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Epidemiological and clinical characteristics of 333 confirmed cases with coronavirus disease 2019 in Shanghai, China

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Abstract

Coronavirus disease 2019 (COVID-19) is an emerging infectious disease first identified in Wuhan City, Hubei Province, China. As of 19 February 2020, there had been 333 confirmed cases reported in Shanghai, China. This study elaborates on the epidemiological and clinical characteristics of COVID-19 based on a descriptive study of the 333 patients infected with COVID-19 in Shanghai for the purpose of probing into this new disease and providing reference. Among the 333 confirmed cases in Shanghai, 172 (51.7%) were males and 161 (48.3%) were females, with a median age of 50 years. 299 (89.8%) cases presented mild symptoms. 139 (41.7%) and 111 (33.3%) cases were infected in Wuhan and Shanghai, respectively. 148 (44.4%) cases once had contact with confirmed cases before onset, while 103 (30.9%) cases had never contacted confirmed cases but they had a sojourn history in Wuhan. The onset date of the first case in Shanghai was 28 December, with the peak appearing on 27 January. The median incubation period of COVID-19 was estimated to be 7.2 days. 207 (62.2%) cases had fever symptoms at the onset, whereas 273 (82.0%) cases experienced fever before hospitalization. 56 (18.6%) adults experienced a decrease in white blood cell and 84 (42.9%) had increased C-reactive protein after onset. Elderly, male and heart disease history were risk factors for severe or critical pneumonia. These findings suggest that most cases experienced fever symptoms and had mild pneumonia. Strengthening the health management of elderly men, especially those with underlying diseases, may help reduce the incidence of severe and critical pneumonia. Time intervals from onset to visit, hospitalization and diagnosis confirmed were all shortened after Shanghai's first-level public health emergency response. Shanghai's experience proves that COVID-19 can be controlled well in megacities.

KEYWORDS

clinical characteristics, COVID-19, epidemiology, Shanghai

Xiao Yu, Xiaodong Sun, Peng Cui and Hao Pan are contributed equally to this work.

1 | INTRODUCTION

Since early December, 2019, China has been experiencing an outbreak of coronavirus disease 2019 (COVID-19), which is caused by a new coronavirus and first reported in Wuhan, Hubei Province (Zhu et al., 2020). This new virus has been proved to be capable of human-to-human transmission (Chan et al., 2020a; Li et al., 2020; Riou & Althaus, 2020). Entering January 2020, imported and local infections successively appeared in Shanghai (Cai et al., 2020). In order to control the spread of COVID-19, Shanghai Municipal People's Government launched a public health first-level response on 24 January 2020 (Shanghai Municipal People's Government, 2020). By 19 February 2020, there had been 333 confirmed cases in Shanghai.

Recent studies have revealed characteristics of early transmission and clinical course of COVID-19(Chen et al., 2020; Huang et al., 2020; Li et al., 2020; Wang, Yuan, et al., 2020; Young et al., 2020). Due to the differences in susceptible populations, exposure environments, virus virulence and management mechanisms, characteristics of the disease may vary among different cities, especially in Shanghai, a megacity with a highly mobile population and the highest ageing rate in China (Shanghai Municipal Statistics Bureau, 2018). Besides, the results of Shanghai's prevention and control work reflected in these data may provide references for other megacities for the prevention and control of COVID-19. Here, we provide an analysis of the data on 333 confirmed cases to describe the epidemiological and clinical characteristics of COVID-19 in Shanghai.

2 | METHODS

2.1 | Study design and participants

We conducted a descriptive study of all the 333 confirmed COVID-19 cases reported in Shanghai in the case reporting system as of February 19th, 2020.

2.2 | Case definition

All the cases were tested positive for COVID-19 in the laboratory and were diagnosed by clinical experts according to the 5th Diagnosis and Treatment Plan (China Medical Administration, 2020). Suspected cases were clinically diagnosed based on symptoms and exposure history, and confirmed cases were those suspected cases with positive results for viral nucleic acid test. The severity of symptoms of COVID-19 is divided into non-pneumonia, mild, severe and critical pneumonia. 'Severe' refers to dyspnoea, and respiratory rate ≥ 30/min, blood oxygen saturation ≤ 93%, PaO_2/ FiO_2 ratio ≤ 300 mmHg; "critically ill" refers to those cases that present with respiratory failure, or septic shock, or multiple organ dysfunction/ failure (China Medical Administration, 2020). We used clinical severity of all patients reported in the case reporting system as of 19 February 2020.

2.3 | Data collection

After cases were reported to Center for Disease Control and Prevention in Shanghai (CDC), field investigation was taken within 24 hr and an epidemiological investigation report was formed. The epidemiological investigation report includes (a) basic demographic information; (b) onset, diagnosis and treatment process; (c) suspicious exposure history within 2 weeks before onset; (d) experts' diagnosis opinions; (e) laboratory results; and (f) prevention and control measures.

Specific information in epidemiological investigation reports was extracted and entered into a database built with Epidata software (Epidata Association). All personally identifiable information was removed during analysis.

2.4 | Laboratory test

Laboratory test was performed according to the *Technical Guidelines for Laboratory Testing of Coronavirus Disease 2019* (Chinese bureau of disease control prevention, 2020). Upper and lower respiratory tract specimens were acquired from patients. RNA was extracted and tested by real-time RT-PCR. Tests were carried out in biosafety level 2 laboratories. The patient was considered as laboratory tested positive only when two targets, open reading frame 1a or 1b (ORF1ab) and nucleocapsid protein (N), were both positive. Primers and probes are shown in appendix.

2.5 | Statistical analysis

Continuous variables were expressed as medians and interquartile ranges (IQR) and compared by using Wilcoxon rank-sum tests. Categorical variables were summarized as counts and percentages in each category and compared by using chi-square and Fisher's exact tests. All missing data were not imputed or analysed. Multivariate logistic regression analysis was used to analyse the risk factors for severe/critical illness, and variables with $p < .2$ in univariate analysis were included.

The incubation period was calculated according to three different exposure histories (Backer, Klinkenberg, & Wallinga, 2020; Donnelly et al., 2003; Goh et al., 2006):

1. Cases with a travel history (not living history) in Wuhan.

Incubation period of environmental exposure cases (day) = [(date of onset-date of arrival in Wuhan) + (date of onset-date of departure from Wuhan)]/2.

2. Cases with multiple exposures to confirmed cases.

Incubation period of cases with multiple exposures to confirmed cases (day) = [(Date of onset-date of first contact) + (date of onset-date of last contact)]/2.

TABLE 1 Demographic characteristics of COVID-19 cases in Shanghai (*n* = 333)

Category	*N* (%)
Sex	
Female	161 (48.3)
Male	172 (51.7)
Age, years	
Median ([IQR], [range])	50 [35, 63], [0,88]
<15	10 (3.0)
15–44	138 (41.4)
45–59	78 (23.4)
≥60	107 (32.1)
BMI	
<18.5	19 (5.7)
18.5–23.9	150 (47.6)
≥24	146 (46.3)
Missing	18 (5.4)
Occupation	
Staff in service industry	132 (39.6)
Retiree	101 (30.3)
Farmer/worker	20 (6.0)
Medical staff	4 (1.2)
Other	61 (18.3)
Missing	15 (4.5)
Anamnesis	
Yes	107 (32.1)
Diabetes	28 (8.4)
High blood pressure	64 (19.2)
Heart disease	24 (7.2)
Respiratory disease	5 (1.5)
No	226 (67.9)
Smoking history	
Yes	26 (7.8)
No	265 (79.6)
Missing	42 (12.6)
Alcohol history	
Yes	81 (24.3)
No	207 (62.2)
Missing	45 (13.5)
Symptom severity	
Non-pneumonia	8 (2.4)
Mild pneumonia	299 (89.8)
Severe pneumonia	10 (3.0)
Critical pneumonia	16 (4.8)
Location of the infections	
Wuhan	139 (41.7)
Shanghai	111 (33.3)
Other aAreas (three main areas are listed below)	83 (24.9)
Jiang su	12(3.6)
An hui	8(2.4)
Outside China	8 (2.4)
Exposure history	
Contact-confirmed cases	148 (44.4)
Without clear confirmed case contacts	
With Wuhan sojourn	103 (30.9)
Contact people with Hubei sojourn	21 (6.3)
Other suspicious sojourn[a] or contacts	61 (18.3)

[a]These suspicious places include other places like Ezhou, Huanggang, Huangshi in Hubei and other provinces in China, like Jiangsu, Zhejiang and Anhui.

3. Cases with single exposure to confirmed cases.

Incubation period of cases with single exposure to confirmed cases (day) = Date of onset-date of contact.

The incubation period distribution was estimated by fitting a gamma distribution.

Analyses were performed with R software (R Foundation for Statistical Computing). Distribution map was plotted with ArcGis 10.3 (Environmental Systems Research Institute, Inc.).

2.6 | Ethics approval

This study was reviewed and approved by Shanghai Municipal CDC Ethics Review Committee.

3 | RESULTS

3.1 | Demographic characteristics

As shown in Table 1, of all the 333 confirmed cases, the ratio between male (172, 51.7%) and female (161, 48.3%) was 1.07:1, the median age was 50 years (IQR, 35 to 63; Range 0 to 88 years). Patients aged 15–45 years (138, 41.4%) and above 60 years (107, 32.1%) accounted for a relatively large amount. As for body mass index (BMI), 19 (5.7%) cases were underweight and 145 (43.5%) cases were overweight. 101(30.3%) cases were retired people, and 4 (1.2%) cases were healthcare workers (Only one of them was infected in medical process). 107 (32.1) cases had anamnesis. 24 (7.4%) cases had a smoking history, and 78 (24.1%) cases had an alcohol history. Most cases (299, 89.8%) had mild pneumonia.

As of 19 February 2020, 2 cases died of COVID-19 and the mortality rate of this disease in Shanghai was 0.06%. One of the dead was an 88-year-old man with hypertension, heart disease and chronic

obstructive pulmonary disease. The time from onset to death was 5 days. The other deceased was a 79-year-old female suffering from hypertension and cerebral infarction. The time from onset to death was 13 days. Both patients underwent active medical treatment, including antiviral, anti-inflammatory and immune enhancement, but the treatment was not effective.

139 (41.7%) cases were infected in Wuhan and 111 (33.3%) cases in Shanghai. Exploring all the patients' exposure history, we found that 148 (44.4%) cases had clear contacts with confirmed cases. Among those who did not report exposure to confirmed cases, 103 (30.9%) cases had sojourn history in Wuhan, 21 (6.3%) contacted people with sojourn history in Hubei Province, and 61 (18.3%) had been to other suspicious places or had confirmed cases near their residence.

3.2 | Spatiotemporal distribution

As shown in Figure 1, the onset date of Shanghai's first case was 28 December 2019, with the peak was arriving on 27 January 2020. Also, the incidence peak of people infected in Wuhan appeared on 27 January 2020. The number of patients infected in Shanghai gradually increased from 12 January 2020, reaching the peak on 2 February. From 7 February 2020, no cases reported in Shanghai were infected in Wuhan.

Of all the 333 confirmed cases, 242 (72.7%) cases currently live in Shanghai. 3 cases had onset symptoms before 14 January 2020 (stage 1), 74 cases before 24 January 2020 (stage 2), 216 cases before 4 February 2020 (stage 3) and 242 cases before 19 February 2020 (stage 4) (Figure 2). In the above stated four stages, the number of streets or towns with confirmed cases was 4, 49, 94 and 101, respectively (Figure 2).

3.3 | Incubation period

There were 64 cases with a travel history in Wuhan, and the median incubation period was 7.8 days (IQR, 5.0 to 8.2 days; range, 0.5 to 20 days). The gamma distribution fit indicated that the estimated median incubation period was 7.2 days (95% confidence interval [CI], 6.1 to 8.4 days) (Figure 3a).

57 cases had multiple exposures to confirmed cases, and the median incubation period was 7.5 days (IQR, 5.0 to 7.9 days; range, 0.5 to 23 days). As shown in the gamma distribution, the estimated median incubation period was 7.0 days (95% CI, 5.9 to 8.1 days) (Figure 3a).

11 cases had single exposure to confirmed cases, and the median incubation period was 9.0 days (IQR, 5.0 to 8.0 days; range, 1 to 14 days). As demonstrated in the gamma distribution, the estimated median incubation period was 7.5 days (95% CI, 4.4 to11.8 days) (Figure 3a).

We pooled all the 132 cases together to fit the gamma distribution, and the results showed that the estimated median incubation period was 7.2 days (95% CI, 6.4 to 7.9 days), and with the 95th, 99th percentile of the distribution was 16.0 and 20.4 days, respectively (Figure 3b).

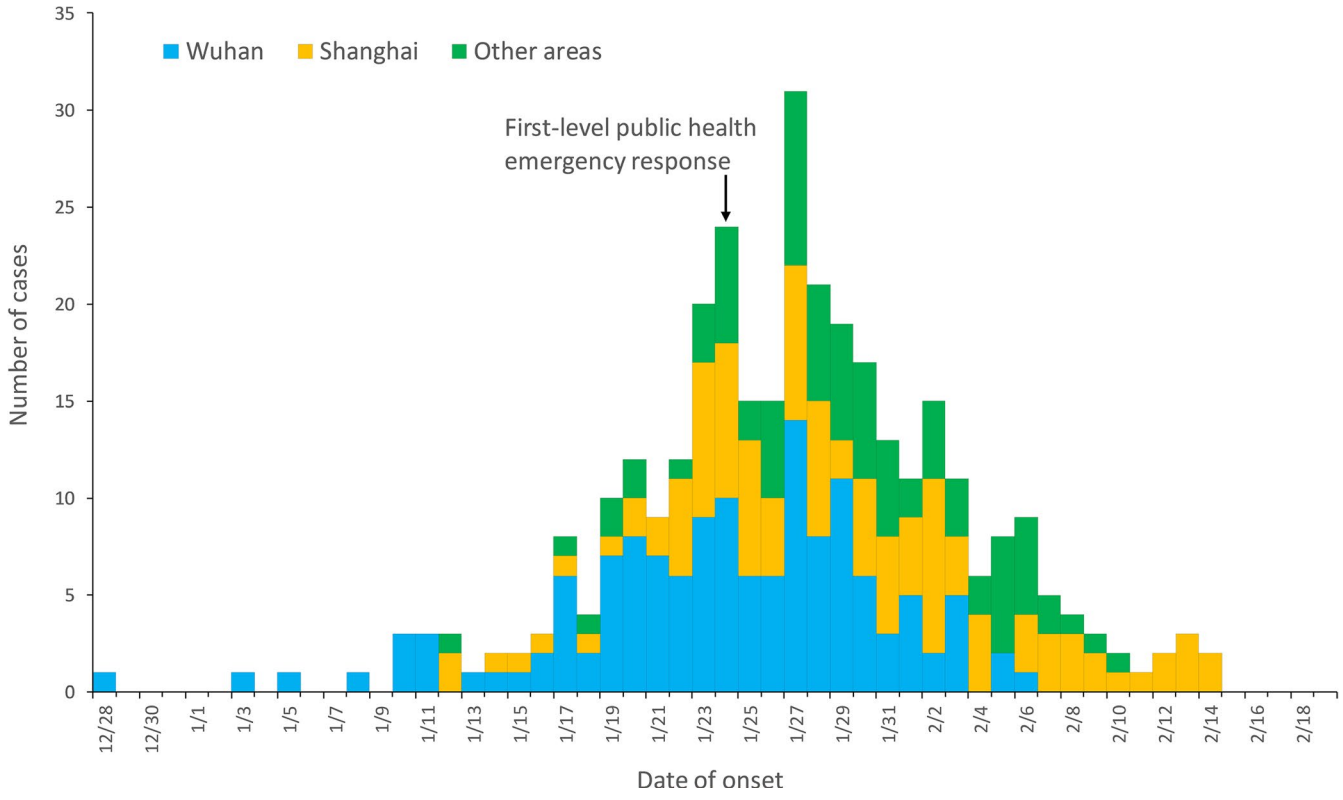

FIGURE 1 Epidemic curve of 333 confirmed COVID-19 cases infected in different areas (Wuhan, Shanghai, other areas) [Colour figure can be viewed at wileyonlinelibrary.com]

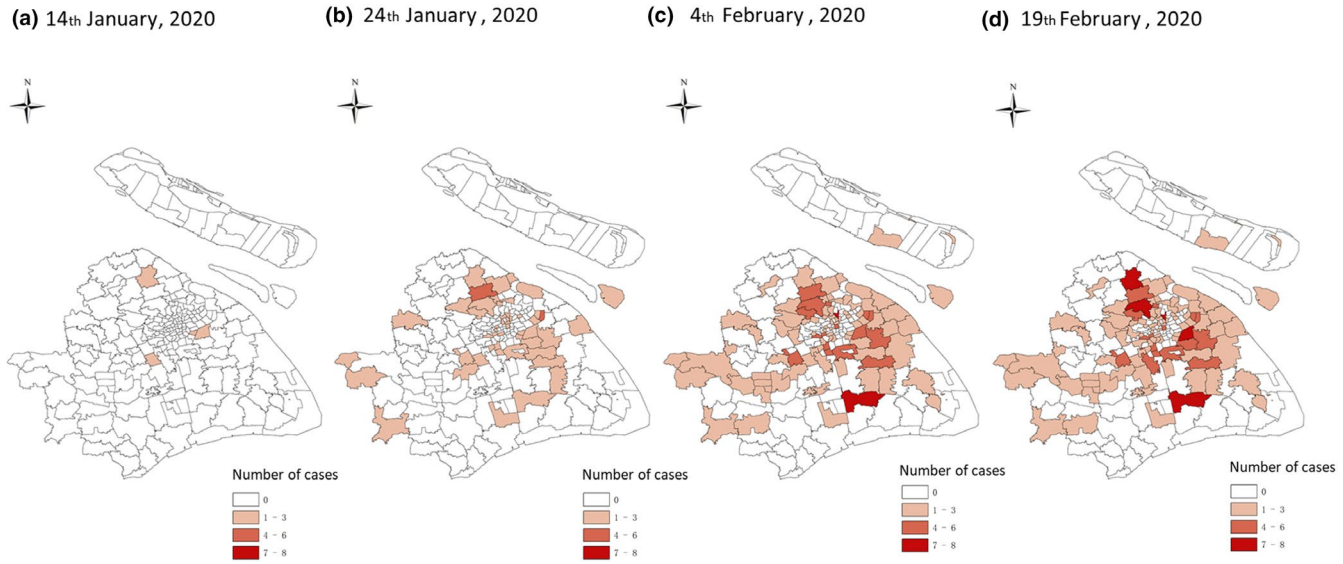

FIGURE 2 The spatial and temporal distribution of COVID-19 in Shanghai [Colour figure can be viewed at wileyonlinelibrary.com]

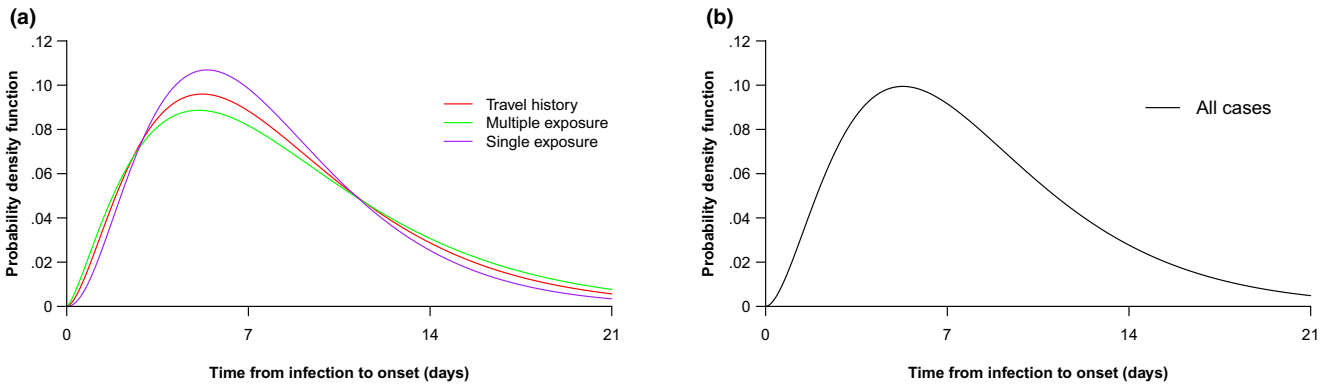

FIGURE 3 Estimated incubation period distribution (the time from infection to illness onset). (a) Estimated separately according to three types of cases: 64 cases with a travel history in Wuhan area, 57 cases with multiple exposure to confirmed cases and 11 cases with single exposure to confirmed cases. (b) Estimated all the 132 cases with detail contact history information [Colour figure can be viewed at wileyonlinelibrary.com]

3.4 | Time intervals from onset to visit, hospitalization and diagnosis confirmed

As shown in Table 2, overall, median onset visit interval of patients was 1.0 days (IQR, 0.0 to 4.0 days) and became shorter after 24 January. Median onset hospitalization interval and onset diagnosis-confirmed interval was 3.0 (IQR, 1.0 to 6.0) and 5.0 days (IQR, 3.0 to 8.0 days), respectively. Also, onset hospitalization interval and onset diagnosis-confirmed interval were all shorter after 24 January.

3.5 | Clinical characteristics

207 (62.2%) cases had fever, 106 (31.8%) had cough, and 40 (12.0%) had fatigue symptoms at the onset (Table 3).

From onset to hospitalization, the most common symptom was still fever (82.0%), followed by dry cough (41.1%) and fatigue (15.0%). Respectively, 123 (37.0%) cases experienced fever with other symptoms at the onset, and 199 (59.8%) had fever and other symptoms from onset to hospitalization. The most common combination of symptoms at the onset and from onset to hospitalization was fever with dry cough, fever with fatigue and fever with myalgia. From onset to hospitalization, the median peak temperature in cases with fever symptoms was 38.0°C (IQR, 37.7 to 38.5°C) (Table 3).

Of the cases with the first blood routine after the onset, 56 (18.6%) adults showed a decrease in white blood cell count, 1 (0.7%) had an increase in white blood cell count, with statistical difference between female and male. 84 (42.9%) cases had increased C-reactive protein (Table 4). Lots of blood routine data for children were missing. According to the data we have obtained, only 1 (14.3%) of the children's white blood cell count decreased.

TABLE 2 Time interval distribution before and after 24 January

Time Interval	Overall	Before 24 January (include 24 January)	After 24 January	*p*
Onset visit interval (days)	1.0 [0.0, 4.0]	2.0 [1.0, 5.0]	1.0 [0.0, 3.0]	<0.001
Onset hospitalization interval (days)	3.0 [1.0, 6.0]	5.0 [2.8, 8.2]	2.0 [0.0, 4.0]	<0.001
Onset diagnosis-confirmed interval (days)	5.0 [3.0, 8.0]	8.0 [5.0, 10.0]	4.0 [2.0,6.0]	<0.001

TABLE 3 Symptoms of COVID-19 patients from onset to hospitalization (*n* = 333)

Symptoms	Onset	Onset to hospitalization
Fever	207 (62.2)	273 (82.0)
Dry cough	106 (31.8)	137 (41.1)
Fatigue	40 (12.0)	50 (15.0)
Pharyngalgia	31 (9.3)	39 (11.7)
Headache	30 (9.0)	36 (10.8)
Expectoration	29 (8.7)	42 (12.6)
Myalgia	25 (7.5)	26 (7.8)
Chill	20 (6.0)	21 (6.3)
Snivel	19 (5.7)	21 (6.3)
Nasal congestion	13 (3.9)	13 (3.9)
Dizziness	8 (2.4)	8 (2.4)
Chest congestion	7 (2.1)	15 (4.5)
Diarrhoea	7 (2.1)	11 (3.3)
Joint sore	5 (1.5)	9 (2.7)
Polypnoea	2 (0.6)	7 (2.1)
Dyspnoea	1 (0.3)	4 (1.2)
Fever + any other symptoms	123 (37.0)	199 (59.8)
Fever + Dry cough	12 (3.6)	28 (8.4)
Fever + Fatigue	10 (3.0)	10 (3.0)
Fever + Myalgia	8 (2.4)	8 (2.4)
Peak temperature (°C, median, IQR)	NA[a]	38.0 [37.7, 38.5]

[a]NA means data not available.

3.6 | Clinical severity analysis

307 cases had non- or mild pneumonia, and 26 had severe or critical pneumonia. Univariate analysis showed that older age groups, men and anamnesis especially heart disease were risk factors for severe or critical illness (Table 5). In multivariate analysis, for each increase in the age group, the risk of severe/ critical illness increased by 4.33 times; the risk of severe/ critical illness for men was 4.56 times that of women. The risk of severe/ critical illness in people with heart disease was 4.17 times that of people without heart disease (Table 6).

4 | DISCUSSION

Seen from the perspective of the infected areas, the cases in Shanghai were mainly imported. However, due to the nature of human-to-human transmission, the number of patients infected in Shanghai had gradually increased, which indicates that the COVID-19 has a strong ability to transmit between humans. In order to control the disease, Shanghai launched first-level public health response on 24 January 2020 (Shanghai Municipal People's Government, 2020). After the response was launched, Shanghai Municipal People's Government integrated resources to deal with the epidemic. All group activities were cancelled; masks were recommended to be worn in public places, and fever monitoring was conducted at the exit and entry points. Shanghai residents cooperated with the government by staying indoors. After 24 January 2020, although the number of cases peaked on 27 January, the number of new cases decreased significantly within two weeks, and kept at a low level after 8 February 2020 (Figure 1). The time intervals from onset to visit, hospitalization and diagnosis confirmed were all shortened. The mortality rate of COVID-19 in Shanghai was only 0.06%, much lower than that of mainland China (2.3%) (Novel Coronavirus Pneumonia Emergency Response Epidemiology Team, 2020). Another international metropolis, New York, reported a cumulative 26,697 cases from 1 March 2020 to 27 March 2020, with no downward trend (NYC Health, 2020). But Shanghai has had only 333 cases in over 1.5 months and has brought the local outbreak under control. These data manifested the effectiveness of the powerful prevention and control measures in Shanghai.

The median age of Shanghai's cases was 50 years old, which was older than those in Beijing (47.5 years old) (Tian et al., 2020) and New York (47 years old) (NYC Health, 2020), possibly for the reason of the city's ageing population(Shanghai Municipal Statistics Bureau, 2018). Of the 10 children cases in Shanghai, 7 were infected by their family members and all children cases had mild symptoms (7 non-pneumonia, 3 mild pneumonia). In concert with other research (Wang, Yuan, et al., 2020), children cases account for only a small ratio of all age groups in Shanghai and had milder symptoms, but the reasons remain unclear. Considering that some studies suggest that the expression of the receptor for COVID-19, which was currently regarded as angiotensin-converting enzyme 2 (ACE2) (Zhou et al., 2020), is not lower in children compared to that in adults (Xie, Chen, Wang, Zhang, & Liu, 2006), we suspect that fewer trips and less socializing in children lead to the lower morbidity, or simply because symptoms in children are

TABLE 4 First blood routine after onset of Adults (n = 323) and Children (n = 10)

	Adults (n = 323)				Children (n = 10)			
Blood routine	Overall	Female(n = 157)	Male (n = 166)	p	Overall	Female(n = 4)	Male (n = 6)	p
White blood cell								
Normal[b]	244 (81.1)	108 (73.5)	136 (88.3)	0.002	6 (85.7)	2 (100.0)	4 (80.0)	NA[a]
Decrease	56 (18.6)	39 (26.5)	17 (11.0)		1 (14.3)	0 (0.0)	1 (20.0)	
Increase	1 (0.3)	0 (0.0)	1 (0.6)		0 (0.0)	0 (0.0)	0 (0.0)	
Missing[c]	22	10	12		3	2	1	
Neutrophil								
Normal[b]	229 (97.4)	111 (98.2)	118 (96.7)	0.585	1 (33.3)	1 (100.0)	0 (0.0)	0.223
Decrease	5 (2.1)	2 (1.8)	3 (2.5)		1 (33.3)	0 (0.0)	1 (50.0)	
Increase	1 (0.4)	0 (0.0)	1 (0.8)		1 (33.3)	0 (0.0)	1 (50.0)	
Missing[c]	88	44	44		7	3	4	
Lymphocyte								
Normal[b]	229 (88.4)	114 (90.5)	115 (86.5)	0.303	4 (66.7)	1 (100.0)	3 (60.0)	0.741
Decrease	28 (10.8)	12 (9.5)	16 (12.0)		1 (16.7)	0 (0.0)	1 (20.0)	
Increase	2 (0.8)	0 (0.0)	2 (1.5)		1 (16.7)	0 (0.0)	1 (20.0)	
Missing[c]	64	31	33		4	3	1	
C-reactive protein								
Normal[b]	112 (57.1)	58 (63.7)	54 (51.4)	0.111	4 (80.0)	0 (0.0)	4 (100.0)	0.402
Increase	84 (42.9)	33 (36.3)	51 (48.6)		1 (20.0)	1 (100.0)	0 (0.0)	
Missing[c]	127	66	61		5	3	2	

[a]NA means data not available.

[b]Normal range of white blood cell is 4.0–10.0 × 10^9/L, except 6.0 ~ 15.0 × *10^9/L in child aged 6 month to 6 years; normal range of neutrophil is 1.5 ~ 7.5 × 10^9/L; normal range of lymphocyte is 0.8 ~ 4.0 × 10^9/L; normal range of C-reactive protein is 10 mg/L or less.

[c]All the missing data were not included in the statistical test.

milder and harder to detect. The less severe symptoms in children may be due to their different immune mechanisms from those of adults.

There are two facts worth discussing about the exposure history. One was that 103 cases had sojourned Wuhan without contacting confirmed cases and the other one was that 21 cases contacted people sojourning in Hubei but not confirmed cases. In our investigation, most of these patients did not even notice that people they contacted had symptoms like fever or cough. Mahase E pointed out that many asymptomatic or mildly infected people may scatter in the community as sources of infection (Mahase, 2020). And a familial cluster analysis indicated that patients in the incubation period may also be contagious (Chan et al., 2020b). Our investigation supported their opinions that asymptomatic and latent infections may become the focus of further prevention and control.

In our calculation, cases with single exposure to confirmed cases had a longer median incubation period (9.0 days) than those with a travel history in Wuhan (7.8 days) and multiple exposures to confirmed cases (7.5 days). This may be attributed to the greater amounts of pathogens that the patients were exposed to on account of the prolonged or multiple exposures. After pooling data and fitting gamma distribution, we estimated that the median incubation period was 7.2 days. However, our results showed a difference from other researches (Backer et al., 2020; Guan et al., 2020; Ki & nCo, 2020; Li et al., 2020), of which the median incubation period ranged from 3.0 to 6.4 days. Most articles did not announce their calculation methods, and the cases used to calculate in these articles were mainly travellers (Backer et al., 2020; Ki & nCo, 2020; Li et al., 2020). It is possible that the authors of these articles directly subtracted the date of travellers' departure from the date of onset when calculating incubation period, but the date of leaving infected areas is not necessarily the date of exposure. This algorithm underestimates the incubation period. Our method of choosing patients with clear earliest and last exposure time or single exposure time to estimate incubation period was more reasonable.

The clinical symptoms of COVID-19 include fever and cough, which are not specific compared with influenza or other respiratory diseases (Fajardo-Dolci et al., 2010; Mohammad, Korn, Schellhaas, Neurath, & Goertz, 2019; Shiley, Nadolski, Mickus, Fishman, & Lautenbach, 2010). However, though some of the patients (37.8%) did not have fever at onset, most patients (82.0%) indeed experienced fever from onset to hospitalization. This suggests that screening patients for fever symptoms is relatively effective. In our study, we found that most patients had normal white blood cell count, neutrophil and lymphocyte level, but 42.9% of the adults' cases experienced an increasing C-reactive protein in their

TABLE 5 Univariate analysis of clinical severity risk factors

Category	Non-pneumonia/mild pneumonia(n = 307)	Severe/critical pneumonia(n = 26)	p
Age (median, IQR)	47.0 [34.0, 62.0]	65.0 [63.0, 74.8]	<0.001
Age group (years)			
<15	10 (3.3)	0 (0.0)	<0.001
15–44	136 (44.3)	2 (7.7)	
45–59	75 (24.4)	3 (11.5)	
≥60	86 (28.0)	21 (80.8)	
Sex			
Female	155 (50.5)	6 (23.1)	0.013
Male	152 (49.5)	20 (76.9)	
BMI			
<18.5	18 (6.2)	1 (4.0)	0.359
18.5–23.9	141 (48.6)	9 (36.0)	
≥24	131 (45.2)	15 (60.0)	
Missing[a]	17	1	
Smoking history			
Yes	24 (8.9)	2 (8.0)	1
No	246 (91.1)	23 (92.0)	
Missing[a]	37	1	
Alcohol history			
Yes	76 (28.9)	5 (20.0)	0.546
No	187 (71.1)	20 (80.0)	
Missing[a]	44	1	
Anamnesis			
Yes	91 (29.6)	16 (61.5)	0.002
No	216 (70.4)	10 (38.5)	
Diabetes			
Yes	23 (7.01835)	5 (19.2)	0.089
No	284 (92.5)	21 (80.8)	
High blood pressure			
Yes	55 (17.9)	9 (34.6)	0.069
No	252 (82.1)	17 (65.4)	
Heart disease			
Yes	16 (5.2)	8 (30.8)	<0.001
No	291 (94.8)	18 (69.2)	
Respiratory disease			
Yes	3 (1.0)	2 (7.7)	0.062
No	304 (99.0)	24 (92.3)	
Onset visit interval	1.0 [0.0, 4.0]	1.0 [0.0, 4.0]	0.386
Onset hospitalization interval	3.0 [1.0, 6.0]	3.0 [2.0, 6.0]	0.291
Onset diagnosis-confirmed interval	5.0 [3.0, 8.0]	5.0 [3.0, 8.5]	0.602

[a]All the missing data were not included in the statistical test.

first blood routine after onset (Table 4), which was consistent with other researches (Singhal, 2020). Though elevated C-reactive protein is not expected with viral infections, Hakan Cinemre et.al found that C-reactive protein levels can increase in influenza-like illness and acute respiratory infection when the aetiology is influenza. They also suspected that this might be explained by tissue destruction (Cinemre et al., 2016). Since

TABLE 6 Multivariate analysis of clinical severity risk factors

Factor	β	Standard Error	OR	OR 95% CI	*p*P
Intercept	−7	1.1			<0.001
Age group	1.5	0.4	4.3	2.1–9.1	<0.001
Sex	1.5	0.5	4.6	1.7–12.6	0.003
Heart disease	1.4	0.6	4.2	1.2–14.2	0.024
Diabetes	0.1	0.6	1.1	0.3–3.6	0.884
High blood pressure	−0.4	0.6	0.7	0.2–2.0	0.495
Respiratory disease	0.7	1.1	2.0	0.2–18.3	0.538

[a]Age group (<15 = 1, 15–44 = 2, 45–59 = 3, ≥60 = 4),age group < 15 was used as the reference; sex(female = 1, male = 2),female was used as the reference; heart disease, diabetes, high blood pressure, respiratory disease(no = 1, yes = 2), the status no was used as the reference.

most patients with COVID-19 have systemic symptoms similar to influenza, the two kinds of infection may share the same mechanism of elevated C-reactive protein. It is possible to combine changes in C-reactive proteins with other tests, such as CT imaging to discriminate the infection of COVID-19, and further studies are needed.

Consistent with other researches (Novel Coronavirus Pneumonia Emergency Response Epidemiology, 2020; Wang, Chen, Lu, Chen, & Zhang, 2020), the number of male patients (51.7%) was slightly higher than that of female patients (48.3%) in Shanghai. The proportion of men (76.0%) in our severely or critically ill patients, however, was much higher than that of women (24.0%). Current research suggests that ACE2 is the receptor for COVID-19 (Zhou et al., 2020), and its expression in men is higher than that in women (Zhao et al., 2020), which may be the reason for the higher proportion of men with severe illness. People with heart disease or in older age groups tend to be more severely ill, perhaps because their immune systems are weak. Considering these risk factors for severe/critical illness, it is understandable that two fatal cases in Shanghai both had an old age and suffered from underlying diseases (one patient had heart disease). Interestingly, smoking is not associated with the severity of the disease, and that may be due to the levels of ACE2 are lower in smokers (Wan, Shang, Graham, Baric, & Li, 2020). This discovery was not consistent with the study of Liu W et.al (Liu et al., 2020), but in concert with a meta-analysis (Lippi & Henry, 2020). However, diabetes and hypertension are to a certain extent associated with diseases severity, but there is no statistical significance. However, they are risk factors for severe symptoms in other studies (Fang, Karakiulakis, & Roth, 2020), and our sample size may be limited to finding a statistical significance.

This study has several limitations. First, some cases have incomplete documentation of smoking history, alcohol history and clinical features. Second, our sample size is limited, especially for sever or critical patients, which may lead to some meaningful results being ignored.

5 | CONCLUSIONS

In summary, the prevention and control measures in Shanghai are effective. Most patients have mild symptoms and experience fever. Elderly, male and heart disease history is the risk factors for severe or critical pneumonia. It is necessary to strengthen the health management of these groups.

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CONFLICT OF INTEREST

All authors declare no competing interests.

AUTHORS' CONTRIBUTIONS

Xiaodong Sun, Hao Pan and Huangyu Wu involved in conception and design. Xiao Yu, Peng cui, Ruobing Han, Chenyan Jiang, Qiwen Fang, Dechuan Kong, Yiyi Zhu, Yaxu Zheng, Xiaohuan gong, Wenjia Xiao, Shenghua Mao and Bihong Jin involved in acquisition of data. Xiao Yu and Peng cui analysed and interpreted the data. Xiao Yu, Peng cui, Hao Pan, Xiaodong Sun and Chen Fu involved in writing, review and/or revision of the manuscript. Chen Fu supervised the study.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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APPENDIX 1

PRIMERS AND PROBES OF ORF1AB AND N GENE

ORF1ab: forward primer CCCTGTGGGTTTTACACTTAA; reverse primer ACGATTGTGCATCAGCTGA; probe 5′-FAM-CCGTCTGCGG TATGTGGAAAGGTTATGG-BHQ1-3′.

N: forward primer GGGGAACTTCTCCTGCTAGAAT; reverse primer CAGACATTTTGCTCTCAAGCTG; probe 5′-FAM- TTGCTGC TGCTTGACAGATT-TAMRA-3′.