Quarantine At Home May Not Enough!-From the Epidemiological Data In Shaanxi Province of China

Lei Shi

The First Affiliated Hospital of Xi'an Jiaotong University

Qian Li

Centers for Disease Control and Prevention of Xi'an

Kang Li

The First Affiliated Hospital of Xi'an Jiaotong University

Jie Zheng

The First Affiliated Hospital of Xi'an Jiaotong University

Yingli He

The First Affiliated Hospital of Xi'an Jiaotong University

Xi Zhang

The First Affiliated Hospital of Xi'an Jiaotong University

Xianfeng Gong

Xi'an Chest Hospital

Wei Wang

The Central Hospital of Ankang

Qing Zhang

The Central Hospital of Hanzhong

Chao Dai

The Second People's Hospital of Hanzhong

Wenxuan Zhao

The Central Hospital of Xianyang

Xuefei Meng

The Central Hospital of Weinan

Feng Du

The Central Hospital of Baoji

Pei Fan

The People's Hospital of Tongchuan

Chunyan Li

The Second People's Hospital of Yanan

Chunyan Gao

The Central Hospital of Shangluo

Yuan Yang

The First Affiliated Hospital of Xi'an Jiaotong University

Xiaoqing Liu

The First Affiliated Hospital of Xi'an Jiaotong University

Yunru Chen

The First Affiliated Hospital of Xi'an Jiaotong University

Jinfeng Liu

The First Affiliated Hospital of Xi'an Jiaotong University

Jianzhou Li

The First Affiliated Hospital of Xi'an Jiaotong University

Nan Yang

The First Affiliated Hospital of Xi'an Jiaotong University

Yinghua Niu

The First Affiliated Hospital of Xi'an Jiaotong University

Hongmei Chen

The First Affiliated Hospital of Xi'an Jiaotong University

Guoyu Zhang

The First Affiliated Hospital of Xi'an Jiaotong University

Taotao Yan

The First Affiliated Hospital of Xi'an Jiaotong University

Li Zhu

The First Affiliated Hospital of Xi'an Jiaotong University

Qunying Han

The First Affiliated Hospital of Xi'an Jiaotong University

Wanhua Fan

The First Affiliated Hospital of Xi'an Jiaotong University

Feng Ye

The First Affiliated Hospital of Xi'an Jiaotong University

Zhengwen Liu

The First Affiliated Hospital of Xi'an Jiaotong University

Shumei Lin

The First Affiliated Hospital of Xi'an Jiaotong University

Yingren Zhao

The First Affiliated Hospital of Xi'an Jiaotong University

Tianyan Chen (✉ chentianyan@xjtufh.edu.cn)

The First Affiliated Hospital of Xi'an Jiaotong University

Research note

Keywords: SARS-CoV2, COVID-19, Epidemiological features, Family cluster

Posted Date: October 21st, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-47517/v2>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.
[Read Full License](#)

Version of Record: A version of this preprint was published at BMC Research Notes on November 4th, 2020. See the published version at <https://doi.org/10.1186/s13104-020-05342-5>.

Abstract

Objectives : A pneumonia associated with 2019 novel coronavirus (2019-nCoV, subsequently named SARS-CoV2) emerged worldwide since December, 2019. We aimed to describe the epidemiological characteristics of 2019 coronavirus disease (COVID-19) in Shaanxi province of China.

Results: 1. Among the 245 patients, 132 (53.9%) were males and 113 (46.1%) were females. The average age was 46.15 ± 16.43 years, ranging from 3 to 89 years. 2. For the clinical type, 1.63% (4/245) patients were mild type, 84.90% (208/245) were moderate type, 7.76% (19/245) were severe type, 5.31% (13/245) were critical type and only 0.41% (1/245) was asymptomatic. 3. Of the 245 patients, 116 (47.35%) were input case, 114 (46.53%) were non-input case, and 15 (6.12%) were unknown exposure. 4. 48.57% (119/245) cases were family cluster, involving 42 families. The most common pattern of COVID-19 family cluster was between husband and wife or between parents and children.

Introduction

Since late December 2019, a novel coronavirus disease, later named COVID-19 by World Health Organization (WHO), has emerged in Wuhan, China[1-3], and then spread to other provinces in China and the world. As of July 17, 2020, nearly 13,810,534 confirmed cases and 590,005 death cases have been reported in almost all countries and territories.

Wuhan city has been closed since January 23, 2020, in the following 2 days, the Chinese government mobilized all forces to stop the epidemic, including the suspension of public transport, subway, ferry and long-distance passenger transport, and the temporary closure of airports and trains. Shaanxi is located in the northwest of China, bordering Wuhan in the southeast, covering an area of 205800 square kilometers, with 10 cities and a permanent population of 38.64 million. It is very important to understand the epidemiological characteristics of COVID-19 transmission outside Wuhan for the effective control strategies.

During major infectious disease outbreaks, quarantine always be the necessary preventive measure, but experience about COVID-19 pandemic is limited. During the past several months, to slow down the spread of coronavirus, countries around the world have been implementing various measures, including "social distancing," "work at home," "quarantine at home," "centralized isolation," "lockdown" and so on. Most countries in COVID-19 take the measure of quarantine at home for diagnosed individuals, patients with severe symptom were then sent to hospital. Some countries take the measure of centralized isolation. In China, centralized isolation is adopted for all SARS-CoV-2 nucleic acid positive individuals. Quarantine at home can reduce the risk of community communication but increases the risk of transmission within the family [4]. Centralized isolation can reduce COVID-19 mortality and reduced the rate of growth in hospitalizations[5].

In this study, we described the epidemiological characteristics of COVID-19 cases in Shaanxi province of China. Totally, 245 cases were reported in 10 cities of Shaanxi from January 23, 2019 to February 22,

2020 in China. We hope to provide valuable information for the public health policy makers from COVID-19 outbreak area.

Methods

Patients

This is a retrospective study, all the patients admitted in Shaanxi province. Totally, 245 COVID-19 patients were enrolled in this study from January 23, 2020 to February 22, 2020. The diagnosis was confirmed by RT-PCR for nasopharyngeal swab nucleic acid.

Data source

Since January 23, 2020, the Centers for Disease Control and Prevention (CDC) of Shaanxi Province has started the COVID-19 investigation. De-identified data were extracted from the case report system of Health Commission of Shaanxi Province. The personally identifiable information of all subjects were removed to protect personal privacy. The clinical type were also double checked with the doctors from hospitals Which treat the COVID-19 patients in Shaanxi Province.

Variable information

The demographic characteristics, onset time, diagnosis time and hospitalization treatment institutions were collected. If the patient returned in 14 days before the onset of the disease from a place where there has COVID-19 outside Shaanxi, they were classified as input exposure. All COVID-19 patients are classified as mild, moderate, severe and critically cases at admission, according to COVID-19 guidelines (the sixth version) made by National Health Commission of the People's Republic of China. The clinical type was as follows:

Mild: Slight clinical symptoms, no pneumonia in imaging.

Moderate : Fever, respiratory tract and other symptoms, pneumonia in imaging.

Severe: Presenting any one of the followings:

- 1) Respiratory distress, respiratory rates ≥ 30 per minute;
- 2) Pulse oxygen saturation $\leq 93\%$ at rest;
- 3) Oxygenation Index (PaO_2/FiO_2) ≤ 300 mmHg.

Pulmonary imaging progressed more than 50% in 24-48 hours regard as severe case.

Critical: Presenting any one of the followings

- 1) Respiratory failure with invasive ventilation;

2) Signs of shock (circulatory failure)

3) Failure of any other organ failure with ICU care.

For the epidemiological curve, the date of onset is defined as the date when the case reports fever or cough in the epidemiological investigation. The date of diagnosis refers to the date when the coronavirus nucleic acid test was positive. All cases are confirmed by virus nucleic acid test results. Asymptomatic patients indicate the novel coronavirus nucleic acid test positive, but no fever, cough and pulmonary imaging changes. The onset date of asymptomatic patients was defined as the positive date of virus nucleic acid test in laboratory.

Statistical analysis

The continuous measurements of normal distribution were represented as means (standard deviations, SDs), the non-normal distributions were showed as median values (Interquartile ranges, IQR), and the categorical variables were represented as subject number (percentage). We used GraphPad Prism 8 and ArcGIS Online for data analysis.

Results

Gender and age distribution:

The gender and age distribution of confirmed cases in Shaanxi province is shown in Figure 1. Of the 245 patients 132 (53.9%) were males and 113 (46.1%) were females (Fig. 1A). The average age was between 46.15 ± 16.43 years, ranging from 3 to 89 years, the majority age is between 25-75 years old. Under 18, 18-24, 25-35, 36-45, 46-55, 56-65, 66-75 and over 75 years old accounted for 3.27% (8/245), 5.31% (13/245), 17.14% (42/245), 24.08% (59/245), 20.41% (50/245), 15.10% (37/245), 11.84% (29/245) and 2.86% (7/245) respectively (Fig. 1B). For the clinical type, mild type, moderate type, severe type and critical type accounted for 1.63% (4/245), 84.90% (208/245), 7.76% (19/245) and 5.31% (13/245). Only 0.41% (1/245) was asymptomatic (Fig. 1C).

Time distribution:

Of the 245 patients, 116 (47.35%) were input case, 114 (46.53%) were non-input case, and 15 (6.12%) were unknown exposure. The data showed that in the early stage of epidemic, the input cases were the main type, and the input and local cases coexisted from the 4th day, lasting for 2 weeks. During this period, the input cases decreased and the local cases increased gradually, the local cases were the main type from the 3rd week. From the 27th day (February 18), there was no new case for the first time (Fig. 2A).

According to the epidemic curve drawn by the onset date, the number of patients increased gradually from January 14, peaked on January 27, and then decreased gradually. The epidemic curve by the diagnosis date shows that the number of reported cases reached the first peak on January 27, and had

two single day high values on January 31 and February 5, then decreased slowly. There was no new cases for the first time on February 18 (Fig. 2B).

Geographical distribution by time:

Based on the retrospective analysis of the date and geographical location of the cases, the geographical distribution of coronavirus pneumonia in four different periods after the closure of Wuhan was observed in Shaanxi Province. Of all the cases, 1.22% (3/245) cases were before January 23, 2020 (Fig. 3A), accounting for 2/12 cities in Shaanxi. 41.22% (101/245) of cases occurred before February 1, 2020, accounting for 11/12 cities in Shaanxi (Fig. 3B). 89.39%(219/245) of cases occurred before February 11, 2020 (Fig. 3C) and all the cases occurred before 22 February 2020, accounting for all the cities in Shaanxi (12/12) (Fig. 3D). It shows that 10 days after the closure of Wuhan, the confirmed cases have been distributed in most cities in Shaanxi Province.

Cluster and Family cluster analysis:

The cluster refers to COVID-19 cases with a clear history of exposure in epidemiological history. The family cluster is defined as epidemiology found that there were ≥ 2 patients of COVID-19 in a family related in time and place. Of the 245 patients, there were 60.28% (149/245) cluster cases (Fig. S1A). The frequency of cluster occurs at 2 persons, 3 persons, 4 persons, 5 persons, more than 5 people were 20 times (40 people), 13 times (39 people), 7 times (28), 3 times (15 people) and 3 (27 people) (Fig. S1B and S1C). There were totally 42 family cluster events, involving 119 people, accounting for 48.57% (119 / 245) of the total number (Fig. S1D). The most common pattern of COVID-19 family cluster was between husband and wife or between parents and children (Fig. S1E and S1F). Some typical examples of family cluster are showed in Fig. S2.

Discussion

This is a descriptive study on epidemiology characteristics of the COVID-19. It presents the novel coronavirus pneumonia incidence in Shaanxi province within 1 month after the closure of Wuhan. Totally 245 cases were reported in Shaanxi, China. It needs to be explained that these situations have taken place under the strict prevention and control measures, indicating the control measures were effective in Shaanxi.

2019 novel coronavirus is the seventh known coronavirus that can infect humans. The other six coronavirus are HCoV-229E, HCoV-OC43, HCoV-NL63, HCoV-HKU1 and SARS-CoV[6], which cause severe acute respiratory syndrome[7], and MERS-CoV leading to Middle East respiratory syndrome[8]. SARS-CoV was first appeared in Guangdong, then spread to 24 provinces in China and 28 other countries in the world[9-11]. MERs-Cov was first identified in Saudi Arabia in 2012. Since 2012, MERS has spread to 27 countries in the world, including the Middle East, Asia and Europe[12]. We found that, like SARS and MERS, all the population were susceptible to 2019 novel coronavirus, but most of the patients showed moderate symptoms in COVID-19. This is consistent with the conclusions of other researchers[13, 14].

It is worth noting that of the 24 patients who were classified as mild type on the diagnosis date, 83.33% (20/24) have fever, cough and pulmonary imaging changes in the following hospitalization days. 17 cases among them were corrected to moderate type, 2 cases to severe type, and 1 case to critical type during the hospitalization. Of the 245 patients, only 0.41% (1/245) was asymptomatic. It is suggested that the symptoms or imaging examination on diagnosis day can't reflect the severity of the disease.

We retrospectively analyzed the novel coronavirus pneumonia incidence in Shaanxi province. January 23, 2020 was the first day to detect coronavirus nucleic acid in Shaanxi Province, and December 31, 2019 was the first day of symptoms in confirmed patient. Considering the first four patients with symptoms have returned after the onset in Wuhan (returned on 21 January, 14 January, 15 January, 19 January), and the first patient with symptoms in Shaanxi returned on January 7, he has onset on January 14 and has diagnosed on January 25. It is estimated that the first patient in Shaanxi Province appeared on January 7, 2020. It is worth noting that the peak time for symptoms was 19 days later.

Of the 245 patients, there are 42 family cluster events, accounting for 48.57% of the total number, indicating COVID-19 is easily transmitted among family members. We found that the most common pattern of COVID-19 family cluster was between husband and wife or between parents and children, showing close contact is the most important mode of transmission. This is consistent with other articles[15, 16]. Considering that there are many ways of transmission of the coronavirus, and viral nucleic acids have already been found in blood, urine, feces and conjunctival secretions and the respiratory tract[17, 18]. If suspected or mild patients quarantined at home, it may increase the risk of transmission in family. The government should consider centralized isolation when make the prevention and control measures, so as to minimize the risk of disease transmission.

Conclusion

In conclusion, we described and analyzed the epidemiological characteristics of 245 COVID-19 cases in Shaanxi province of China. The COVID-19 infection was of family clustering onset in Shaanxi, the suspected or mild patients may have the risk of spreading disease if they were quarantined at home. Although the majority of patients were moderate cases, strict centralized isolation had proven to be the most effective measure to control new cases. We hope to provide valuable reference information for the public health policy makers from novel coronavirus pneumonia outbreak area.

Limitation:

There are also several limitations in this study. First of all, the study was conducted in an area outside of Wuhan, with some regional restrictions, where the total number of cases was relatively small. Secondly, in the epidemiological investigation of the cases, there may be the problem of memory bias for symptoms and contact history.

Abbreviations

2019-nCoV: 2019 novel coronavirus; COVID-19: 2019 coronavirus disease; WHO: World Health Organization ; CDC: Centers for Disease Control and Prevention; SDs: Standard deviations; IQR: Interquartile ranges.

Declarations

Ethics approval and consent to participate

This study belongs to the data analysis of information related to outbreak treatment, which was reviewed and approved by the ethics review committee of Shaanxi Health Commission, with a waiver of informed consent.

Consent for publication

Not Applicable.

Availability of data and materials

The datasets analyzed in the current study will be available from the corresponding author upon reasonable request.

Competing Interests

All authors declare no competing interests.

Funding

This study was funded by the Key R & D plan of Shaanxi Province, China (number 2020ZDXM-SF-004). The funding body had no role in study design; collection, analysis, and interpretation of data; writing of the report; or the decision to submit the paper for publication.

Author's contributions

LS, QL, KL, FY, SML, ZWL, YRZ and TYC designed research; LS, QL, XFG, WW, QZ, CD, WXZ, XFM, FD, PF, CYL, CYG, YY, XJL, YRC, JFL, JZL, NY, YHN, HMC, GYZ, TTY, LZ, QYH, WHF performed research; LS, QL, KL, JZ, YLH, XZ, TYC analyzed data; and LS, QL, KL, JZ, YLH, XZ, TYC wrote the paper. All authors have read and approved the manuscript.

Acknowledgements

We thank all health care workers and show the greatest appreciation to all those involved in the epidemiological investigation, diagnosis and treatment of diseases for their valuable input in disease control.

References

1. Lu H, Stratton CW, Tang YW: **Outbreak of pneumonia of unknown etiology in Wuhan, China: The mystery and the miracle.** *Journal of medical virology* 2020, **92**(4):401-402.
2. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, Zhao X, Huang B, Shi W, Lu R *et al*: **A Novel Coronavirus from Patients with Pneumonia in China, 2019.** *N Engl J Med* 2020, **382**(8):727-733.
3. Sohrabi C, Alsafi Z, O'Neill N, Khan M, Kerwan A, Al-Jabir A, Iosifidis C, Agha R: **World Health Organization declares Global Emergency: A review of the 2019 Novel Coronavirus (COVID-19).** *International journal of surgery* 2020, **76**(4):71-76.
4. Sjodin H, Wilder-Smith A, Osman S, Farooq Z, Rocklov J: **Only strict quarantine measures can curb the coronavirus disease (COVID-19) outbreak in Italy, 2020.** *Eurosurveillance* 2020, **25**(13):7-12.
5. Lyu W, Wehby GL: **Shelter-In-Place Orders Reduced COVID-19 Mortality And Reduced The Rate Of Growth In Hospitalizations.** *Health Affair* 2020, **39**(9):1615-1623.
6. Su S, Wong G, Shi W, Liu J, Lai ACK, Zhou J, Liu W, Bi Y, Gao GF: **Epidemiology, Genetic Recombination, and Pathogenesis of Coronaviruses.** *Trends in microbiology* 2016, **24**(6):490-502.
7. Hu B, Zeng LP, Yang XL, Ge XY, Zhang W, Li B, Xie JZ, Shen XR, Zhang YZ, Wang N *et al*: **Discovery of a rich gene pool of bat SARS-related coronaviruses provides new insights into the origin of SARS coronavirus.** *PLoS pathogens* 2017, **13**(11):e1006698.
8. Zaki AM, van Boheemen S, Bestebroer TM, Osterhaus AD, Fouchier RA: **Isolation of a novel coronavirus from a man with pneumonia in Saudi Arabia.** *N Engl J Med* 2012, **367**(19):1814-1820.
9. Ksiazek TG, Erdman D, Goldsmith CS, Zaki SR, Peret T, Emery S, Tong S, Urbani C, Comer JA, Lim W *et al*: **A novel coronavirus associated with severe acute respiratory syndrome.** *N Engl J Med* 2003, **348**(20):1953-1966.
10. Zhong NS, Zheng BJ, Li YM, Poon, Xie ZH, Chan KH, Li PH, Tan SY, Chang Q, Xie JP *et al*: **Epidemiology and cause of severe acute respiratory syndrome (SARS) in Guangdong, People's Republic of China, in February, 2003.** *Lancet* 2003, **362**(9393):1353-1358.
11. Drosten C, Gunther S, Preiser W, van der Werf S, Brodt HR, Becker S, Rabenau H, Panning M, Kolesnikova L, Fouchier RA *et al*: **Identification of a novel coronavirus in patients with severe acute respiratory syndrome.** *N Engl J Med* 2003, **348**(20):1967-1976.
12. de Wit E, van Doremalen N, Falzarano D, Munster VJ: **SARS and MERS: recent insights into emerging coronaviruses.** *Nature reviews Microbiology* 2016, **14**(8):523-534.
13. Xu XW, Wu XX, Jiang XG, Xu KJ, Ying LJ, Ma CL, Li SB, Wang HY, Zhang S, Gao HN *et al*: **Clinical findings in a group of patients infected with the 2019 novel coronavirus (SARS-Cov-2) outside of Wuhan, China: retrospective case series.** *BMJ* 2020, **368**:m606.
14. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, Liu L, Shan H, Lei CL, Hui DSC *et al*: **Clinical Characteristics of Coronavirus Disease 2019 in China.** *N Engl J Med* 2020, **58**(4):711-712.
15. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, Wang B, Xiang H, Cheng Z, Xiong Y *et al*: **Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in**

Wuhan, China. *Jama* 2020;323(11):1061-1069.

16. Chan JF, Yuan S, Kok KH, To KK, Chu H, Yang J, Xing F, Liu J, Yip CC, Poon RW *et al*: **A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster.** *Lancet* 2020, **395**(10223):514-523.
17. Zhang J, Wang S, Xue Y: **Fecal specimen diagnosis 2019 Novel Coronavirus-Infected Pneumonia.** *Journal of medical virology* 2020;92(6):680-682.
18. Gao QY, Chen YX, Fang JY: **2019 novel coronavirus infection and gastrointestinal tract.** *Journal of digestive diseases* 2020;21(3):125-126.

Figures

Figure 1

Gender and age distribution of COVID-19 patients in Shaanxi, China. (A) Gender distribution. (B) Age distribution. (C) Clinical type.

Figure 2

Time distribution of COVID-19 in Shaanxi, China. (A) Input case, non-input case and unknown exposure by diagnosis date. (B) Number of cases by onset and diagnosis date.

Figure 3

Geographical distribution by time of COVID-19 patients in Shaanxi, China. (A) By January 23, 2020. (B) By February 1, 2020. (C) By February 11, 2020. (D) By February 22, 2020. Drawn by ArcGIS Online, <https://www.esri.com/zh-cn/arcgis/products/arcgis-online/>. 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.

Supplementary Files

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

- [FigureS1.jpg](#)
- [FigureS2.jpg](#)