Epidemiological Characteristics and Coping Strategies of COVID-19 in Shandong Province, China

Muye Ma

Weifang Medical University

Wenqiang Yin

Weifang Medical University

Gejin Wang

Zibo Vocational Institute

Dahai Yu

Affiliated Zibo First Hospital of Weifang Medical University

Jinqiang Ma (✉ majinqiang64@126.com)

Weifang Medical University <https://orcid.org/0000-0003-2330-2573>

Research article

Keywords: COVID-19, Shandong Province, Epidemiology, Coping strategies

Posted Date: November 19th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-76607/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background: The COVID-19 spread from Hubei Province to the whole country and even many countries in the world, which has greatly impacted the public health-economic and social development in China and the world. This study aims to investigate the epidemiological characteristics of COVID-19 in Shandong Province, analyze the incidence trends, and explore the coping strategies for providing the basis and reference for COVID-19 epidemic prevention and control.

Methods: Descriptive analysis was performed for epidemiological characteristics of confirmed COVID-19 cases from Jan. 21, 2020 to Feb. 15, 2020, in Shandong Province, and the spatiotemporal distribution of confirmed cases was drawn.

Results: As of Feb. 15, 2020, there were 537 confirmed cases in Shandong Province and the cumulative incidence was 0.53/100000. The daily number of new confirmed cases showed a trend of first increase and then decrease, and the increase rate of the cumulative confirmed cases showed a downward trend. The severe rate, critical rate, cured rate and fatality rate were 2.98%, 2.23%, 30.54%, and 0.37%. Confirmed cases were more Males than females, and the infected patients covered all age groups. The cumulative number of confirmed cases of the resident population in the province has gradually exceeded that of the population from other places to Shandong, and the number of patients who had a history of close contact with confirmed cases has significantly increased over time. Qingdao had the largest number of confirmed cases.

Conclusions: Our findings analyzed the early period of the epidemic in Shandong Province, which provide a novel insight for epidemic prevention and control.

Background

Since December 2019, cases of viral pneumonia of unknown causes were detected in Wuhan City, Hubei Province, China, and the virus was subsequently confirmed to be a new type of coronavirus that had never been found in humans before[1]. The virus began to spread from person to person in close contacts since December 2019[2, 3], and the National Health Commission included it in the National Category B Infectious Diseases and adopted prevention and control measures following Category A Infectious Diseases[4, 5]. The World Health Organization (WHO) officially identified the epidemic as a "Public Health Emergency of International Concern, PHE-IC" on January 31, and on February 11, 2020, the new coronavirus was named Coronavirus disease-2019 (COVID-19)[6].

The outbreak spread from Hubei Province to the whole country and even many countries in the world, which caused a major impact on public health, economic and social development in China and the world. Since the first confirmed case of COVID-19 pneumonia appeared in Shandong Province on January 21, a total of 537 cases were confirmed as of February 15. The situation was relatively severe and prevention and control measures needed to adapt.

In this article, we reviewed and analyzed the COVID-19 outbreak in Shandong Province, and we proposed emergency strategies and measures for the outbreak. the objective of the research is to provide a scientific basis and reference for the prevention and control of the COVID-19 outbreak.

Methods

Data source

The data of the COVID-19 epidemic in Shandong province was retrieved online, mainly from the Shandong Provincial Health Commission and the official websites of the Municipal Health Commissions; and the data from January 21, 2020, to February 15, 2020, was collected.

Diagnostic criteria and clinical types of COVID-19

The diagnostic criteria and clinical types(mild, moderate, severe and critical) of confirmed cases were based on the "Novel Coronavirus Pneumonia Diagnosis and Treatment Plan (Trial Sixth Edition)"[7] and the "Novel Coronavirus Pneumonia Prevention and Control Plan (Fifth Edition)"[8]issued by the China National Health Commission.

Variables

The COVID-19 epidemic, demographic data, mainly including the number of daily and cumulative confirmed cases, the number of severe and critical cases, the number of cured and fatality cases, the travel,residence and contact history and the gender, age of patients, et cetera were reviewed. The incidence rate was calculated based on the number of permanent residents in Shandong province according to the "Shandong Statistical Yearbook-2019"[9].

Data analysis

Descriptive analysis method was applied to analyze the overall situation of the epidemic in Shandong Province, to review the epidemiology of COVID-19 outbreak; the enumeration data were shown as the form of rate and composition ratio, and we calculated the incidence rate, chain growth rate and ratio of severe and critical patients, cured rate and fatality rate and others. We used Microsoft Excel 2016 to establish a database to analyze data and we used Python's Data Visualization Module Pyecharts and other tools to draw epidemic maps, and analyzed the temporal and spatial distribution of confirmed cases of COVID-19 in Shandong Province.

Results

Overview of the COVID-19 epidemic situation in Shandong

The first confirmed case of COVID-19 reported in Shandong Province on January 21, 2020. As of 24:00 on February 15, a total of 537 confirmed cases were reported. There were confirmed patients in all cities except Dongying City. Among them, Qingdao City (57 cases) and Jining City (51 cases) had the largest number of confirmed cases, followed by Jinan City (47 cases). The province's incidence rate was 0.53 per

100,000, and more than half of cities in Shandong the incidence rate higher than 0.53 per 100,000(Shandong average rate). The data is shown in Table 1.

Table 1
Number of confirmed cases and cumulative incidence of COVID-19 in various regions of Shandong Province

Regions	Number of confirmed cases	Cumulative incidence rate (1/100,000)
Shandong Province	537	0.53
Jinan City	47	0.53
Qingdao City	57	0.61
Zibo City	29	0.62
Zaozhuang City	24	0.61
Dongying City	0	0.00
Yantai City	46	0.65
Weifang City	43	0.46
Jining City	51	0.61
Tai'an City	32	0.57
Weihai City	38	1.34
Rizhao City	16	0.55
Binzhou City	14	0.36
Dezhou City	37	0.64
Liaocheng City	38	0.63
Linyi City City	47	0.44
Heze City	18	0.21

The growth trend of the confirmed COVID-19 cases in Shandong

Since the first confirmed case appeared in Shandong Province on January 21, the number of new confirmed cases per day was up to 45 on February 5, and gradually declined since then. According to the date, the number of confirmed cases in the last three days were 13, 11, and 7 respectively; the number of confirmed cases gradually increased over time, and the overall growth trend after February 10 was significantly slower than before(Fig. 1). Judging from the growth rate of the cumulative confirmed cases, there was a large fluctuation before January 27, and thereafter it had been in a downward trend(Fig. 2).

The statistics of confirmed cases base on category (Severe, critical, fatality, cured, etc.)

The cumulative number confirmed cases of severe symptoms had a gradual increase before February 8. The number of critical cases increased day by day since January 30, but the overall fluctuation was relatively small. After the first cured patients on January 30, the cumulative number of cured patients gradually increased, and the growth rate gradually increased over time. As of February 15th, Shandong Province had a total of 16 cases of severe illness and 12 cases of critical. The rates of severe and critical patients were 2.98% and 2.23% respectively; 164 cases were cured, and 2 cases died. The cured rate and fatality rates were 30.54% and 0.37% respectively. As Fig. 3 shows.

Epidemiological characteristics of the confirmed cases of COVID-19 in Shandong

Gender and age distribution of confirmed cases of COVID-19 in Shandong Province (Fig. 4): Among the confirmed cases, there were 299 male patients (55.68%) and 238 female patients (44.32%). The number of male cases was higher than that of female, and the male to female ratio was 1.26:1. From the perspective of age distribution, the oldest confirmed case was 91 years old, the youngest was only 9 months old, and the average age was 43 years old. There were confirmed patients in all age groups, and most of the patients were aged 30–59 years old; There were more females than males in patients who 60 years old and above, and more males than females who under 60 years old.

The trend of confirmed cases of permanent population in Shandong and population came to Shandong from other places (Fig. 5): According to the population information of confirmed patients provided by the official website of the Shandong Provincial Health Commission, from January 21 to February 1, the number of confirmed cases of population to Shandong from other places was higher than the confirmed cases of permanent population. On February 2, the number was the same. From February 3 to February 15, the cumulative number of confirmed cases in the province's permanent population exceeded the number of confirmed cases of population came to Shandong. Moreover, the gap between the two was gradually increasing, showing that the cumulative number of cases in this province had a significant upward trend, and the number of confirmed cases in the population to Shandong from other places tended to be flat.

Contact, travel and residence history of confirmed cases of COVID-19 in Shandong Province (Fig. 6): From January 21 to February 6, the cumulative number of confirmed cases with a history of contact in Hubei or with a history of travel or residence in provinces other than Shandong and Hubei was higher than that of confirmed cases from January 21 to February 6, and the latter only took two days to achieve a surpass in number, and the gap gradually widened from February 8 to February 15. Although the cumulative number of confirmed cases with a history of contact in Hubei or provinces other than Shandong was increasing, the growth rate had gradually slowed since February 8.

Temporal and spatial distribution of confirmed cases

Qingdao City reported the first confirmed case of COVID-19 on January 21 (Fig. 7a), and then cases in other cities were confirmed; on January 24, More than half of the cities in Shandong had confirmed cases (Fig. 7b); as of January 27, except for Dongying City, Shandong Province had confirmed cases in all cities (Fig. 7c); on February 5, the number of cases in Shandong reached a peak (45 cases, Fig. 7d), and the

daily increase in the number of confirmed cases had slowed since February 10 (Fig. 7e); by February 15, The 6 cities Jinan, Qingdao, Yantai, Weifang, Jining Linyi had more confirmed cases, with more than 40 cases (Fig. 7f).

Discussion

The first confirmed patient with COVID-19 in Shandong Province was a 37-year-old male from Wuhan who worked in Rizhao City. He was treated in Rizhao and Qingdao due to fever and other symptoms. He had lived in Wuhan within two weeks before and he was admitted to the hospital for isolation and treatments. On January 21, the expert group evaluated and confirmed that he had infected COVID-19. At the same time, the Shandong Novel Coronavirus Leading Group immediately arranged epidemic prevention and control works and emphasized the on-duty requirements of key positions, and strictly implemented the "daily report, zero reports" rules. Since then, in the face of the gradual increase in the number of confirmed cases per day, Shandong Province launched a Level I response to major public health emergencies on January 24[10] to mobilize the entire province to curb the spread of the virus. Over time, the number of daily confirmed cases in Shandong Province increased to the highest on February 5 and then showed a downward trend. The growth rate of the cumulative confirmed cases fluctuated before January 27, but gradually declined from January 28. The stabilization indicates that the incidence of pneumonia caused by the COVID-19 in Shandong Province had slowed down and that the series of prevention and control measures implemented in Shandong Province were effective.

From the above studies, as of February 15th, most of the patients diagnosed with COVID-19 in Shandong Province were mild or moderate. Severe rate is 2.98%, and the fatality rate was 0.37%, which was lower than the number of confirmed cases in Chongqing Province which was 537 Cases in that time[11]; the critical rate was 2.23%, which was lower than that of Shanxi Province[12]; the cured rate was 30.54%, which was higher than the cured rate in Chongqing and Shanxi Province. This might be related to the actual conditions faced by different provinces and cities, and to a certain extent indicated that the diagnosis and treatment measures in Shandong Province were effective.

The results of this study show that there were more males than females in the confirmed cases, and the male-to-female ratio was 1.26:1, which similar to the findings of Ou Jianming et al.[13] and slightly higher than the research results of COVID-19 Emergency of the Chinese Center for Disease Control and Prevention and Response Mechanism Epidemiology Group[14]. Compared with women, men are more mobile and have a wider social network and groups. In the passenger and cargo transportation, logistics, express delivery, and other industries, the number of men employed is significantly higher than that of women, so men are more susceptible to infection. In the age distribution, the oldest confirmed case was 91 years old and the youngest was only 9 months. There were infected persons in all age groups, indicating that the virus was generally susceptible to infect all age groups[15]. The age of the patients was concentrated in the range of 30–59 years old; most were middle-aged and young people. It may be that this age group is active, socially extensive, and contacts with many people, which may increase the risk of infection. This study also finds that there were more female patients whom more than 60 years of

age, and more male patients under 60 years old than female patients, which may be related to differences in male and female physiological characteristics.

Judging from the travel, residence and contact history of confirmed cases, the cumulative number of confirmed cases with a history of travel, residence in other places rather than Shandong and Hubei before February 6 was higher than the cumulative number of confirmed cases with a history of contact in Hubei and a history of close contact with confirmed cases. This was mainly because of the initial outbreak of the epidemic coincided with the Spring Festival. Factors such as the flow of people, vacations, and the increase of the migrant population in a short period provided favorable conditions for the further spread of the epidemic. Studies show that the development of the COVID-19 epidemic or pandemic was related to the level of population mobility[16]. Frequent population mobility was extremely conducive to the spread of infectious diseases. After that, the number of patients with a history of close contact with the confirmed case increased rapidly and quickly exceeded the number of cases with a history of living or travel in other places rather than Shandong and Hubei, and a history of contact in Hubei in a short time, indicating that the local epidemic spread rapidly through contact, which gave rise to what Academician Zhong Nanshan said "super spreaders" and second-generation cases[17]. By reviewing the case data, it is known that Zhang XX from Weifang, Shandong[18] and Tian XX from Heze, Shandong[19] deliberately concealed their travel, illness, and close contact history, resulting in a total of more than 100 people being isolated and causing a local epidemic and the disease spread rapidly and multiple infections. After February 10, the cumulative number of confirmed cases with a history of travel or residence in other places rather than Shandong and Hubei, a history of contact in Hubei, and a history of close contact with confirmed cases had slowed down, which further illustrated that Shandong Province initiating the highest-level response to detect and control the infection in the first time was effective. Measures such as blocking possible transmission channels and protecting susceptible populations had effectively curbed the spread of the epidemic.

The Temporal and spatial distribution map of confirmed cases of COVID-19 in Shandong Province shows that during the epidemic, the first confirmed patient was confirmed in Qingdao, and as of February 15, the city had the highest number of cases in Shandong. As an open coastal city and an economically developed city in northern China, Qingdao was affected by factors such as climate, geography, economy and social culture and dense population and developed transportation, coupled with a large flow of population, were extremely conducive to the spread of the virus.

There were no confirmed patients in Dongying City. The reason was not only that the government and relevant departments took timely and early measures to curb the spread of the epidemic in Dongying, but it might also be due to other factors of Dongying City. For example, comparing with densely populated areas with convenient transportation, Dongying City had a low population density, underdeveloped railway and air transportation, and high per capita GDP and fewer migrant workers, making it less likely to have close contact with people from Hubei. From the perspective of the national epidemic situation, Tibet, Qinghai, and other western regions in China; there were sparsely populated areas and relatively underdeveloped transportation had fewer confirmed cases. The characteristics of the epidemic in

Dongying were also consistent with some of the characteristics of the national epidemic distribution. Therefore, taking targeted joint prevention and control measures according to the characteristics of the area is an effective means to reduce the incidence the outbreak.

Although the research results show that the incidence of COVID-19 in Shandong Province has slowed down, it is also facing pressure from resuming work, resuming production, and returning to school. Besides, the global pandemic situation is severe and the vaccine is still in the experimental stage[20], COVID-19 prevention and control still cannot be relaxed. Therefore, based on the epidemiological characteristics of the COVID-19 and the latest developments and changes of the epidemic or pandemic, the future response strategies for prevention and control are given as follow:

First and foremost, construct a multi-level public security intelligent monitoring, early warning, and control system. Further expand the monitoring network, improve big data analysis technology, enhance early monitoring and early warning capabilities, and realize real-time intelligent epidemic warning[21–23]. Improve the real-time query system for epidemic risk levels and comprehensively promote the use of health passcodes (or health virtual pass cards) across the country to further accurately identify people form high, medium, and low-risk areas. The construction of monitoring, early warning, and control system for diseases of unknown origin and emerging infectious diseases should be established.

Moreover, scientifically and rationally allocate and utilize existing medical and health resources, and improve the joint prevention and control work mechanism. For large general hospitals and infectious disease hospitals, training bases for epidemic prevention and control should be established; emergency management departments, disease control departments, lower-level hospitals, and primary health institutions need work together to conduct regular epidemic prevention and control-related training and drills to strengthen and improve multi-departmental collaboration and upper-lower level linkage mechanisms. For county-level general hospitals, independent infectious disease departments should be set up, and existing outpatient clinics and wards should have the ability to be transformed base on the combining peace and war principles, and should equip with negative pressure wards, and negative pressure ambulances to ensure that if an outbreak occurs, it can be reached quickly for emergency treatment of critically ill patients. For primary health institutions such as village clinics and community health service centers (stations), efforts should be made to build fever screening sentinels to enable them to have early screening capabilities, give full play to the role of sentinel surveillance against the epidemic or pandemic, and preliminary screening, identification, treatments, and referral of fever patients are effectively carried out to effectively "early detect and report" the outbreak, which is more conducive to the epidemic prevention and control. For centers for disease control (CDC), it is necessary to establish a certain scale of epidemiological investigation teams in each county and district, and increase investment in efforts to laboratory construction, and support to do more scientific researches to accelerate vaccine research and development[24].

Besides, effectively carry out the epidemic investigation, prevention and control of the flow of population, implement strict entry-exit inspection and quarantine measures, continue to implement travel registration

and body temperature testing systems. It is necessary to continue to strengthen the disinfection and ventilation of public places, adopt flexible working hours to reduce the number of people gathering. [25].

Last but not the least, attach importance to social mobilization, strengthen health education, communication, increase the public's initiative and motivation for epidemic prevention and anti-epidemic, and encourage the public to take the initiative to pay attention to infectious diseases and epidemic-related information and report the epidemic to relevant professional agencies in time. Governments and relevant professional institutions should incorporate the social risk early warning force of major epidemics into the formal public opinion monitoring and release system so as to timely verify and scientifically screen the information. It is necessary for us to continue to strengthen the breadth and depth of health education[26], increase public awareness of the COVID-19. Carry out online health education and consulting services to enhance the public's protection awareness[27].

Conclusions

In short, our findings analyzed the early period of the epidemic in Shandong Province, which provide a novel insight for epidemic prevention and control. At present, the global epidemic situation is still severe, but vaccines have not yet been put into use in large quantities. Therefore, finding the coping strategies for epidemic prevention and control is still the top priority of all future tasks.

Abbreviations

COVID-19: Coronavirus disease-2019; WHO: World Health Organization; GDP: Gross Domestic Product; CDC: Centers for Disease Control

Declarations

Acknowledgements

Not applicable.

Authors' contributions

MM and GW designed the study and collated the data. MM analyzed epidemiologic data and wrote the manuscript. DY and WY improved data interpretation and revised the manuscript. WY and JM critically reviewed and improved the manuscript. All authors substantially contributed to the study and approved its submission.

Funding

This study receives no funding or financial support.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was approved by Weifang Medical University, Affiliated Zibo First Hospital of Weifang Medical University and Zibo Vocational Institute. Because of the urgent need to collect data on this emerging infectious disease, the requirement for written informed consent was waived. The oral informed consent was obtained from each participant and this form of consent was confirmed.

Consent for publication

Not applicable.

Competing interests

All authors declare that there is no competing interests.

Author details

¹Weifang Medical University, Weifang 261053, China. ²Zibo Vocational Institute, Zibo 255314, China.

³Affiliated Zibo First Hospital of Weifang Medical University, Zibo 255200, China

References

1. Li Q, GUAN X, WU P, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected. *N Engl J Med*, 2020; (2020-01-29). DOI: 10.1056/NEJMoa2001316. [Epub ahead of print].
2. Wang C, Hornby PW, Hayden FG, et al. A novel coronavirus outbreak of global health concern. *Lancet*, 2020; (2020-01-24). DOI: 10.1016/S0140-6736(20)30185-9. [Epub ahead of print].
3. Paules CI, Marston HD, Fauci AS. Coronavirus infection—more than just the common cold. *JAMA*, 2020; (2020-01-23). DOI: 10.1001/jama.2020.0757. [Epub ahead of print].
4. Central People's Government of the People's Republic of China. Announcement of National Health Commission of the People's Republic of China (Health Commission [2020] No.1). [EB/OL] [2020-01-21]. http://www.gov.cn/xinwen/2020-01/21/content_5471158.htm.
5. Gostic K, Gomez ACR, Mumma RO, et al. Estimated effectiveness of symptom and risk screening to prevent the spread of COVID-19. *eLife*, 2020; (2020-03-06). DOI: 10.7554/eLife.55570. [Epub ahead of print].
6. Xinhua net. WHO named the novel coronavirus pneumonia as "Covid-19". [EB/OL]. [2020-02-11]. http://www.xinhuanet.com//2020-02/11/c_1125561343.html.
7. General Office of National Health Commission, General Office of National Administration of Traditional Chinese Medicine. Diagnostic and treatment protocol for Novel Coronavirus Pneumonia

- (trialversion 6). [EB/OL]. [2020-02-19]. <http://www.nhc.gov.cn/xcs/zhengcwj/202002/8334a8326dd94d329df351d7da8aefc2.shtml>.
8. General Office of National Health Commission. Prevention and control protocol for Novel Coronavirus Pneumonia (version 5). [EB/OL]. [2020-02-21]. <http://www.nhc.gov.cn/xcs/zhengcwj/202002/a5d6f7b8c48c451c87dba14889b30147.shtml>.
 9. Shandong Provincial Bureau of Statistics. Shandong Statistical Yearbook—2019. [EB/OL]. [2019-12-27]. <http://tjj.shandong.gov.cn/tjnj/nj2019/indexch.htm>.
 10. Health Commission of Shandong Province. Shandong launches level I response to major public health emergencies. [EB/OL]. [2020-01-26]. http://wsjkw.shandong.gov.cn/ztlz/rdzt/qlzhfkgz/fkdt/202001/t20200126_2511853.html.
 11. Yang YQ, Sun Q, Wang YX, et al. The epidemic analysis and trend prediction of NCP in Chongqing. *Journal of Chongqing Normal University(Natural Science)*, 2020;37(1). (2020-02-18). <http://kns.cnki.net/kcms/detail/50.1165.n.20200218.0746.002.html>. [Epub ahead of print].
 12. Li SH, Shang LP, Yuan LR, et al. Epidemiological analysis of COVID-19 in Shanxi Province. *Chinese Journal of Nosocomiology*. 2020;30(8):1157–61.
 13. Ou JM, Ye WJ, Zheng KC, et al. Epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in FuJian, China. *Chinese Journal of Zoonoses*, 2020; (2020-03-02). DOI: 10.3969/j.issn.1002-2694.2020.00.029. <http://kns.cnki.net/kcms/detail/35.1284.R.20200302.1320.004.html>. [Epub ahead of print].
 14. Epidemiology Working Group for NCIP Epidemic Response, Chinese Center for Disease Control and Prevention, Chinese Center for Disease Control and Prevention. The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. *Chinese Journal of Epidemiol*. 2020;41(2):145–51.
 15. National Health Commission of the People's Republic of China. National Health Commission Press Conference. Beijing, Feb.4, 2020.
 16. Chan JF, Yuan S, Kok KH, 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): 514–523.
 17. Wang G, Li YQ, Jiang JJ, et al. The epidemic characteristics of coronavirus disease 2019 in different regions of Guangxi. *Journal of Tropical Medicine*, 2020;(2020-02-26). <http://kns.cnki.net/kcms/detail/44.1503.R.20200226.1402.002.html>. [Epub ahead of print].
 18. People.cn. 68 medical staff were quarantined due to a patient's deliberate concealment in Weifang, Shandong. [EB/OL]. [2020-02-05]. <http://yuqing.people.com.cn/GB/n1/2020/0205/c209043-31572290.html>.
 19. Health Commission of Shandong Province. The first case involving the prevention of infectious diseases in Shandong! A man was sentenced to 10 months for deliberately concealing the history of contact and fever in Wuhan, editor. [EB/OL]. [2020-03-02]. http://wsjkw.shandong.gov.cn/ztlz/rdzt/qlzhfkgz/fkdt/202003/t20200302_2595983.html.

20. Ma Z, Cao GJ, Guan M. Research status and development of human coronavirus. *International Journal of Laboratory Medicine*. 2020;41(5):518–22.
21. Gao SS, Cao JJ, Feng L, et al. Analyzing the application of Big Data in the outbreak, prediction and early warning of infectious diseases. *Chinese Health Service Management*. 2016;33(4):270–2.
22. Zhang C, Xu J, Geng XN, et al. The outpatient management and strategies for 2019 novel Coronavirus. *Chinese Health Service Management*, 2020;(2020-03-04).
<http://kns.cnki.net/kcms/detail/51.1201.R.20200303.1700.002.html>. [Epub ahead of print].
23. Wu J, Tao Q, Chen J, et al. Preliminary application of intelligence technology in early screening and warning of infectious disease clustering in schools. *Chinese Journal of Public Health*. 2019;35(4):516–20.
24. Wu QH, Yang WZ. *Public health emergency management*. Beijing: People's Medical Publishing House; 2013. pp. 192–3.
25. Li SX, Shan Y. Latest research advances on novel coronavirus pneumonia. *Journal of Shandong University(Health Sciences)*. 2020;58(3):19–25.
26. Guo J, Yang HL, Liu LL, et al. Status quo and determinants of awareness on basic public health service among migrant population. *Chinese Journal of Public Health*. 2019;35(1):63–6.
27. Chinese Society of General Practice. Recommendations guiding compact regional medical consortiums and county-based healthcare networks in the control and prevention of COVID-19 epidemic. *Chinese General Practice*. 2020;23(8):889–92.

Figures

Figure 1

The trend of daily confirmed cases and cumulative confirmed cases of COVID-19 in Shandong Province

Figure 1

The trend of daily confirmed cases and cumulative confirmed cases of COVID-19 in Shandong Province

Figure 2

The growth rate of the cumulative confirmed cases of COVID-19 in Shandong Province

Figure 2

The growth rate of the cumulative confirmed cases of COVID-19 in Shandong Province

Figure 3

The cumulative number of severe, critical, cured and fatality cases of COVID-19 in Shandong Province,

Figure 3

The cumulative number of severe, critical, cured and fatality cases of COVID-19 in Shandong Province,

Figure 4

Gender and age distribution of confirmed cases of COVID-19 in Shandong Province

Figure 4

Gender and age distribution of confirmed cases of COVID-19 in Shandong Province

Figure 5

The trend of cumulative confirmed cases of permanent population and population came to Shandong from other places

Figure 5

The trend of cumulative confirmed cases of permanent population and population came to Shandong from other places

Figure 6

contact, travel and residence history of confirmed cases of COVID-19 in Shandong

Figure 6

contact, travel and residence history of confirmed cases of COVID-19 in Shandong

Figure 7

Temporal and spatial distribution of confirmed cases of COVID-19 in various cities in Shandong Province

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 7

Temporal and spatial distribution of confirmed cases of COVID-19 in various cities in Shandong Province

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.