Clinical and Demographic Characteristics of Cluster Cases and Sporadic Cases of Coronavirus Disease 2019 (COVID-19) in 141 Patients in the Main District of Chongqing, China, Between January and February 2020

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ABE Peng Chen*
BCF Ying Zhang*
DE Yongsheng Wen
BD Jinjun Guo
BCE Weizhi Bai
EF Jinwei Jia
ACG Yu Ma
BDEG Yi Xu

Chongqing Emergency Medical Center, Chongqing University Central Hospital, Chongqing, P.R. China

* Peng Chen and Ying Zhang are co-first authors
Corresponding Authors: Yu Ma, e-mail: 81846846@qq.com, Yi Xu, e-mail: 1057270972@qq.com

Background: In December 2019, an outbreak of coronavirus disease 2019 (COVID-19), due to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), occurred in Wuhan, China. Patients with COVID-19 were also identified in Chongqing. This study aimed to investigate the clinical and demographic characteristics of cluster cases and sporadic cases of COVID-19 in 141 patients in the main district of Chongqing during one month, between January and February 2020.

Material/Methods: A retrospective study included 141 patients with a diagnosis of COVID-19. The diagnosis was confirmed using real-time reverse transcription-polymerase chain reaction (RT-PCR) for SARS-CoV-2. The patients were divided into cluster cases (n=90) and sporadic cases (n=51). Demographic and clinical characteristics were compared between the two study groups and included the presence of comorbidities, the presenting symptoms, chest computed tomography (CT) imaging findings, and laboratory findings.

Results: The mean age of the 141 patients diagnosed with COVID-19 was 47.3 years, and the most common presenting symptom was a persistent cough (48.9%). The 90 cluster cases (63.8%) were older than the sporadic cases, and cross-infection from family gathering occurred in 82.2%, and cough was more common than fever, and there was an increased prevalence of asymptomatic, mild, and moderate cases. Cluster cases showed fewer typical manifestations of COVID-19 on chest CT. However, the laboratory findings between the cluster and sporadic cases showed no significant differences.

Conclusions: There were demographic and clinical differences between cluster cases and sporadic cases of COVID-19 in the main district of Chongqing during the month between January to February 2020.

MeSH Keywords: Cluster Analysis • Human Characteristics • Pneumonia, Viral • COVID-19

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Background

In December 2019, an outbreak of coronavirus disease 2019 (COVID-19) due to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) occurred in Wuhan, China and cases were also confirmed in Chongqing from January 20th, 2020 [1–3]. By February 25th, 2020, there were 576 confirmed cases of COVID-19 in Chongqing, including more than 150 cases in the main district of Chongqing [3].

With the continued increase in patient numbers, the proportion of cluster cases with COVID-19 due to crowd-gathering and family-gathering exceeded 60%, which has resulted in measures to prevent the spread of infection by home quarantine. Compared with sporadic cases, the clinical characteristics of cluster cases are unclear, and there have been few studies to compare cluster and sporadic cases of COVID-19. Therefore, this study aimed to investigate the clinical and demographic characteristics of cluster cases and sporadic cases of COVID-19 in 141 patients in the main district of Chongqing during one month, between January and February 2020.

Material and Methods

Ethical approval

This retrospective study was conducted in accordance with the declaration of Helsinki and was approved by the Institutional Ethics Board of Chongqing Emergency Medical Center (No. 202006). Patient clinical data used in this study were anonymized.

Data collection

The study included 141 patients who had a confirmed diagnosis of COVID-19 using real-time reverse transcription-polymerase chain reaction (RT-PCR) for SARS-CoV-2. Patients were transferred to the designated hospitals in the main district of Chongqing from January 25th to February 25th, 2020. The patients were divided into cluster cases (n=90) and sporadic cases (n=51). Demographic and clinical characteristics were compared between the two study groups and included the presence of comorbidities, the presenting symptoms, chest computed tomography (CT) imaging findings, and laboratory findings.

Patient comorbidities that were evaluated included hypertension, diabetes, coronary heart disease, and chronic obstructive pulmonary disease (COPD). Symptoms included fever, cough, fatigue, muscle ache, sore throat, headache, rhinorrhea, dyspnea, nausea or vomiting, diarrhea, and palpitations. Chest computed tomography (CT) imaging findings and laboratory findings were recorded. The patients were divided into mild, moderate, and severe, according to clinical symptoms and the prevalence of acute respiratory distress syndrome (ARDS), acute cardiac injury, shock, and acute kidney injury (AKI). Two reviewers extracted the clinical data from the patient records, and two independent reviewers analyzed the data.

Definition of the cluster cases and sporadic cases

The cluster cases were cases of COVID-19 that were diagnosed in the previous 14 days in involving two or more cases caused by direct human-to-human transmission in the home, residence, workplace, and other communal places. The sporadic cases occurred in isolated individuals and were not associated with communal infection with others.

Classification of clinical symptoms [4]

The clinical symptoms of patients in both groups of cluster and sporadic cases of COVID-19 were defined as mild, moderate, and severe [4]. Mild cases had mild clinical symptoms with no signs of pneumonia on CT chest imaging [4]. Moderate cases presented with fever and respiratory symptoms with no signs of pneumonia on CT chest imaging [4]. Severe cases had hypoxia with a respiratory rate of more than 30 breaths per minute, oxygen saturation <93% at rest, the Carrico index, or the ratio of oxygen partial pressure to fractional inspired oxygen (PaO_2/FiO_2) <300 mmHg. Some patients developed respiratory failure requiring mechanical ventilation, and some patients developed shock and organ failure and required monitoring and treatment in the Intensive Care Unit (ICU).

Statistical analysis

Data were presented as the mean±standard deviation (SD) for continuous variables and percentages for categorical variables. Statistical analysis was performed using Student's t-test for quantitative variables and Pearson's chi-squared (χ^2) test or Fisher's exact test for categorical variables. Data were analyzed using SPSS version 22.0 (IBM, Chicago, IL, USA). A P-value <0.05 was considered to be statistically significant.

Results

Clinical and demographic patient characteristics

The study included 141 patients who had a confirmed diagnosis of coronavirus disease 2019 (COVID-19) in the main district of Chongqing, China, from January 25th to February 25th, 2020. The patients were divided into cluster cases (n=90) and sporadic cases (n=51). Table 1 summarizes the demographic and clinical characteristics of the 141 patients included in the study. The mean age was 47.3 years. Five patients (3.5%) were

Table 1. Clinical and demographic characteristics of 141 patients with a confirmed diagnosis of coronavirus disease 2019 (COVID-19) in the main district of Chongqing, China, from January 25th to February 25th, 2020.

Characteristics	N=141	Percentage (%)
Age (mean±SD) (years)	47.3±6.8	
Gender, n (%)		
Men	73	51.8
Women	68	48.2
Comorbidities		
Hypertension	34	24.1
Diabetes	26	18.4
Coronary heart disease	23	16.3
COPD	17	12.1
Time from contact to illness (days)	7.9±4.1	
Time from symptoms to admission (admissionadmission,days	3.3±1.7	
Symptoms, n (%)		
Fever	67	47.5
Dry cough	48	34.0
Productive cough	21	14.9
Fatigue	19	13.5
Muscle ache	17	12.1
Sore throat	14	9.9
Headache	13	9.2
Rhinorrhea	11	7.8
Dyspnea	14	9.9
Nausea or vomiting	9	6.3
Diarrhea	5	3.5
Palpitations	16	11.3
Asymptomatic	32	22.7
Clinical classification		
Mild case	57	40.5
Moderate case	69	48.9
Severe case	15	10.6
Complications		
ARDS	12	8.5
Acute cardiac injury	7	5.0
Shock	6	4.2
Acute kidney injury	4	2.8

ARDS – acute respiratory distress syndrome; COPD – chronic obstructive pulmonary disease; SD – standard deviation.

Table 2. Radiology and laboratory findings in 141 patients with a confirmed diagnosis of coronavirus disease 2019 (COVID-19) in the main district of Chongqing, China, from January 25th to February 25th, 2020.

Characteristics	N=141	Percentage (%)
Chest radiology		
Bilateral lung involvement	111	78.7
Typical CT findings	111	78.7
Laboratory examination		
White blood cell count, ×10⁹/L		
≤3.5	17	12.1
3.5–9.5	113	80.1
≥9.5	11	7.8
Lymphocyte count, ×10⁹/L		
Normal	106	75.2
Reduced	35	24.8
C-reactive protein (CRP)		
Normal	47	33.3
Increased	94	66.7

children <12 years of age, and 17 patients (12.1%) were >65 years of age. The youngest patient diagnosed with COVID-19 was 4 years of age, and the oldest was 89 years of age. There were 73 male patients (51.8%) and 68 female patients (48.2%). Comorbidities included hypertension (24.1%), diabetes (18.4%), coronary heart disease (16.3%), and chronic obstructive pulmonary disease (COPD) (12.1%). The mean time from contact to symptomatic illness, or the incubation period, was 7.9 days. The mean time from the onset of symptoms to hospital admission was 3.3 days (Table 1).

The most common presenting symptoms of COVID-19 were cough (48.9%), fever (47.5%), and fatigue (13.5%), and only 14 patients (9.9%) had symptoms of dyspnea. In 34% of patients, dry cough was present, and a productive cough was present in 14.9%. Early symptoms of COVID-19 included muscle aches (12.1%), a sore throat (9.9%), headache (9.2%), and rhinorrhea (7.8%). Nausea or vomiting occurred in 6.3% of patients, and diarrhea was present in 3.5%. Sixteen patients (11.3%) had palpitations, and 11 patients (7.8%) had an increased heart rate (≥100 bpm) (Table 1).

The cases were clinically divided into mild, moderate, and severe [4]. Mild cases accounted for 40.5%, moderate cases for 48.9%, and severe cases for 10.6%. Acute respiratory distress syndrome (ARDS) was the most common presentation in severe cases and was found in 12 patients (8.5%). Acute cardiac injury occurred in seven patients (5.0%), shock occurred in six patients (4.2%), and acute kidney injury (AKI) occurred in four patients (2.8), who required dialysis therapy.

Table 2 shows the radiology and laboratory findings in 141 patients with COVID-19. Radiological examination of the chest showed that bilateral lung involvement was most common (78.7%), and 111 patients (78.7%) showed typical manifestations of COVID-19 on chest computed tomography (CT) [3,5,6]. The findings from laboratory investigations were consistent with the features of COVID-19 infection, including a normal white blood cell count and lymphocyte count, and an increased level of C-reactive protein (CRP). Laboratory results in the moderate and severe cases showed that 27.5% of the patients had abnormal myocardial enzymes, with an increase in creatine kinase myocardial band (CK-MB) being most common. Increased levels of troponin were found in 26.7% of patients. Some moderate and severe cases (18.1%) showed acute kidney injury (AKI) with increased levels of blood urea nitrogen (BUN) and serum creatinine (Table 2).

Differences between the cluster cases and the sporadic cases

Of the 141 patients included in the study, 90 patients (63.8%) were cluster cases, which included 74 patients who acquired COVID-19 by family-gathering (74/90, 82.2%). Of the 141 patients included in the study, 51 cases (36.2%) were sporadic. Comparison of clinical characteristics between the cluster cases and sporadic cases are shown in Table 3. In the cluster cases, the mean patient age was 50.1 years, and there were 43 male patients (47.8%). In the sporadic cases, the mean patient age was 42 years, and there were 30 male patients (58.8%). The cluster cases were significantly older than the sporadic cases of COVID-19, but there were no significant differences

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Table 3. The clinical characteristics of cluster and sporadic cases of coronavirus disease 2019 (COVID-19) in the main district of Chongqing, China, from January 25th to February 25th, 2020.

Characteristics	Cluster cases (N=90)	Sporadic cases (N=51)	P-value
Age (mean±SD) (years)	50.1±8.2	42.0±7.7	0.01
Gender, n (%)			
Men	43 (47.8)	30 (58.8)	NS
Women	47 (52.2)	21 (41.2)	
Comorbidities			
Hypertension	25 (27.8)	9 (17.6)	NS
Diabetes	18 (20.0)	8 (15.7)	NS
Coronary heart disease	14 (15.6)	9 (17.6)	NS
Chronic obstructive pulmonary disease	10 (11.1)	7 (13.7)	NS
Time from contact to illness	8.3±3.2	7.1±3.8	NS
Symptoms, n (%)			
Fever	36 (40)	31 (60.8)	0.02
37.3–38.0	25 (69.4)	14 (45.2)	0.04
≥38.0	11 (30.6)	17 (54.8)	
Cough	40 (44.4)	29 (56.9)	NS
Fatigue	9 (10)	10 (19.6)	NS
Muscle ache	9 (10)	8 (15.7)	NS
Sore throat	8 (8.9)	6 (11.8)	NS
Headache	8 (8.9)	5 (9.8)	NS
Rhinorrhea	7 (7.7)	4 (7.8)	NS
Dyspnoea	7 (7.8)	7 (13.7)	NS
Nausea or vomiting	6 (6.7)	3 (6)	NS
Diarrhea	3 (3.3)	2 (3.9)	NS
Palpitations	10 (11.1)	6 (11.8)	NS
Asymptomatic	29 (32.2)	3 (5.9)	0.00
Clinical classification			
Mild case	41	16	0.02
Moderate case	44	25	
Severe case	5	10	
Radiology examination			
Bilateral lung involvement	70 (77.8)	41 (80.4)	NS
Typical chest CT manifestations	66 (73.3)	45 (88.2)	0.04

Table 3 continued. The clinical characteristics of cluster and sporadic cases of coronavirus disease 2019 (COVID-19) in the main district of Chongqing, China, from January 25th to February 25th, 2020.

Characteristics	Cluster cases (N=90)	Sporadic cases (N=51)	P-value
Laboratory examination			
White blood cell count, ×10⁹/L			
≤3.5	12 (13.3)	5 (9.8)	
3.5–9.5	71 (78.9)	42 (82.4)	NS
≥9.5	7 (7.8)	4 (7.8)	
Lymphocyte count, ×10⁹/L			
Normal	67 (74.4)	39 (76.5)	
Reduced	23 (25.6)	12 (23.5)	NS
C-reactive protein (CRP)			
Normal	32 (35.6)	15 (29.4)	
Increased	58 (64.4)	36 (70.6)	NS

NS – not significant.

between the two groups in terms of gender, comorbidities, and length of the incubation period for infection (Table 3).

The clinical characteristics of the 141 patients showed that the most common symptoms in the cluster cases were cough (44.4%), followed by fever (40%). However, in sporadic cases, the most common symptoms were fever (60.8%), followed by cough (56.9%). Patients in the sporadic case group were significantly more likely to have a moderate or high fever (≥38°C). There was no significant difference between the cases for the prevalence of early symptoms of COVID-19, including symptoms of fatigue, muscle ache, sore throat, headache, and rhinorrhea. There were no significant differences between the cases for the prevalence of gastrointestinal symptoms such as nausea, vomiting, and diarrhea, for cardiac symptoms, including palpitations, or the incidence of dyspnea. However, in the cluster cases, 32.3% (29/90) of patients were asymptomatic, which was significantly higher than that in the sporadic cases in which 5.9% (3/51) of patients were asymptomatic. Cluster patients were significantly more likely to be clinically mild or moderate. Only five patients with severe symptoms were found in the cluster cases, which was significantly less than for the sporadic cases.

The prevalence of bilateral lung involvement showed no significant difference between the cluster cases and the sporadic cases. However, chest CT identified fewer typical manifestations of COVID-19 in the cluster cases, which was significantly different from sporadic cases. The laboratory findings showed that both the cluster cases and sporadic cases had normal white blood cell and lymphocyte counts and increased C-reactive protein (CRP), with no significant differences.

Compared with the sporadic cases of the COVID-19, the cluster cases were significantly older, and unlike sporadic cases, where fever was the dominant symptom, the cluster cases were more likely to present with cough and a significantly increased proportion were asymptomatic. The cluster cases were more likely to be mild or moderate cases with fewer typical manifestations of COVID-19 on chest CT when compared with the sporadic cases. Figures 1 and 2 show representative chest CT images in an example of a cluster case and a sporadic case, respectively.

Discussion

As of February 25, 2020, the number of confirmed cases of infection from coronavirus disease 2019 (COVID-19) due to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in Wuhan, and mainland China increased leading to increased prevention programs [1,7–10]. The number of confirmed cases in many other provinces and cities outside Hubei province continued to decline. However, for confirmed cases in the main district of Chongqing, almost cases were caused by crowd-gathering. Although early-stage prevention with home quarantine effectively controlled the spread of COVID-19, with the gradual resumption of work and production, the risk of crowd-gathering to spread disease would be expected to increase. The prevention of cluster spread of COVID-19 when work resumes in China is an important issue.

The characteristics of cluster cases of COVID-19 has remained unclear, which has hindered the assessment and prevention
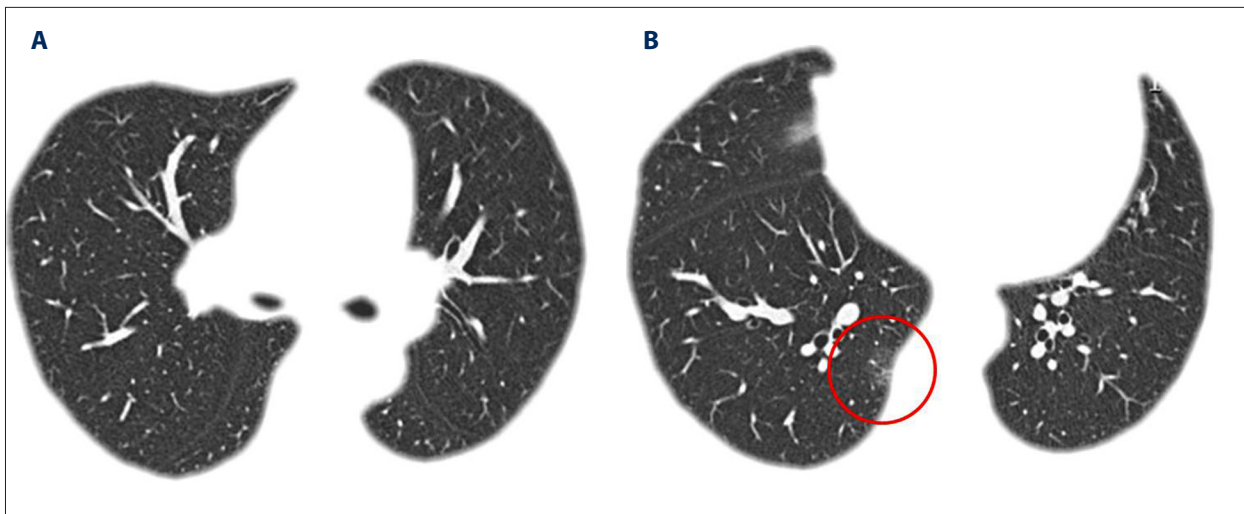
Figure 1. A cluster case of coronavirus disease 2019 (COVID-19). Transverse chest computed tomography (CT) images of a 30-year-old female patient on hospital admission. The patient had symptoms of a cough for three days. (**A, B**) Ground-glass opacities are shown in the posterior basal segment of the right lower lobe, indicating the presence of interstitial inflammation.
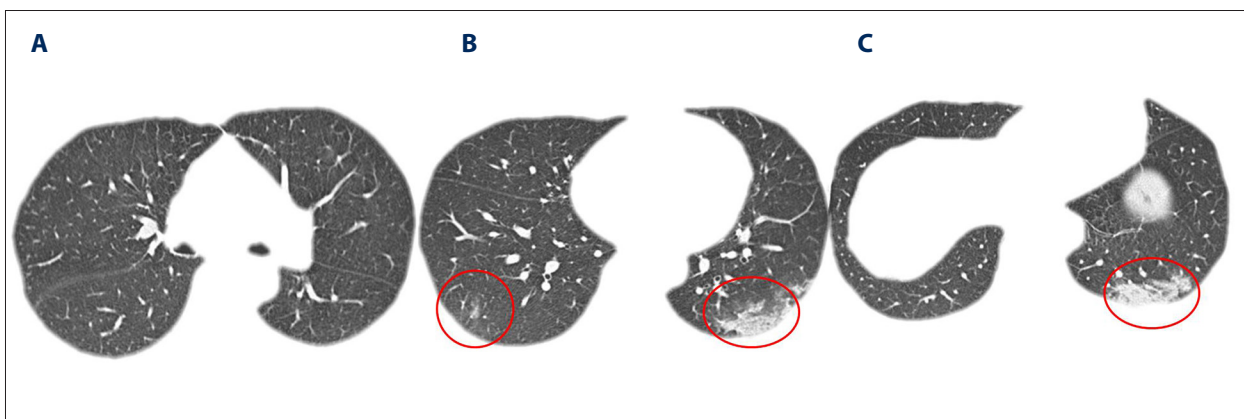
Figure 2. A sporadic case of coronavirus disease 2019 (COVID-19). Transverse chest computed tomography (CT) images of a 32-year-old female patient on hospital admission. The patient had symptoms of a fever and cough for two days. (**A–C**) Ground-glass opacities are shown in both lower lobes with a 'crazy-paving' pattern of lung consolidation in the posterior basal segment of the left lower lobe.

of the disease of cluster spread. This study aimed to investigate the clinical and demographic characteristics of cluster cases and sporadic cases of COVID-19 in 141 patients in the main district of Chongqing during one month, between January and February 2020. The findings may provide guidance for the prevention of local epidemics, and to provide a reference for the development of prevention strategies in other provinces and regions.

In the present study, out of 141 patients with COVID-19, the mean age was 47.3 years, and 51.8% of the cases were male patients. The findings from this study supported those of previous studies that there was a relationship between COVID-19 and patient comorbidity [11]. The most common comorbidity was hypertension, followed by diabetes and coronary heart

disease. The mean incubation period of 7.9 days was longer than previously reported [12,13]. Also, the time from the onset of symptoms to hospital admission, of 3.3 days, was shorter than previously reported [7]. This finding may have reflected that because patients were more alert to COVID-19, minor symptoms prompted patients to seek rapid medical assistance.

In this study, some patients presented with muscle aches, a sore throat, and other early symptoms of COVID-19, which was different from some previous studies in which fever was the main symptom [7,14]. There were more patients with cough in this study, with a significantly higher proportion with a dry cough. The proportion of severe cases was also lower than that reported in Wuhan and Hubei province [3,7,15]. It is possible that the pathogenicity of the virus was reduced, or that

treatment improved, leading to a reduction in the proportion of severe cases.

In most patients in this study, radiological examination showed bilateral lung involvement with typical chest computed tomography (CT) findings of COVID-19 in most patients. Laboratory examination showed normal white blood cell counts and lymphocyte counts and increased levels of C-reactive protein. These findings were similar to those previously reported in patients with COVID-19 in Wuhan and Hubei provinces [7,15].

In all the 141 patients, 90 patients (63.8%) were cluster cases, and 51 patients (36.2%) were sporadic cases. With the spread of COVID-19 in the main district of Chongqing, the number of cluster cases exceeded the sporadic cases. The cluster cases were significantly older and associated with family gatherings (82.2%). There was no difference in the proportion of comorbidities and the incubation period between cluster cases and sporadic cases [16].

Unlike sporadic cases, in which fever was the dominant symptom, the cluster cases included more patients who presented with a cough. Previous studies have shown that cluster cases of COVID-19 were prone to present with gastrointestinal symptoms, of which diarrhea was the most common symptom [16]. The findings from this study showed no significant differences between the cluster and sporadic cases for gastrointestinal symptoms of nausea, vomiting, and diarrhea, or cardiac symptoms, or dyspnea. However, in this study, a significantly greater proportion of asymptomatic patients were found in the cluster cases, with a significantly lower proportion of severe cases. Also, there were fewer typical manifestations of COVID-19 on chest CT in the cluster cases compared with the sporadic cases. It has previously been reported that asymptomatic individuals are potential sources of COVID-19 infection [17,18]. For cluster cases, although symptoms were less severe and included asymptomatic cases, mild and moderate cases were increased, which may indicate that more attention should be given to disease prevention in the cluster cases.

As a municipality directly under the central government, Chongqing is adjacent to the west of Hubei province and 940 kilometers from Wuhan. Chongqing has a population of about 31 million, of which the main district has a population of about 8.55 million. The spread of COVID-19 has recently been reduced using home quarantine strategy, but migration between Chongqing and Wuhan and the gradual resumption of work will increase the risk of crowd gatherings, which may result in an increased spread of disease. The prevention of infection caused by crowd gatherings, especially in shopping malls, schools, and supermarkets, should be the required next stage of disease control [19]. By comparing cluster cases and sporadic cases, the characteristics of cluster cases have been identified, which have shown that patients who had

mild symptoms or who were asymptomatic had the potential to transmit COVID-19.

The results of this study highlighted the importance of formulating effective and targeted disease prevention measures. For example, more comprehensive measures are required for screening patients, especially for older people who gather in public places, equipping individuals with personal protection equipment (PPE) when they return to work, schools, and crowded places, and reducing unnecessary crowd gatherings [20,21]. Also, the findings from this study support that medical assistance should be sought quickly for symptoms of cough and fever [20,21].

This study had several limitations. Firstly, this was a retrospective study that included data obtained from designated hospitals in the main district of Chongqing. Future studies to compare cluster and sporadic cases of COVID-19 should increase the number of patients included in the study. This study was of a short duration of one month, and the length of hospital stay, cure rate, mortality, and other indicators such as other comorbidities, require further study. Also, to reduce infection risk, not all patients with COVID-19 patients had blood biochemistry, and electrocardiogram (ECG), ultrasound examination, and other investigations, which indicates that future prospective studies are required.

Conclusions

This study aimed to investigate the clinical and demographic characteristics of cluster cases and sporadic cases of COVID-19 in 141 patients in the main district of Chongqing during one month, between January and February 2020. There were demographic and clinical differences between cluster cases and sporadic cases of COVID-19, with more cluster cases. Cluster cases were older than sporadic cases, and infection occurred due to family gatherings and cross-infection. The spread of the disease was effectively controlled by home quarantine, which reduced the symptoms. There were fewer typical manifestations of COVID-19 on chest CT in cluster cases compared with sporadic cases. Cluster cases also included asymptomatic individuals. These findings may have implications for the spread of infection when the population begins to return to work, as the clinical characteristics of the cluster cases indicate that comprehensive measures may be required to prevent the further spread of COVID-19, including comprehensive surveillance, wearing masks in public places, reducing unnecessary social and family gathering, and timely medical treatment.

Conflict of interest

None.

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