuperscript{1} On December 31, experts from the Chinese Center for Disease Control and Prevention went to Wuhan to learn about the situation and collected samples from patients.\textsuperscript{2} On January 3, 2020, scientists from the National Institute for Disease Control and Prevention of Disease Control and Prevention identified the sequence of a new beta-type corona virus from specimens from patients in Wuhan and published it to the public. The study found that the patient was infected with a beta-type corona virus with genetic characteristics different from SARS-CoV and MERS-CoV, which was temporarily named the 2019 novel corona virus (2019-nCoV) and later renamed “severe acute respiratory syndrome corona virus 2 (SARS-CoV-2). The disease caused by it is called Corona virus disease (COVID-19).\textsuperscript{3,4} Subsequently, cases of COVID-19 have been reported in 31 provinces, Hong Kong, Macao, Taiwan, China and other countries. Facing the grim situation of the global outbreak, this study focuses on analyzing the overall epidemic characteristics of Sichuan Province, which is close to Wuhan in the east. This study also analyzed the overall epidemic characteristics of China, selected key time points for comparison, explored the epidemic epidemic law, and analyzed the global epidemic trend to provide the basis for China to cope with imported cases abroad and other countries to grasp the timing of prevention and control to formulate appropriate strategies.

Methods
To reflect the actual geographical distribution risk of confirmed cases in Sichuan Province, the current residential addresses of confirmed cases from the Sichuan COVID-19 Surveillance System were selected for distribution description. For comparison with neighboring provinces, the situation of confirmed cases reported by the National Health and Health Commission,\textsuperscript{5} Hubei Province,\textsuperscript{6} and other provinces Health and Health Commission, were analyzed using the address of reporting unit (usually hospital/ CDC). Data from various countries were from the WHO COVID-19 Daily Report published since January 21.\textsuperscript{7} The case number in China before that first Report and the first case information of Thailand, Japan, Republic of Korea, and USA mentioned in the previous Report of WHO referred to their national government websites.\textsuperscript{8-11} The population of various cities in Sichuan
Province, and the number of counties and districts of the cities were from the Statistical Yearbook of Sichuan Province.\textsuperscript{12}

The characteristics of cumulative confirmed cases, daily new cases, morbidity, etc. were compared based on temporal and spatial factors; the length of time from the first case report to the end of the local case (nonforeign imported case) (abbreviated as "epidemic length") was analyzed to explore the influencing factors of prevention and control of the outbreaks. Setting key analysis time and units based on key time points of policy and disease incubation periods. Drawing the epidemic maps of Sichuan and China in different times and spaces by SAS software (SAS studio https://welcome.oda.sas.com/). Directly visually display the development and changes of the epidemic situation and explore the epidemic law by layers. Confirmed cases scatter plot, column diagram as well as line diagram were also used to display the the time trend.

Results

Prevalence in Sichuan Province (non-foreign imported cases)

Geographical distribution Up to the March 4, Sichuan Province ended the increase in confirmed cases in the mainland (the first wave). Each city of Sichuan Province (in total 21) have reported the confirmed cases, with a total mainland case number of 539 and an incidence rate of 0.6462 / 100,000. Analysis of confirmed cases was based on their current address, with 48.33\% in urban and 51.67\% in rural areas. The top five cities with confirmed case numbers were Chengdu, Ganzi, Dazhou, Nanchong, and Guang'an. The top five incidencie cities were Ganzi Prefecture, Panzhihua, Guang'an City, Chengdu City, and Dazhou City (Table 1). The confirmed cases were distributed in 103 counties, accounting for 56.28\% of Sichuan Province. Among them, there were 3 cities (in total 21 cities) found cases reported in all their counties. Geographically, the regions with the higher number of cases and counties are located in the eastern part of Sichuan Province, which is directly adjacent to Chongqing and closer to Hubei Province. Although the number of confirmed cases in the eastern counties is relatively high, a small number of counties in the western part also have a high incidence (Table 1, Fig. 1, Fig. 2).
### Table 1: Number and incidence of COVID-19 in different cities of Sichuan Province

| City      | Population | Number of Counties | Confirmed case number | Rank of case number | Incidence /100,000 | Rank of incidence |
|-----------|------------|--------------------|-----------------------|---------------------|--------------------|-------------------|
| Cheng Du  | 1633       | 20                 | 144                   | 1                   | 0.8818             | 4                 |
| Gan Zi    | 119.6      | 18                 | 78                    | 2                   | 6.5217             | 1                 |
| Da Zhou   | 572        | 7                  | 42                    | 3                   | 0.7343             | 5                 |
| Nan Chong | 644        | 9                  | 39                    | 4                   | 0.6056             | 7                 |
| Guang An  | 324.1      | 6                  | 30                    | 5                   | 0.9256             | 3                 |
| Ba Zhong  | 332.2      | 5                  | 24                    | 6                   | 0.7225             | 6                 |
| Lu Zhou   | 432.4      | 7                  | 24                    | 6                   | 0.555              | 9                 |
| Nei Jiang | 369.9      | 5                  | 22                    | 8                   | 0.5948             | 8                 |
| Mian Yang | 485.7      | 9                  | 21                    | 9                   | 0.4324             | 12                |
| De Yang   | 354.5      | 6                  | 19                    | 10                  | 0.536              | 10                |
| Sui Ning  | 320.2      | 5                  | 17                    | 11                  | 0.5309             | 11                |
| Pan Zhi Hua | 123.6    | 5                  | 15                    | 12                  | 1.2136             | 2                 |
| Liang Shan| 490.8      | 17                 | 15                    | 13                  | 0.3056             | 15                |
| Yi Bin    | 455.6      | 10                 | 12                    | 14                  | 0.2634             | 17                |
| ZI Gong   | 292        | 6                  | 9                     | 15                  | 0.3082             | 14                |
| Mei Shan  | 298.4      | 6                  | 8                     | 16                  | 0.2681             | 16                |
| Ya An     | 154        | 8                  | 6                     | 17                  | 0.3896             | 13                |
| Guang Yuan| 266.7      | 7                  | 6                     | 17                  | 0.225              | 18                |
| ZI Yang   | 251.2      | 3                  | 4                     | 19                  | 0.1592             | 19                |
| Le Shan   | 326.7      | 11                 | 3                     | 20                  | 0.0918             | 21                |
| A Ba      | 94.4       | 13                 | 4                     | 21                  | 0.1059             | 20                |
| Subtotal  | 8341       | 183                | 539                   |                     | 0.6462             |                   |
| Overseas imported cases | 21      |                    |                       |                     |                    |                   |
| Imported case after Wuhan unsealed | 1 |                    |                       |                     |                    |                   |
| Total     |            | 561                |                       |                     |                    |                   |

*In Sichuan, up to March 4, a total of 21 cities has reported (covered all the city-level geographical unit), with a subtotal number of confirmed case 539, and a incidence 0.6432/100,000. The subtotal number was the first wave confirmed number. It did not contain 21 overseas imported cases reported from March 17 to April 6 and only one imported from Wuhan after Wuhan unsealed. Wuhan was unsealed on April 8 and this cases was reported on April 17. The 22 cases were discovered all in the observation period after they back to Chengdu and did not cause secondary transmission.*

**Time distribution** The time of the first confirmed case report in Sichuan Province was mainly concentrated in one week after Wuhan lockdown (January 24-January 31). At this stage, the current address of the first confirmed case was distributed in 70 counties, accounting for 68% of the counties (103) in Sichuan Province on March 4. The maximum number was the 3rd and 4th days after Wuhan lockdown (January 26–27). During the two days 28 counties (27%) reported their first case. The rapid increase in the confirmed number was concentrated in the four weeks after the closure of Wuhan (January 24-February 20), and the increase was particularly obvious in the first two weeks (Fig. 3).

Prevalence in neighboring provinces of Sichuan and other parts of the China

**Spatiotemporal distribution** On December 31, 2019, 27 cases were first reported on the official website of Hubei Province, all in Wuhan; on January 23, 2020, Hubei announced entered the Grade II response and Wuhan lockdown. Of the 835 cases reported nationwide (including 5 from Hong Kong, Macao, and Taiwan), 549 in Hubei (495 in Wuhan) and 267 in all provinces outside Hubei. A total of 15
cases in Sichuan Province were distributed in 7 cities (the first imported case was diagnosed on the January 21), ranking 9th in the China. The number of cases in Chongqing, adjacent in eastern of Sichuan, was the only neighboring province with more cases than Sichuan (cumulative cases 27). The epidemic situation in Yunnan, and Guizhou adjacent in the southern of Sichuan is relatively light.

Twenty-eight days later, on February 20, a total of 75,993 cases (including Hong Kong, Macao, and Taiwan, 102 cases, the total number of which were corrected based on Hubei's revision) were reported, of which 63,088 were in Hubei (45,346 in Wuhan). The revision was originally made by the Hubei Health and Medical Commission website on February 21), a total of 12,905 cases (including Hong Kong, Macao, and Taiwan) in provinces outside Hubei. 525 cases in Sichuan Province were distributed in all cities (21 cities), ranking 11th in China, next to Chongqing. Fourteen days later, on March 5, a total of 80,710 cases (including Hong Kong, Macao, and Taiwan, 158 cases) were reported nationwide, including 67,592 cases in Hubei (49,797 in Wuhan), and a total of 13,118 cases (including Hong Kong, Macau, and Taiwan) in provinces outside Hubei. A total of 539 cases in Sichuan were distributed in all cities (21 cities), ranking 11th in China. The number of new cases nationwide fell below one hundred the next day.

The concentrated outbreak time of confirmed cases was the first 4 weeks after the implementation of the lockdown measures (Fig. 4). From December 31, only reports were reported in Wuhan. Later on January 19 the first confirmed case was reported outside Wuhan (reported in Shenzhen of Guangdong province). In the first three weeks from December 31 to January 23 (Wuhan lockdown, 118 cities reported cases), the confirmed cases turned 31 times. In the next four weeks, 90% of the cities nationwide were covered, and the number of cases increased by 91 times compared with January 23. In the 5th to 6th weeks, the number of newly confirmed cases and the number of reported areas slowed down significantly, with an increase of only 0.06 times (63 cities except Wuhan increased in total 473 cases, and the average daily increase was 0.53 cases / city). In the 7th week (March 5-March 12), there was only a small increase of 62 cases in 10 cities of China except for Wuhan.

Distribution of the epidemic length in each region In the seventh week after the closure of Wuhan (on March 12), all cities of China except Wuhan, Taiwan, and Hong Kong have ended the growth of cases.
Based on statistics at the city level (according to the high population density of municipalities, the districts of municipalities were analyzed as a city unit), the length calculated by the information of occurrence and end of local cases in a total of 413 cities were used to analysis. The study shows that the largest date length from the first case confirmed to zero case in each city was 53 days, and an average and median length were 22 and 23 days, respectively. When the length was 21 days, the frequency of the cities was highest, approximately 26 Cities (6.3% in 413). Further analysis of the epidemic length at the county-level (regional unit) in Sichuan Province, included a total of 103 counties that had epidemics. The results showed that there was no local case increase after March 4. The largest date length from the first confirmed case to zero growth was 33 days, with a mean and median of 9 days. The highest city frequency of the date length was 1 day, approximately 31 cities (30% in 103) (Fig. 5). Taking the migration from Hubei during the two weeks before it lockdown as a possible high risk factor, this study compared the provinces of which the migration rank close to Sichuan Province and found the peak time in Sichuan Province was earlier and the peak value was lower (Fig. 6).

Global Situation During The Same Period
The earliest confirmed cases outside China were reported in Thailand on January 13 followed by Japan (January 15) and Republic of Korea (January 20), the USA (January 21), Singapore and Vietnam (January 23). On February 21, four weeks after the first reported case in Korea, the number of confirmed cases began to rise rapidly. In addition, Italy began to rise rapidly two weeks after the first case report and Iran increased quickly in the second week of the first case report. Furthermore, the USA (5 weeks after the first case) and other European countries such as Spain (3 weeks after the first case), France (5 weeks after the first case), Germany (4 weeks after the first case), and Switzerland (1 week after the first case) have begun to rise rapidly, and Many European countries slightly earlier than the USA into the rising period. The length of time from the first report to the period of rapid rise in different countries varied. Most of them entered the rapid growth phase were within 1 month (Fig. 7). The confirmed cases reported in USA increased sharply in the 8 to 9 week.

From the scatter plot of confirmed cases (top 10 countries), it was found that when the daily increase
exceeded 20–30 cases, most countries entered a obvious increase stage (Fig. 8). From the time point of the first daily increase of 20 cases, Germany, Spain, and Italy reached the peak of daily increment after 28, 29, 34 days, and the daily increment showed a downward trend. The average daily increment of 7-days rolling also showed an inflection point in Italy. France, UK, USA appeared a peak in 36 days, 32 days, and 44 days respectively. According to the regional division in WHO report, many countries in African Region and South-East Asia Region were closer to the equator with slow growth or at the early stage. In Eastern Mediterranean Region and Region of the Americas, most countries were at rapid growth phase, as well as Russian in European Region. Most european countries as well as USA presented an inflection point or at a plateau period in the 4th to 5th weeks but falling slowly. The curve of China dropped fast after the 5th week (Fig. 9). China reached the peak of the daily increment of the epidemic in 18 days if do not take into account the clinical diagnosis cases and cost 27 days if take into account (Hubei province in China reported clinical diagnosis on February 13–15, and was counted in the 28th COVID-19 Situation Report by WHO which was only applicable to Hubei province). China was dominated by the imported cases since the 8th weeks with the basically disappearance of local cases and the rapid rise of epidemics in other countries abroad (Fig. 10). The overseas imported cases were first reported in Ningxia Province of China on Feb 26 and were cumulative to 1610 on April 21, 21 of which was reported by Sichuan Province.

Discussion
The eastern region of Sichuan Province is adjacent to Chongqing, and Hubei provinces. Many counties there have reported cases, which is related to the fact that imported cases were the main cases in our province in the early stage. Combined with the "Baidu Migration Data" analysis, the national migration scale index on January 23 and before was slightly higher than that of the same period last year (January 24 was the Chinese New Year's Eve), but after January 25, the national migration scale index fell slightly until March 12, which was lower than the same time of last year. On January 23, the proportion of migrants in cities across China (the ratio of the population moved to a city to the total population moved into kinds of cities in whole country), the top 3 were Chongqin, Chengdu, and Zhoukou city. Twelve of 100 cities were in Sichuan Province, all of which are located in the eastern
part. Among them, Chengdu ranked first in the 26–30 days. The proportion of emigration place (the ratio of the emigration to a certain city to the total emigration of the whole country), 9 of the top 100 were in Sichuan Province, which were also located in the east. This result suggested that the population flow in eastern Sichuan was relatively large. In addition, the low incidence in western Sichuan was also associated with a lower population density in the western region than in the east. In a few of these areas the incidence was also high because of the an outbreak.16

The first reports of kinds of cities in Sichuan Province were concentrated in the first week after Wuhan closed. This reflected a rapid response and quarantine nature of Sichuan Province. The number of cases increased significantly in the first 2 weeks (14 days), which was in line with the average incubation period of 14 days.17,18 This suggested that the first two weeks after the occurrence of the first case was a critical stage for taking quarantine, prevention and control measures.

The spatiotemporal distribution of the country suggests that the virus spreads rapidly during the two incubation periods. The analysis of the length of the epidemic indicates that after China has adopted strong prevention and control measures, most regions can control the growth rate of the epidemic in approximately 3 weeks. The average and median of the epidemic length of county-level regional units are significantly lower than the epidemic length of city-state regional units. It is suggested that regional units of different levels can combine actual conditions to formulate prevention and control measures, duration of prevention and control, and resumption time. Especially for areas where there is no community outbreak in the local area, production can be resumed early to reduce economic losses. The doubling of cases in spatiotemporal distribution shows that under the Chinese national defense control model, the epidemic trend needs to go through two release stages. It was released rapidly in the first month after initiating prevention and control measures throughout China. The release was accelerated release in the second month and was three times that of the first month (approximately the regeneration index of COVID-19 reported in the recent research). It indicated that on March 12, the incidence of major countries in the world was still in the first stage, and from March 25, most countries entered the second stage of rising. After comparing and analyzing the morbidity,
we found that the length from the first case to the rapid rise of cases varies in different countries. Most countries entered the period of rapid growth after 4 weeks. The delayed entry of first confirmed cases in a few countries was related to the late launch of extensive testing. The effective control of the epidemic in China was also related to the reduction of direct contact of the money by using the mobile payment method. The popularity of foreign mobile payments was slightly lower than that in China, which increases the risk of prevention and control.

As COVID–19 is a major public health emergency that has occurred in China since the founding of the People's Republic of China. In the early stage of the epidemic, due to the insufficient capacity of hospitals to receive treatment and the failure of a few medical institutions to timely connect with the disease prevention and control information system, hospitals were in overload operation and medical staff were busy with treatment, which objectively resulted in the phenomena of late report, missed report and false report. On March 18, the newly confirmed was reported zero growth in Wuhan for the first time. Since then, the spread of the epidemic has been basically blocked, and the control of the passage from Wuhan to other city has been lifted, creating favorable conditions for the comprehensive and detailed verification and revision of the epidemic data. The revised types included reductions and additions. Among them, 217 cases were reduced after verification (some of the patients had been treated in different districts or in multiple hospitals, resulting in repeated card reporting); 542 cases were added (previous cases not reported in time due to late reporting and omission). The total confirmed cases number was revised from 50,008 to 50,333 in April 17 based on the principles of realism and transparency of data. Although this part of the newly confirmed number accounted for a small proportion (0.6%) of the total confirmed number in Wuhan, it was insufficient that this part of the revised number was not distributed to days by the reporting date, so this part of data was not included in the analysis in this study.

Conclusions
Combined with the history of the epidemic in China, it is suggested that if countries take effective and powerful measures the number of confirmed cases will increase rapidly in the recent month, which will inevitably challenge the medical resources and population health of countries. If no measures are
taken, it is difficult to estimate the number of infections and the overall economic losses caused. Combined with the severity and mortality rates, the health loss to the population is fatal.

In addition, with the period of entering into zero growth and gradual cure of local cases in China, high vigilance must be maintained. From February 26, 2020, the different provinces of China have begun to report imported cases abroad. With the change of epidemic situation in different countries and the different measures taken by governments, the import abroad of China has soared. A small number of overseas associated cases have appeared. In response, from March 28, 2020, entry of foreigners holding valid Chinese visas and residence permits will be suspended. Some countries with improved epidemic situations also need to quickly formulate a continuous "local strategy of entry checkpoints" in order to deal with the possible second wave of indigenous epidemics in the context of the global epidemic.

Abbreviations
COVID-19: Coronavirus disease; CDC: Centers for Disease Control and Prevention; Korea: Republic of Korea; MERS-CoV: Middle East Respiratory Syndrome Coronavirus; SARS-CoV: Severe acute respiratory syndrome coronavirus; SARS-CoV-2: severe acute respiratory syndrome coronavirus 2; UK: the United Kingdom; USA: the United States of America; WHO: World Health Organization; 2019-nCoV: 2019 novel coronavirus, a tentatively name of SARS-CoV-2

Declarations
Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Availability of data and materials
The city level COVID-19 confirmed cases number information of Sichuan were available from the Sichuan National Health and Health Commission website. The county level information of Sichuan were obtained by applying to the Surveillance System of Sichuan CDC. The confirmed cases number information of other provinces were available from the National and province level Health and Health Commission. Data of various countries were from the WHO COVID-19 Daily Report published since
January 21, which also contained the confirmed information of the different provinces in China before the date of March 15. The case number information before the WHO reports were available from kinds of national government websites. The confirmed number data in the WHO reports could also be downloaded in github website, collated as a public database continuously updated by Johns Hopkins University Center for Systems Science and Engineering. The population of Sichuan Province were available from the Statistical Yearbook of Sichuan Province.

Competing interests
The authors declare that they have no competing interests.

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Author Contributions
XX and BZ conceived of and designed the study. The data collection was arranged and carried out by XX, JZ, RL, YL, LZ, TD, YC and ZW. YZ, LF and CP provided support on interpretation of data. XX analyzed the data, used SAS software drawing the map and drafted the work. XZ, YD and XW provided substantive revision. All authors contributed to the manuscript preparation, read and approved the manuscript.

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References

1. Wuhan Municipal Health Commission. *Briefing on the pneumonia epidemic situation.* Dec 31, 2019. [http://wjw.wuhan.gov.cn/front/web/showDetail/2019123108989](http://wjw.wuhan.gov.cn/front/web/showDetail/2019123108989). Accessed 23 Jan 2020.

2. The 2019-nCoV Outbreak Joint Field Epidemiology Investigation Team

   The 2019-nCoV Outbreak Joint Field Epidemiology Investigation Team. Li Q. *Notes from the Field: An Outbreak of NCIP (2019-nCoV) Infection in China — Wuhan, Hubei Province, 2019 – 2020.* *China CDC Weekly*, 2020, 2020.

3. World health organization. *Naming the coronavirus disease (COVID-19) and the virus that causes it.* Jan 12, 2020. [https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it](https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it). Accessed 20 Jan 2020.

4. 10.1101/2020.02.07.937862

   Alexander EG, Susan CB, Ralph SB, et al. Severe acute respiratory syndrome-related coronavirus – The species and its viruses, a statement of the Coronavirus Study Group. *BioRxiv [Preprint]*. February 07, 2020. [https://doi.org/10.1101/2020.02.07.937862](https://doi.org/10.1101/2020.02.07.937862).

5. China National Health Commission. *Notification on the pneumonia epidemic situation (in Chinese).* [http://www.nhc.gov.cn/xcs/yqtb/list_gzbd.shtml](http://www.nhc.gov.cn/xcs/yqtb/list_gzbd.shtml). Accessed 23 April 2020.

6. Hubei province Health Commission. *Press statement by Hubei province Health Commission (in Chinese).* [http://wjw.hubei.gov.cn/bmdt/ztzl/fkxxgzbdrfyyq/xxfb/](http://wjw.hubei.gov.cn/bmdt/ztzl/fkxxgzbdrfyyq/xxfb/). Accessed 23 April 2020.
7. The world health organization. *Coronavirus disease (COVID-2019) situation reports.*
https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports.
Accessed 23 April 2020.

8. Thailand Ministry of Public Health situation. *Update on novel coronavirus (in Thai).*
https://ddc.moph.go.th/viralpneumonia/index.html. Accessed 23 Mar 2020.

9. Ministry of Health, Labour and Welfare J. *Press statement on novel coronavirus (in Japanese).*
https://www.mhlw.go.jp/stf/newpage_08906.html. Accessed 23 Mar 2020.

10. KCDC. *Press statement of novel coronavirus (in Korean).*
https://www.cdc.go.kr/board/board.es?mid=a20501000000&bid=0015&list_no=365794&act=view#. Accessed 23 Mar 2020.

11. Centers for Disease Control and Prevention. https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/cases-in-us.html. Accessed 23 April 2020.

12. Sichuan Provincial Bureau of Statistics. *Sichuan Investigation Team, National Bureau of Statistics. Statistical Yearbook of Sichuan, 2018.* China Statistics Press.
http://tjj.sc.gov.cn/index.shtml. Accessed 31 Mar 2020.

13. Hubei province Health Commission. *Press statement of 2019-Ncov (in Chinese).*
http://wjw.hubei.gov.cn/bmdt/ztzl/fkxxgzb/dgfyxxq/xfb/202001/t20200124_2014635.shtml.
Accessed 23 Jan 2020.

14. Hubei province Health Commission. *A letter to the people of Hubei province (in Chinese).*
http://wjw.hubei.gov.cn/fbjd/dtyw/202001/t20200123_2014580.shtml.
Accessed 24 Jan 2020.

15. Baidu migration data. http://qianxi.baidu.com/. Accessed 23 April 2020.

16. Sichuan province Health Commission. *The 16th Press statement of COVID-19 (in Chinese).*
http://wsjkw.sc.gov.cn/scwsjkw/zxft/2020/2/27/0189103808184147b6855bee6a3ac129.shtml
Accessed 23 April 2020.

17. China state Administration of Traditional Chinese Medicine. *Chinese Clinical Guidance for COVID-19 pneumonia diagnosis and treatment (7th edition) (in Chinese).*
http://www.nhc.gov.cn/yzygj/s7653p/202003/46c9294a7dfe4cef80dc7f5912eb1989.shtml.
Accessed 31 Mar 2020.

18. China Disease Prevention and Control Bureau. *Chinese Prevention and control Guidance for COVID-19 pneumonia (6th edition) (in Chinese).*
http://www.nhc.gov.cn/jkj/s3578/202003/d29e176f35ad4b0a80c74c1d347bfbc.shtml.
Accessed 31 Mar 2020.

19. Wuhan city Health Commission. Wuhan revised the number of covid-19 confirmed cases and death cases.
http://www.wh.gov.cn/sy/whyw/202004/t20200420_1032836.shtml. Accessed 23 April 2020.

20. Johns Hopkins University Center for Systems Science and Engineering. *Novel Coronavirus (COVID-19) Cases.* https://github.com/CSSEGISandData/COVID-19.
Accessed 23 April 2020.

Figures
City-level distribution of mainland confirmed cases in Sichuan Province (up to March 4) *Each city of Sichuan Province (in total 21) have reported the confirmed cases, with a total mainland case number of 539 and an incidence rate of 0.6462 / 100,000. SAS software was used to create the map (SAS studio on line, https://welcome.oda.sas.com/). Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.
County-level distribution of mainland confirmed cases in Sichuan Province (up to March 4)

*The confirmed cases were distributed in 103 counties, accounting for 56.28% of Sichuan Province. The regions with the higher number of cases and counties are located in the eastern part of Sichuan Province, which is directly adjacent to Chongqing and closer to Hubei Province. SAS software was used to create the map (SAS studio on line, https://welcome.oda.sas.com/). Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.
Figure 3

Time distribution of the number of confirmed cases and counties with first diagnosed cases in Sichuan Province (mainland cases) *The maximum number was the 3rd and 4th days after Wuhan lockdown. The rapid increase was particularly obvious in the first two weeks
Spatiotemporal distribution of the epidemic (comparison of key points, local cases) *The graph shows the number of cases in Wuhan on December 31; the case distribution in each city on January 23 (Wuhan lockdown), on February 20 (4th week after the closure of the Wuhan); and the increase number of cases from the 4th to 6th weeks and the 6th to 7th weeks, respectively after Wuhan lock down. SAS software was used to create the map (SAS studio on line, https://welcome.oda.sas.com/). Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.
Analysis of the epidemic length (local cases) in China and Sichuan. *Here zero growth excludes overseas imported cases as well as their associated cases, and very few cases who leave Wuhan after it was sealed on April 8. Briefly, the length calculated by the information of occurrence and end of local cases in the first wave.
The comparison of average daily increment between Sichuan and other 6 Provinces. *One unit of the abscissa was a week (7 days). It set the day when the first cases reported as the start point. During the two weeks before Hubei lockdown, the top destinations of Hubei's emigration population was Henan Province. Sichuan Province ranked 7th. Taking the migration from Hubei at this stage as a possible high risk factor, this chart selected the provinces that rank close to Sichuan Province (4 to 10) for comparison. The peak time in Sichuan Province was earlier and the peak was lower. The fluctuation after the 8th week of each province was mainly imported cases abroad.
Epidemic trends in major global countries. *The length of time from the first report to the period of rapid rise in different countries varied based on the difference of applicable conditions of nucleic acid detection and the national control strategies. The ordinate represented cumulative number of confirmed cases. The lower right curves indicated the countries with top 10 confirmed cases number worldwide on April 21. Most of them entered the rapid growth phase were within 1 month. The top left curves indicated the countries with top 10 population (except USA, China, Russian which are already in lower right). Most of them were starting to show a strong upward trend, which suggested a high risk in the next few weeks.
A scatter plot of confirmed cases. *The ordinate represented daily growth number of confirmed cases. The solid circles indicate the countries with top 10 confirmed cases number. The hollow circular indicate the countries with top 10 population. The solid circles suggested when the daily increase exceeded 20-30 cases, most countries entered a obvious increase stage.
The analysis of average daily increment of 7-days round in different countries and regions

*One unit of the abscissa was a week (7 days). It set the day when the new cases exceeded 20 as the start point. According to the regional division in WHO report, this figure selected the top 6~10 countries of each regions, of which the daily increase exceed 20, to show the trends of confirmed cases. Countries meeting this condition in South-East Asia Region and Western Pacific Region were just 6 and 8, both less than 10. The countries in part A and E
were closer to the equator with slow growth or at the early stage. In part B and D, most countries were at rapid growth phase, as well as Russian in part C. Most European countries in part C as well as USA in part D presented an inflection point or at a plateau period in the 4th to 5th weeks but falling slowly. The Germany, Spain, Italy, and China (A) cost 28, 29, 34, and 18 days to reached the peak of daily increment. China (B) cost 27 days as it contained an increase of clinical diagnosis published in the 5th weeks. The curve of China dropped fast after the 5th week. The two stars in the curve of China means the start of reporting imported cases abroad (from Feb 26) and the response of suspending entry of foreigners holding valid Chinese visas and residence permits (March 28). From the Feb 26 to April 21, China reported about 1610 imported cases abroad, about 3 times of Sichuan cumulative cases. All the new confirmed case number were up to April 21 in this Figure.
Global distribution of confirmed cases and source distribution of cases imported into China from abroad. With the basically disappearance of local cases in China and the rapid rise of epidemics in other countries abroad, a large number of cases abroad have been re-imported into China. The overseas imported cases were first reported in Ningxia Province of China on Feb 26 and were cumulative to 1610, imported from 48 overseas countries on April 21 and distributed in 19 Provinces of China. SAS software was used to create the map (SAS studio on line, https://welcome.oda.sas.com/). Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.