

## Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.

## **eMethods**

### **Diagnosis and definition of clinical severity of COVID-19 cases**

Since the COVID-19 outbreak occurred in Wuhan in December 2019, the Chinese authorities have thus far released seven editions of the Diagnosis and Treatment Scheme to incorporate the most updated information into the Scheme. The 1<sup>st</sup> edition was released on January 15, which only classified critical and non-critical cases; the 2<sup>nd</sup> edition was released on January 18, which further classified cases into mild/moderate, severe and critical cases; the 3<sup>rd</sup> edition was released on January 22, which slightly modified the criteria for definition of severe case without changes for other aspects; the 4<sup>th</sup> edition as released on January 27, which further classified mild/moderate cases into mild cases and moderate cases; The 5<sup>th</sup> edition was released on February 5, the 6<sup>th</sup> edition on February 19, and the 7<sup>th</sup> edition on March 3. Since the 4<sup>th</sup> edition, the definitions of clinical severity remained the same.

In our dataset, a confirmed case was defined based on epidemiological history (including cluster transmission), clinical manifestations (fever and respiratory symptoms; laboratory evidence of normal or decreased number of leukocytes and/or lymphopenia), lung imaging, and results of SARS-CoV-2 nucleic acid detection. In the 7<sup>th</sup> edition, detection of serum-specific antibodies was further added. The classification of clinical severity of COVID-19 cases is shown below.

#### **Mild case**

The clinical symptoms are mild and no pneumonia manifestations can be found in imaging.

#### **Moderate case**

Patients have symptoms such as fever and respiratory tract symptoms etc., and pneumonia manifestations can be seen in imaging.

#### **Severe case**

Patients who meet any of the following criteria: dyspnea or respiratory rate  $\geq 30$  breaths/min; oxygen saturation  $\leq 93\%$  at a rest state; arterial partial pressure of oxygen (PaO<sub>2</sub>)/oxygen concentration (FiO<sub>2</sub>)  $\leq 300$  mmHg. Patients with  $>50\%$  lesions progression within 24 to 48 hours in lung imaging should be treated as severe cases.

#### **Critical case**

Patients who meet any of the following criteria: occurrence of respiratory failure requiring mechanical ventilation; presence of shock; other organ failure that requires monitoring and treatment in the Intensive Care Unit.

#### **Clinically-diagnosed cases**

The clinically-diagnosed cases were only allowed for the cases in the Hubei Province for the period of February 9 to 19 based on the 5<sup>th</sup> edition of the Scheme released by the National Health Commission of China released on February 8 and abolished on February 19. A presumptive case was defined as meeting the following criteria: (1) recent travel history to Wuhan City or Hubei Province; or close contact with a confirmed or probable case; or cluster transmission; (2) fever and/or respiratory symptoms; (3) laboratory evidence of normal or decreased number of leukocytes and/or lymphopenia. Those presumptive cases with further radiographic evidence showing pneumonia but without a positive RT-PCR test result were defined as clinically-diagnosed cases.

## Key events, features of the situation and interventions in the five periods

**First period** (December 8, 2019 to January 9, 2020): Onset of symptoms in the first known case of pneumonia with unknown etiology in Wuhan City, China was on December 8, 2019; a cluster of cases of pneumonia with unknown etiology was reported to the World Health Organization on December 31, 2019; the Huanan Seafood Wholesales Market (also sold the wild-life animals), where many early cases were linked to, was closed on January 1, 2020; Chinese scientists identified the pathogen as a novel coronavirus on January 7, 2020. No other interventions were imposed, and the SARS-CoV-2 virus was spread among the residents. Fever clinics were established as usually done in the flu season, as well as the recommendation of wearing facial masks to protect from getting seasonal flu. Those were not considered as specific interventions for the COVID-19 outbreak, and very few people wore masks during this period.

**Second period** (January 10 to 22, 2020): The *Chunyun* period started on January 10, and massive human migration might contribute to wide spread of SARS-COV-2 within the city, to other places domestically and internationally. The sequence was shared publicly on January 10 and shared with the WHO on January 12, and the test kits were available on January 13, and distributed to Wuhan CDC on January 16. The China CDC emergency response level was upgraded to Level 1 (the highest level); and the first technical protocols for diagnosis and treatment of COVID-19 was released by the National Health Commission of China on January 15. The human-to-human transmission was officially announced on January 20; and COVID-19 was incorporated as a notifiable disease in the Infectious Disease Law and Health and Quarantine Law in China on January 20. The Hubei authorities upgraded the emergency response level to Level 2 on January 22. No strong interventions were implemented in this period, except the recommendation of wearing facial masks and avoiding crowded areas, but those were not compulsory.

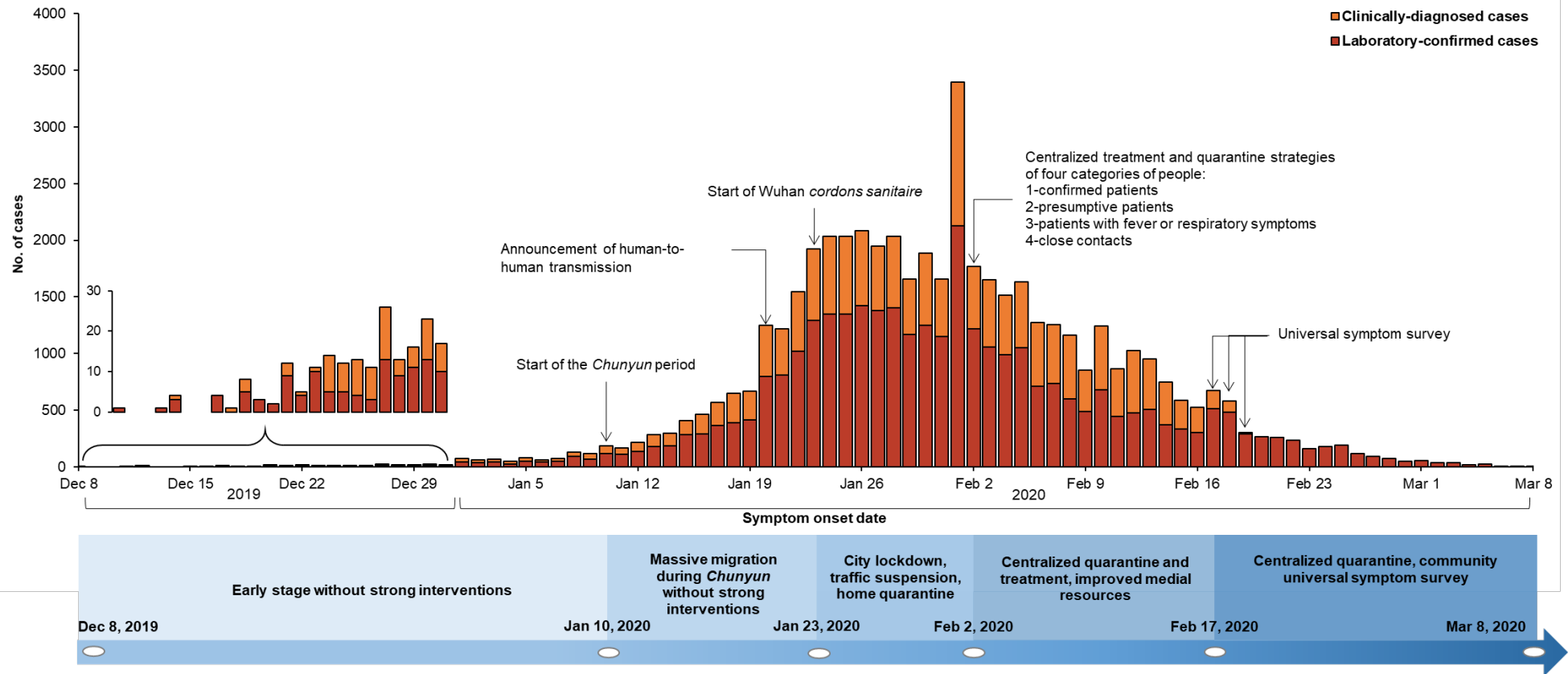
**Third period** (January 23 to February 1, 2020): The Wuhan officials implemented the policy of *cordons sanitaire* on January 23, all outbound transportations (air, train, long-haul buses, and cars) were blocked, a series of compulsory measures were taken subsequently: wearing facial masks in public places, cancellation of all social gathering, suspension of public transit and restriction of vehicular traffic. Due to severe shortage of medical resources (i.e., <1000 designated wards, drugs and ICU capacity, personal protective equipment, nucleic acid testing kits, supply of health care workers) in this period, many confirmed or presumptive cases could not receive timely diagnosis and treatment and were self-quarantined at home, but they were still allowed to go out for seeking medical care. This period was also the Lunar New Year national holiday, and people were recommended to stay at home.

**Fourth period** (February 2 to 16, 2020): Centralized quarantine policy was implemented because of the improvement in medical facilities and increasing supply of healthcare workers. Since the January 23, two infectious disease specific hospitals were built within a remarkably short time (about 10 days) with a total of 2500 beds for patients with severe to critical symptoms. Many hospitals reconstructed their wards to provide more than 25 000 beds to treat patients with moderate to critical symptoms. Meanwhile, 13 exhibition halls, stadia or large public facilities were reconstructed as Fangcang Shelter Hospitals to provide more than 13 000 beds for confirmed patients with mild symptoms. Many hotels, schools and public facilities were temporally requisitioned to accommodate those with fever or

respiratory symptoms (either waiting for the CT and nucleic acid tests or having negative test results for the first time, a total of more than 15 000 beds) or close contacts (a total of more than 59 000 beds). People were allocated to a different hospital/facility if she/he got diagnosed or symptoms status changed (relieved or worsened). At the same time, more than 30 000 health care workers from other provinces of China were deployed to Wuhan to fulfill the shortage of local doctors and nurses. Furthermore, the daily diagnostic testing capacity was improved quickly over time from a few dozen before January 20, and then a few hundred after January 20, and to about 5000 in the late January. The test was only allowed in CDC laboratories at the beginning but more and more hospital laboratories and commercial laboratories were authorized to perform the tests, and over 35 laboratories in Wuhan were granted permission till February 6 with daily diagnostic testing capacity over 10 000. All residents were required to stay at home, and community workers and volunteers were called upon to deliver food, drugs and other necessary goods to the residents.

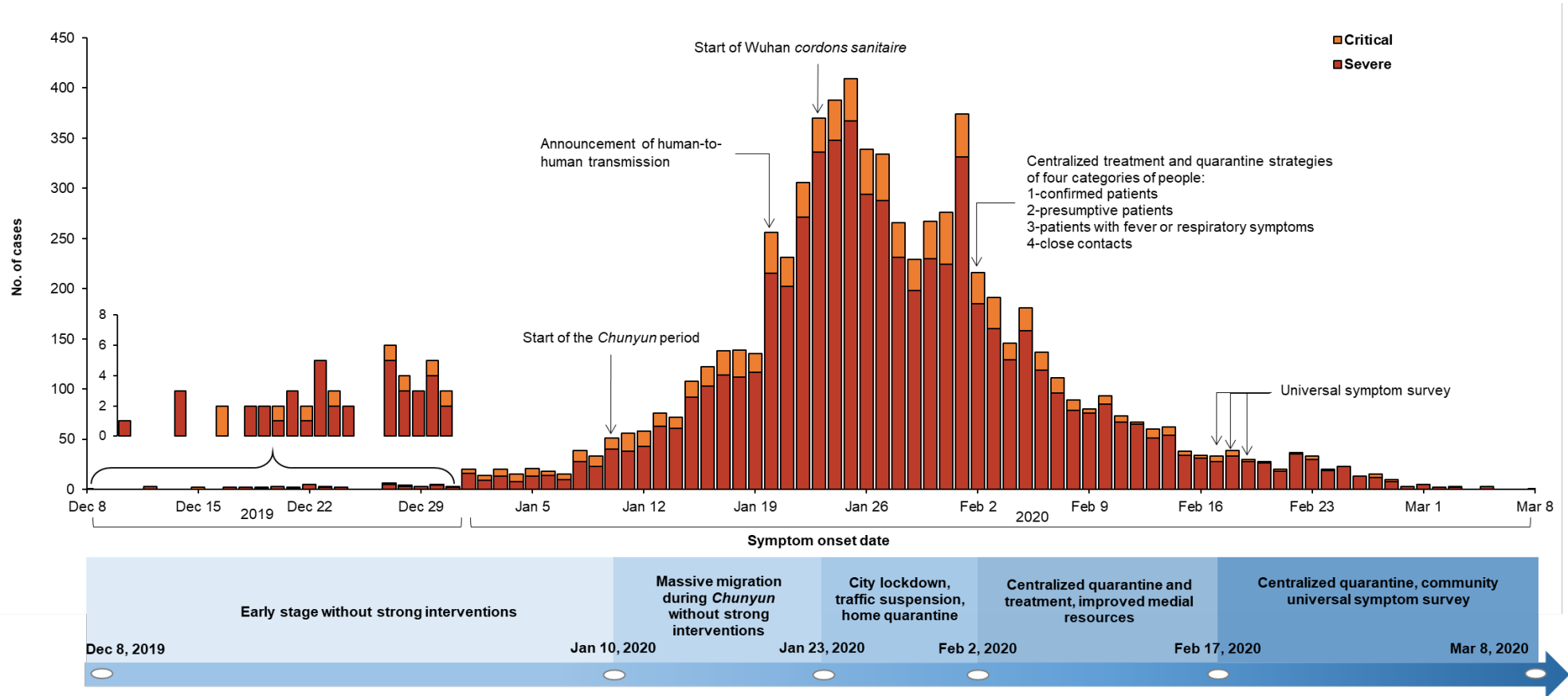
**Fifth period** (February 17 to March 8, 2020): With substantially reduced number of incident cases and improvement in medical resources, the government further initiated the door-to-door and individual-to-individual symptom screening for all residents with support from thousands of community workers and volunteers. Those with suspected symptoms were centrally quarantined and tested for SARS-CoV-2 infection. The daily diagnostic testing capacity was further increased to about 20 000 in this period. The residents remained to stay at home. The Fangcang Shelter Hospitals were closed successively and the last one was closed on March 10, 2020. With proper protection, none of the health care workers came from other provinces was infected.

**eFigure 1. Daily numbers of laboratory-confirmed and clinically-diagnosed COVID-19 cases by symptom onset date across the five periods**



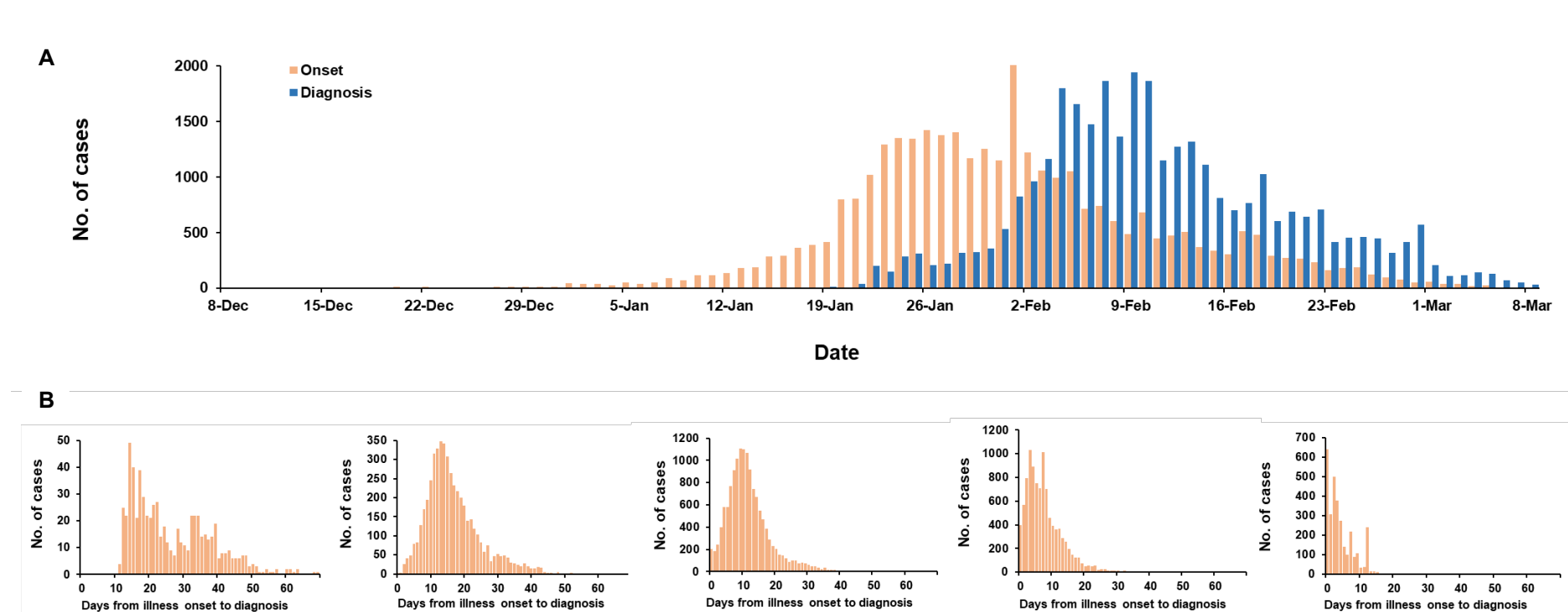
A total of 17 365 clinically-diagnosed cases and 32 583 laboratory-confirmed cases were included in the figure.

**eFigure 2. Daily numbers of laboratory-confirmed severe and critical COVID-19 cases by symptom onset date across the five periods**



A total of 6169 laboratory-confirmed severe cases and 970 laboratory-confirmed critical cases were included in the figure.

**eFigure 3. Time differences between disease symptom onset and diagnosis confirmation of laboratory-confirmed COVID-19 cases**



(A) Time differences between disease onset and confirmed diagnosis of all patients (n=32 583) from December 8, 2019 to March 8, 2020. (B) Time differences between disease onset and confirmed diagnosis in five periods: before January 10, January 10 to 22, January 23 to February 1, February 2 to 16, and February 17 to March 8.

**eTable 1. The daily rate for the laboratory-confirmed COVID-19 cases stratified by age, sex and occupation across the five periods**

Characteristics	Dec 8 - Jan 10	Jan 10-22	Jan 23 - Feb 1	Feb 2-16	Feb 17 - Mar 8	Total
All cases	2.0 (1.8 to 2.1)	45.9 (44.6 to 47.1)	162.6 (159.9 to 165.3)	77.9 (76.3 to 79.4)	17.2 (16.6 to 17.8)	41.5 (41.0 to 41.9)
Males	2.0 (1.8 to 2.3)	44.2 (42.5 to 46.0)	156.6 (152.9 to 160.3)	73.9 (71.8 to 75.9)	14.6 (13.8 to 15.4)	39.4 (38.8 to 40.0)
Females	1.9 (1.7 to 2.1)	47.6 (45.7 to 49.4)	168.9 (164.9 to 172.8)	82.1 (79.8 to 84.3)	20.0 (19.0 to 20.9)	43.7 (43.0 to 44.4)
Healthcare workers	5.1 (2.9 to 5.1)	272.3 (246.9 to 272.3)	617.4 (576.3 to 658.4)	159.5 (141.4 to 177.6)	21.8 (16.1 to 27.4)	130.5 (123.9 to 137.2)
Age group						
0 to 19 y	0.0 (0.0 to 0.1)	0.9 (0.5 to 1.3)	5.7 (4.5 to 7.0)	9.7 (8.4 to 11.1)	7.3 (6.4 to 8.3)	4.0 (3.7 to 4.4)
<1 y	0.0 (0.0 to 0.0)	2.2 (0.0 to 6.3)	16.1 (7.0 to 25.2)	17.0 (9.3 to 24.6)	13.4 (7.7 to 19.1)	7.9 (5.8 to 10.0)
1-2 y	0.1 (0.0 to 0.4)	0.8 (0.0 to 2.3)	2.5 (0.3 to 4.7)	6.0 (0.3 to 8.7)	3.3 (1.6 to 5.0)	2.2 (1.5 to 2.8)
3-5 y	0.0 (0.0 to 0.0)	0.3 (0.0 to 0.8)	2.5 (0.6 to 4.2)	5.9 (0.6 to 8.2)	3.0 (1.6 to 4.4)	2.0 (1.4 to 2.5)
6-9 y	0.0 (0.0 to 0.0)	0.5 (0.0 to 1.5)	2.3 (0.6 to 4.0)	7.7 (5.1 to 10.2)	8.8 (6.5 to 11.1)	3.6 (2.9 to 4.3)
10-19 y	0.0 (0.0 to 0.0)	1.4 (0.0 to 4.0)	8.8 (6.4 to 11.2)	13.0 (10.7 to 15.4)	9.2 (7.5 to 10.9)	5.4 (4.8 to 6.0)
20-39 y	0.7 (0.5 to 0.8)	25.8 (24.1 to 27.5)	87.4 (83.9 to 90.9)	46.1 (44.0 to 48.2)	12.7 (11.8 to 13.6)	23.8 (23.2 to 24.4)
40-59 y	2.4 (2.1 to 2.7)	57.8 (55.3 to 60.4)	206.6 (201.0 to 212.1)	97.3 (94.2 to 100.4)	19.4 (18.2 to 20.5)	51.8 (50.8 to 52.7)
60-79 y	4.9 (4.3 to 5.5)	98.5 (94.2 to 102.8)	350.4 (341.1 to 359.7)	151.0 (146.0 to 156.0)	22.9 (21.2 to 20.5)	83.6 (82.1 to 85.1)
≥80 y	4.4 (2.9 to 5.8)	77.0 (67.2 to 86.8)	278.4 (257.1 to 299.7)	170.7 (157.1 to 184.3)	70.0 (62.7 to 77.4)	86.5 (82.6 to 90.4)

Data were shown as number of confirmed cases per day per million people and its 95% confidence interval.



**eTable 2. The relations of age, sex, occupation and outbreak periods with the severe/critical severity of COVID-19**

Characteristics	No. (%) of severe/critical cases	Adjusted relative risk (95% confidence interval)*	<i>P</i>
Age group			
0-19 y	22 (4.10)	0.47 (0.31-0.70)	<.001
20-39 y	716 (12.12)	[Reference]	
40-59 y	2118 (17.42)	1.41 (1.30-1.53)	<.001
60-79 y	3510 (29.62)	2.33 (2.16-2.52)	<.001
≥80 y	773 (41.34)	3.61 (3.31-3.95)	<.001
Sex			
Male	3702 (23.68)	[Reference]	
Female	3437 (20.59)	0.90 (0.86-0.93)	<.001
Occupation			
Non-healthcare workers	6883 (22.31)	[Reference]	
Healthcare workers	256 (17.41)	1.08 (0.96-1.21)	.22
Outbreak period			
Period 1	243 (53.06)	[Reference]	
Period 2	1748 (35.11)	0.71 (0.64-0.77)	<.001
Period 3	3252 (23.48)	0.47 (0.43-0.52)	<.001
Period 4	1578 (15.86)	0.32 (0.29-0.36)	<.001
Period 5	318 (10.30)	0.22 (0.19-0.25)	<.001

\*Relative risk and the corresponding 95% confidence intervals were calculated using the modified Poisson regression with robust variance.

**eTable 3. Estimates of the effective reproduction number ( $R_t$ ) for the laboratory-confirmed COVID-19 cases from January 1 to March 8, 2020.**

<b>Date</b>	<b>Mean (95% Credible interval)</b>
January 1	2.96 (2.36-3.62)
January 2	3.50 (2.88-4.19)
January 3	3.94 (3.32-4.63)
January 4	3.62 (3.06-4.23)
January 5	3.74 (3.22-4.29)
January 6	3.02 (2.60-3.47)
January 7	2.66 (2.30-3.04)
January 8	2.75 (2.42-3.10)
January 9	2.76 (2.45-3.08)
January 10	2.91 (2.62-3.21)
January 11	3.01 (2.74-3.30)
January 12	3.11 (2.85-3.38)
January 13	3.10 (2.86-3.35)
January 14	3.12 (2.90-3.35)
January 15	3.24 (3.03-3.45)
January 16	3.28 (3.09-3.48)
January 17	3.34 (3.17-3.53)
January 18	3.26 (3.10-3.43)
January 19	3.14 (2.99-3.29)
January 20	3.40 (3.26-3.54)
January 21	3.49 (3.36-3.62)
January 22	3.61 (3.49-3.73)
January 23	3.80 (3.69-3.92)
January 24	3.82 (3.72-3.93)
January 25	3.46 (3.37-3.55)
January 26	3.13 (3.05-3.20)
January 27	2.70 (2.64-2.76)
January 28	2.27 (2.22-2.32)
January 29	1.86 (1.82-1.91)
January 30	1.59 (1.55-1.62)
January 31	1.35 (1.31-1.38)
February 1	1.37 (1.34-1.40)
February 2	1.24 (1.21-1.27)
February 3	1.16 (1.13-1.19)
February 4	1.07 (1.05-1.10)
February 5	1.02 (1.00-1.05)
February 6	0.78 (0.76-0.80)
February 7	0.70 (0.68-0.72)
February 8	0.62 (0.61-0.64)
February 9	0.56 (0.54-0.57)
February 10	0.51 (0.50-0.53)

<b>Date</b>	<b>Mean (95% Credible interval)</b>
February 11	0.49 (0.48-0.51)
February 12	0.48 (0.46-0.50)
February 13	0.50 (0.48-0.52)
February 14	0.51 (0.49-0.53)
February 15	0.48 (0.46-0.50)
February 16	0.49 (0.47-0.51)
February 17	0.55 (0.52-0.57)
February 18	0.59 (0.56-0.62)
February 19	0.62 (0.59-0.65)
February 20	0.65 (0.62-0.68)
February 21	0.68 (0.65-0.72)
February 22	0.62 (0.59-0.65)
February 23	0.52 (0.49-0.55)
February 24	0.50 (0.47-0.53)
February 25	0.49 (0.46-0.52)
February 26	0.45 (0.42-0.48)
February 27	0.41 (0.38-0.44)
February 28	0.39 (0.36-0.42)
February 29	0.34 (0.31-0.37)
March 1	0.28 (0.26-0.31)
March 2	0.25 (0.22-0.28)
March 3	0.23 (0.20-0.26)
March 4	0.21 (0.18-0.24)
March 5	0.21 (0.18-0.24)
March 6	0.17 (0.14-0.20)
March 7	0.15 (0.12-0.18)
March 8	0.10 (0.08-0.13)

The effective reproduction number  $R_t$  was calculated over a 5-day moving average for the whole period, but results are shown since January 1, 2020, given the limited number of diagnosed cases and limited diagnosis capacity in December 2019.