Case fatality risk of the first pandemic wave of novel coronavirus disease 2019 (COVID-19) in China

Xiaowei Deng, MSc[1#], Juan Yang, PhD[1#], Wei Wang, MSc[1#], Xiling Wang, PhD[1#], Jiaxin Zhou, BSc [1], Zhiyuan Chen, BSc [1], Jing Li, BSc [1], Yinzi Chen, BSc [1], Han Yan, BSc [1], Juanjuan Zhang, PhD[1], Yongli Zhang, MSc [2], Yan Wang, MSc[1], Qi Qiu, MSc [1], Hui Gong, BSc [1], Xianglin Wei, BSc [1], Lili Wang[1], Kaiyuan Sun, PhD[3], Peng Wu, PhD[4], Marco Ajelli, PhD[5,6], Benjamin J. Cowling, PhD[4], Cecile Viboud, PhD[3], Hongjie Yu, PhD[1]

#These authors contributed equally to this work.

1. School of Public Health, Fudan University, Key Laboratory of Public Health Safety, Ministry of Education, Shanghai, China

2. Savaid Medical School, University of Chinese Academy of Sciences, Beijing, China

3. Division of International Epidemiology and Population Studies, Fogarty International Center, National Institutes of Health, Bethesda, MD, USA

4. WHO Collaborating Centre for Infectious Disease Epidemiology and Control, School of Public Health, Li Ka Shing Faculty of Medicine, University of Hong Kong, Hong Kong Special Administrative Region, China

5. Bruno Kessler Foundation, Trento, Italy

6. Department of Epidemiology and Biostatistics, Indiana University School of Public Health, Bloomington, IN, USA

Corresponding author to Prof. Hongjie Yu, yhj@fudan.edu.cn

Summary of the article: We used publicly available data to assess the case fatality risk of COVID-19 in mainland China, stratified by region and clinical category. The case fatality risk was highest in Wuhan and increased with age, being male, and clinical severity.

ABSTRACT

Objective To assess the case fatality risk (CFR) of COVID-19 in mainland China, stratified by region and clinical category, and estimate key time-to-event intervals.

Methods

We collected individual information and aggregated data on COVID-19 cases from publicly available official sources from December 29, 2019 to April 17, 2020. We accounted for right-censoring to estimate the CFR and explored the risk factors for mortality. We fitted Weibull, gamma, and lognormal distributions to time-to-event data using maximum-likelihood estimation.

Results

We analyzed 82,719 laboratory-confirmed cases reported in mainland China, including 4,632 deaths, and 77,029 discharges. The estimated CFR was 5.65% (95%CI: 5.50%-5.81%) nationally, with highest estimate in Wuhan (7.71%), and lowest in provinces outside Hubei (0.86%). The fatality risk among critical patients was 3.6 times that of all patients, and 0.8-10.3 fold higher than that of mild-to-severe patients. Older age (OR 1.14 per year; 95%CI: 1.11-1.16), and being male (OR 1.83; 95%CI: 1.10-3.04) were risk factors for mortality. The time from symptom onset to first healthcare consultation, time from symptom onset to laboratory confirmation, and time from symptom onset to hospitalization were consistently longer for deceased patients than for those who recovered.

Conclusions

Our CFR estimates based on laboratory-confirmed cases ascertained in mainland China suggest that COVID-19 is more severe than the 2009 H1N1 influenza pandemic in hospitalized patients, particularly in Wuhan. Our study provides a comprehensive picture of the severity of the first wave of the pandemic in China. Our estimates can help inform models and the global response to COVID-19.

KEY WORDS: Novel coronavirus diseases 2019, severe acute respiratory syndrome coronavirus 2, case fatality risk, China

Introduction

As of April 17, 2020, a total of 82,719 cases of novel coronavirus disease 2019 (COVID-19) have been reported in mainland China, including 4,632 deaths [1, 2]. The first wave of COVID-19 transmission has ended in mainland China, due to implementation of stringent public health interventions [4]. However, as the pandemic continues throughout the world, China faces mounting pressure from travel-related case importations. As of April 17, a total of 1,566 imported cases were reported in 27 (87%, 27/31) Chinese provinces [1, 2]. Coupled with the decline of the public health response and resumption of economic activities, the risk of re-emergence of COVID-19 remains high [5].

The case fatality risk (CFR) is a key metric for clinical severity assessment. It is determined by multiple factors, including the intrinsic virulence of a pathogen, the availability of timely and appropriate treatment, the surge capacity of the healthcare system, and accessibility to medical care. Unbiased and precise estimates of CFR are important to help policy-makers balance the socioeconomic impact of interventions against the potential health benefits [6]. CFR is also a key parameter for mathematical models of SARS-CoV-2 transmission, which have been widely used throughout the outbreak to compare intervention scenarios.

Estimates of the fatality risk of COVID-19 in China have been highly variable (0.98%-18%) [5, 7-14] . These estimates addressed the early stages of the outbreak and suffer from censoring due to time delay between onset and death, they do not include recent updated in COVID-19 statistics [3], and they do not account for improved patient care in later stages of the outbreak. More comprehensive estimates of COVID-19 severity could help preparedness for the potential resurgence of a second wave.

Other important quantities for healthcare system planning and modeling include the distribution of time intervals from symptom onset to seeking care, hospitalization, and death or discharge. Several studies have evaluated these time-to-event distributions early in the epidemic [15-19]; however these may have changed as the outbreak progressed.

A seminal report on the epidemiology of COVID-19 in China indicates that mild cases have a 5.1% probability of death, and this probability increases markedly with severity [22]. However, to our knowledge, no study has evaluated CFR stratified by clinical category upon hospital admission. This information is important for prioritization of patients upon hospital admission.

Here, we assessed CFR among laboratory-confirmed COVID-19 cases reported until mid-April 2020 in mainland China, stratified by clinical category and region. We also explored the risk factors associated with fatal outcomes, and the key time-to-event intervals in provinces outside Hubei.

Methods

Case definitions and surveillance

The National Health Commission of China (NHC) and the Chinese Center for Disease Control and Prevention (China CDC) launched a surveillance system to record information on COVID-19 cases in late December 2019 (See [23] for details). As the epidemic evolved, a total of seven versions of case definitions were issued by NHC [5, 15].

Four clinical categories of laboratory-confirmed COVID-19 patients have been identified by NHC, including mild-, moderate-, severe-, and critical-patients [23-25]. Mild patients, introduced in the fifth and sixth versions of the COVID-19 case definition, refer to patients with no radiographic evidence of pneumonia. Moderate patients, introduced in the fourth version of the case definition, refers to patients with fever, respiratory symptoms, and radiographic evidence of pneumonia. Severe patients, introduced in the second version, refers to patients with either breathing problems, low finger oxygen saturation, low PaO2/FiO2

(PaO2 denotes partial pressure of oxygen in arterial blood; FiO2 denotes fraction of inspired oxygen), or pulmonary imaging having obvious progress of lesions (>50%) within 24~48 hours. Critical patients denote patients having any respiratory failure or shock, and any other organ failure that requires ICU admission. This definition was used from the very beginning of the outbreak.

Patients were discharged when they met all the following criteria: 1) normal body temperature for more than 3 days, 2) significantly improved respiratory symptoms, 3) significantly relieved acute exudative lesions indicated by lung radiographic findings, and 4) negative nucleic acid detection by real-time RT-PCR using respiratory specimens on two consecutive days, with a sampling interval ≥1 day [25].

Data collection

Daily aggregated data (hereafter referred to as the aggregated dataset) on the cumulative number of cases were extracted from the websites of national, provincial, and municipal Health Commissions [1]. Individual records on COVID-19 cases (hereafter referred to as the individual dataset) were collected from two official publicly available sources from December 29, 2019 through to April 17, 2020, including: 1) health authority websites [1]; 2) national and local government affiliated medias [26]. Individual information was extracted and

entered into a structured database comprising demographic characteristics, dates of symptom onset, first healthcare consultation, hospital admission, official announcement (reporting date), as well as outcome (i.e., death/discharge and corresponding dates). Each individual record was extracted and entered by three coauthors and was cross-checked to ensure data accuracy. Conflicting information was resolved based on the Health Commission data. Details on data collection, completeness, and censoring are provided in Appendix, Tables S1-2.

Statistical analysis

Using individual dataset, we analyzed demographic characteristics, risk factors associated with fatal outcome, and key time-to-event intervals to the provinces outside Hubei, where the majority of individual records were obtained (80.8%, 11,793/14,590). We implemented a multivariate logistic regression model to explore the risk factors associated with death. We included age, sex, economic region [27], time interval from symptom onset to first medical consultation, first hospital admission, and laboratory diagnosis. We categorized China into three economic regions (see Appendix, Figure S1) [27].

To estimate the key time-to-event intervals, including symptom onset to first healthcare consultation, hospital admission, laboratory diagnosis, and death or discharge, and from hospital admission to death or discharge, we fitted three

parametric distributions (Weibull, gamma, and lognormal) to empirical data using maximum-likelihood estimation. We selected the best fit based on the Akaike information criterion.

Using the aggregated dataset as of April 17, we applied two methods to estimate CFR. First, we calculated a crude CFR based on the cumulative number of deaths divided by the cumulative number of cases, ignoring the time-lag between symptoms onset and death [28]. In a second approach, we adjusted for delays between hospitalization and death to obtain more accurate estimates of CFR, using the method described by Garske et al. for pandemic influenza A/H1N1 in 2009 [29]. This approach weights cases in the denominator of the CFR based on the distribution of the time interval from hospital admission to death. Recent cases have lower weights since their outcomes is unlikely to be observed (Appendix). This approach generates time-stamped CFR estimates using aggregated data.

To estimate CFR by clinical category, we compiled the proportion of cases and deaths in each category and region from different reports [30-32]. We then applied these proportions to our aggregated datasets of cases and deaths using resampling approaches (Appendix).

Lastly, we assessed the impact of importations on the CFRs and key time-to-event intervals in sensitivity analyses. As of April 17, all 1,566 international importations were reported in provinces outside Hubei and no death has been reported among imported cases. Statistical analyses were performed in R (version 3.6.0).

Ethics

The study was approved by the Institutional review board from School of Public Health, Fudan University (IRB#2020-02-0802). All data were collected from publicly available sources and did not contain any personal information.

Results

As of April 17, 2020, a total of 82,719 laboratory-confirmed cases including 4,632 deaths, 77,029 discharged and 1,058 patients who were still hospitalized were reported in mainland China (see Table S2 for details of each province). Of these, provinces outside Hubei accounted for 14,591 (17.6%, 14,591/82,719) of laboratory-confirmed cases, including 120 deaths (2.6%, 120/4,632), 13,535 (17.6%, 13,535/77,029) discharged cases and 936 (88.5%, 936/1,058) patients who were still hospitalized. We collected individual information from publicly available official sources on 11,793 laboratory-confirmed cases detected outside

Hubei, accounting for 80.8% (11,793/14,590) of total cases reported, 65.0% (78/120) of deceased patients, and 27.7% (3,746/13,533) of recovered patients. Of the 11,793 cases, unresolved patients accounted for 67.6% (7,969/11,793) (Table 1). See Figure S3 for an epidemic curve of cases with available individual information.

The median age of cases outside Hubei was 45 years (range, four days-97 years), and 53% (5,950/11,321) were male. Those who died were significantly older than those who were discharged (median age: 75 vs 42 years, p<0.001). 77% (59/77) of deaths occurred in adults aged 65 years or above, and 60% (47/78) were male. (Table 1)

The intervals from symptom onset to first healthcare consultation, from symptom onset to hospitalization, and from symptom onset to laboratory confirmation were consistently longer for deceased patients than for those who recovered. However, disease progression was quicker in individuals who died: overall, the time interval from symptom onset to death was estimated to be 13.9 days (95%CI: 1.9-47.2), and the interval from symptom onset to discharge was 20.6 days (95%CI: 8.9-39.8). (Table 2)

Based on the total patients reported to the surveillance system, the CFR estimated by Garske's method [29] was somewhat higher than crude CFR estimates (Table 3). CFR was 5.65% (95%CI: 5.50%-5.81%) for mainland China, with highest estimate in Wuhan (7.71%, 95%CI: 7.48%-7.94%), and lowest estimate in the provinces outside Hubei (0.86%, 95%CI: 0.72%-1.03%).

In Wuhan, the CFR among critical patients was 86.49% (95%CI: 80.93%-92.47%), which was 13-fold higher than that in provinces outside Hubei (6.07%, 95%CI: 4.52%-7.72%). The CFR among critical patients was 6.6-fold higher than that of severe patients, 12.1-fold higher than that of moderate patients, and 41.2-fold higher than that of mild patients. Smaller differences in mortality risk by clinical categories (0.8-10.3-fold) were observed in the rest of mainland China. (Figure 1)

The CFR in provinces outside Hubei remained stable at around 1.0% after February 1, as estimated by Garske's method [29]. In Wuhan, the CFR declined rapidly from 88.6% on January 28 to 8.5% on February 24, and remained stable afterwards. Similar patterns were observed in other regions, where the CFR became stable in late February (Figure 2). Multivariate logistic analysis revealed that increasing age and being male were risk factors for mortality (Table 4; see also Table S3 for univariate analysis).

The key time-to-event intervals were shorter for imported cases than that of domestic cases (Appendix, Figure S4). Excluding importations, the CFR in provinces outside Hubei provinces increased to 5.72% (95%CI: 5.57%-5.89%), while the CFR in mainland China increased to 0.93% (95%CI: 0.78%-1.11%).

Discussion

We have shown that the CFR was 5.65% in mainland China, with highest severity in Wuhan (7.71%) and lowest severity in provinces outside Hubei (0.86%). The CFR increased with clinical severity, which was estimated at 86.49% among critical patients in Wuhan, and 6.07% in provinces outside Hubei. Males and older patients were at increased risk of mortality. Both the time from symptom onset to outcome and from hospital admission to outcome was shorter for deceased patients than for those who recovered. These estimates account for delayed outcomes and recent updates in official statistics and could represent the most accurate estimates of COVID-19 severity in China so far.

Our CFR estimate of 0.86% for COVID-19 patients outside Hubei province is higher than the crude CFRs reported by WHO and China CDC, which is 0.4-0.7% [22, 28]. This is expected as the crude CFR is an underestimate due to the inevitable delay between symptom onset and death. Another study of patients

outside Hubei which accounted for censoring reports an estimate comparable to ours (0.98%) [3, 5]. Our estimate for Wuhan is higher than in prior studies however (7.71% vs 5.91% [3, 5]), and this is likely explained by our adjustment for censoring and the addition of revised statistics on cases and deaths.

Large variations in CFR were observed between countries [35]. Variations could be explained by difference in the sensitivity of surveillance systems to detect cases at different levels of the severity pyramid, differences in clinical care of severe and critical patients, and age structure and underlying conditions of the population. Accordingly, settings with limited health services like Iran, report a larger ratio of deaths to cases than other countries [36].

No specialized treatment for COVID-19 patients has been identified, and the mainstay clinical management has been supportive care. For non-critically ill patients, close follow-up is likely to be sufficient to manage the disease. But critically ill patients are more likely to develop ARDS and require ICU admission [37]. This likely explains our findings that critical patients have a higher fatality risk. The fatality risk in Wuhan and in the broader Hubei province was higher than in the rest of China, probably due to shortage of health services, and possible difficulties in keeping record of all cases in Wuhan. There was particular

shortage of advanced health care facilities for critically ill patients, such as extracorporeal membrane oxygenation.

As the domestic epidemic of COVID-19 was gradually brought under control in mainland China, the government implemented strict quarantine of international arrivals to prevent reintroductions. Care seeking delays were much shortened among international travelers due to enhanced monitoring and quarantine, possibly explaining the absence of fatal outcomes among imported COVID-19 cases thus far. Reassuringly, due to the small number of imported cases relative to the domestic epidemic, our CFR estimates were not influenced by inclusion or exclusion of this subpopulation.

Our findings reveal that older individuals and male patients experience higher fatality risk, which is consistent with a seminal report [22, 38]. Additionally, patients with underlying conditions had much higher fatality rates [22, 38]. Our study was unable to address the relative risk of fatal outcome among patients with underlying diseases compared to healthy people, because limited information was available from publicly available data sources.

Our CFR estimates outside Hubei province indicate that the severity of SARS-CoV-2 is lower than that of other diseases caused by zoonotic coronaviruses,

including Middle East respiratory syndrome (MERS, CFR 34.4% [39]), and severe acute respiratory syndrome (SARS, CFR 7% in mainland China and11% globally [40]). In contrast, the CFR of COVID-19, particularly in the epicenter of Wuhan, is more severe than that of pandemic 2009 influenza A(H1N1) virus hospitalizations (CFR of 1.4% in Asia [41]).

Outside Hubei, close contacts of laboratory-confirmed cases were kept in quarantine for 14 days. Local hospitals tested patients with respiratory symptoms, those with epidemiological links to Hubei province, or to other COVID-19 patients. Surprisingly, only a small number of mild cases were captured. In our aggregated dataset for Guangdong province for instance, only 8.2% of reported cases were mild, while the majority (80.1%) had moderate disease severity with presence of pneumonia. Chest x-ray confirmed pneumonia is a threshold for hospital admission in China, and thus our CFR estimates could approximately represent the fatality risk among hospitalized cases. Thresholds for hospitalization may vary among countries due to different clinical practices and health service capacity.

Notably, the definition of suspected cases eligible for laboratory testing was broadened on January 27 to include milder patients. This would bias our sample towards more clinically severe cases before January 27, as reflected by the very

high CRF estimate before that date (89%). In addition to improvement in therapeutic capacity, the shift in surveillance definition could partially explain the declining trend of CFR in February and beyond. A robust estimate of CFR can be obtained after February 23 since 90% of deaths occurred within 26 days of hospitalization; these later estimates should be considered most trustworthy.

Our study has some limitations. First, reliable individual records were retrieved from publicly available official sources; however records were scarce for Hubei because this province did not release complete individual information. And thus, we were unable to estimate key time-to-event intervals in Hubei using maximum-likelihood estimation.

Second, to estimate the CFR stratified by clinical category in provinces outside Hubei, the proportions of patients in each clinical category was obtained from Guangdong data[32]. Geographically comprehensive information was not available. However, the proportion of severe and critical cases was similar in Guangdong province and provinces outside Hubei (10.9% vs. 11.3%), supporting the representativeness of our data.

Third, assessment of clinical severity in Hubei, especially in the epicenter of the outbreak in Wuhan, is challenging because disease severity may be increased by

bottlenecks in local healthcare capacity. Complete and accurate documentation of causes of death during such a large outbreak is challenging. To correct for late reporting, omissions and mis-reporting of COVID-19 cases during the outbreak, Wuhan Authorities conducted a comprehensive and systematic verification between late March and middle April, adding a substantial amount of cases and deaths. We cannot rule out however the potential misclassification of COVID-19 deaths. To the best of our knowledge, these data represent direct deaths from COVID-19 in otherwise healthy patients, as well as deaths among patients with comorbidities and a diagnosis of COVID-19. Even outside of a pandemic situation, ascertainment of cause of death is complicated; further analyses of vital statistics using excess mortality approaches will be important to resolve the direct and indirect contribution of COVID-19 to mortality.

Conclusions

In conclusion, our estimates of CFR among laboratory-confirmed cases suggest that COVID-19 is not as severe as SARS and MERS, but more severe than the pandemic 2009 H1N1 virus among hospitalized patients. The fatality risk of COVID-19 cases is higher in Wuhan, among male and in older ages. Our findings can inform the response to the on-going COVID-19 pandemic, provide useful parameters to model the effect of interventions on morbidity and mortality, and assist preparedness for a potential resurgence of the epidemic in China.

Contributors

H.Y. conceived, designed and supervised the study. W.W., J.L., Y.C., H.Y., Y.Z., Q.Q., H.G., Xiang.W., L.W. and K.S. participated in data collection. X.D., J.Y., X.W., JX.Z., Z.C, J.Z., and Y.W. analyzed the data, and prepared the figures. J.Y. prepared the first draft of the manuscript. X.D., P.W., M.A., B.C., C.V., and H.Y. commented on the data and its interpretation, revised the content critically. All authors contributed to review and revision and approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Declaration of interests

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Table 1. Demographical characteristics of COVID-19 cases outside Hubei province in mainland China, as of April 3, 2020

Characteristic	Died (n=78)	Discharged (n=3,746)	Unresolved (n=7,969) [a]	All cases (n=11,793)
Median age (year, range)	75 (25-94)	42 (0.13-97)	46 (0.01-96)	45 (0.01-97)
Age group (year) (n, %) [b]				
0-6	0 (0)	85 (2)	84 (1)	169 (2)
7-17	0 (0)	129 (4)	200 (3)	329 (3)
18-24	0 (0)	257 (7)	455 (6)	712 (7)
25-49	4 (5)	1865 (52)	3565 (50)	5434 (50)
50-64	14 (18)	877 (24)	1931 (27)	2822 (26)
≥65	59 (77)	407 (11)	893 (13)	1359 (13)
Missing [c]	1 (1)	126 (3)	841 (11)	968 (8)
Sex (n, %)				
Male	47 (60)	1969 (53)	3934 (52)	5950 (53)
Female	31 (40)	1727 (47)	3613 (48)	5371 (47)
Missing [c]	0 (0)	50 (1)	422 (5)	472 (4)
Region (n, %) [d]				
East	31 (40)	1614 (43)	3351 (42)	4996 (42)
Central	20 (26)	978 (26)	2914 (37)	3912 (33)
West and Northeast	27 (35)	1154 (31)	1704 (21)	2885 (24)

[a] Including these cases who may had outcomes (i.e., death/discharge), but their information unavailable from public data sources. [b] Significant difference was observed among patients who died and the discharged ($p<0.001$). [c]: The denominator for estimating the proportion of missing data is the total number of COVID-19 cases. Missing data were excluded for calculating the proportion per strata. [d] Significant difference was observed among patients who died and the discharged ($p<0.05$). East: Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan provinces; Central: Shanxi, Anhui, Jiangxi, Henan, and Hunan provinces; West: Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang; Northeast: Heilongjiang, Jilin and Liaoning.

Table 2. Key time to event intervals of COVID-19 patients outside Hubei province in mainland China, as of April 3, 2020 (mean, 95%CI)

Key time-to-event interval	All (n=11,793)	Died (n=78)	Discharged (n=3,746)
Time from symptom onset to first healthcare consultation (days)	n=3,804	n=36	n=1,360
Estimates from empirical data	1.0 (0.5, 10.2)	2.0 (0.5, 9.6)	1.0 (0.5, 10.0)
Estimates by fitting	1.6 (0.2, 12.4)	1.7 (0.2, 15.6)	1.5 (0.2, 12.1)
Time from symptom onset to hospital admission (days)	n=3,381	n=39	n=1,563
Estimates from empirical data	3.0 (0.5, 13.0)	4.0 (0.5, 12.5)	3.0 (0.5, 13.0)
Estimates by fitting	2.2 (0.3, 19.0)	3.5 (0.2, 16.0)	2.9 (0.2, 13.4)
Time from symptom onset to laboratory confirmation (days)	n=6,406	n=41	n=1,890
Estimates from empirical data	5.0 (0.5, 16.0)	6.0 (1.0, 14.8)	5.0 (0.5, 15.0)
Estimates by fitting	5.0 (0.5, 15.9)	5.8 (0.8, 15.8)	4.9 (0.5, 15.5)
Time from symptom onset to outcome (days)	n=2,178	n=46	n=2,132
Estimates from empirical data	20.0 (9.0, 42.0)	13.5 (3.1, 43.8)	20.0 (10.0, 42)
Estimates by fitting	20.4 (8.5, 40.3)	13.9 (1.9, 47.2)	20.6 (8.9, 39.8)
Time from hospital admission to outcome (days)	n=2,643	n=60	n=2,583
Estimates from empirical data	16.0 (6.0, 38.9)	9.0 (0.7, 37.5)	16.0 (7.0, 39.0)
Estimates by fitting	16.7 (5.8, 36.5)	9.3 (0.7, 39.1)	16.4 (7.0, 38.6)

Table 3. Fatality risk of COVID-19 among all reported cases, and among severe and critical cases [a]

	Number of cases		Fatality risk among all reported cases (%, 95%CI)	
	Death	**Total cases reported**	**Crude**	**Estimated using Garske's method [29]**
Wuhan in Hubei province	3,869	50,333	7.69 (7.46, 7.92)	7.71 (7.48, 7.94)
Outside Wuhan in Hubei province	643	17,795	3.61 (3.35, 3.90)	3.62 (3.35, 3.90)
Provinces outside Hubei	120	14,591	0.82 (0.69, 0.99)	0.86 (0.72, 1.03)
Overall	4,632	82,719	5.60 (5.44, 5.76)	5.65 (5.50, 5.81)

[a] crude fatality risk was calculated as the cumulative number of deaths divided by the cumulative number of laboratory-confirmed cases.

Table 4. Risk factors associated with fatal outcome among COVID-19 patients

Variables	OR (95%CI)	Z-value	P-value
Age, per year increase	1.14 (1.11-1.16)	12.12	<0.001
Sex			
Female	ref	/	/
Male	1.83 (1.10-3.04)	2.32	0.020
Unknown	0 (0-Inf)	-0.02	0.983
Economic regions [a]			
East	ref	/	/
Central	1.41 (0.74-2.70)	1.05	0.294
West and Northeast	1.38 (0.78-2.46)	1.10	0.271
Time from symptom onset to first healthcare consultation			
≤2 days	ref	/	/
>2 days	1.27 (0.55-2.90)	0.56	0.577
Unknown	0.47 (0.21-1.05)	-1.84	0.065
Time from symptom onset to hospital admission			
≤3 days	ref	/	/
>3 days	1.12 (0.47-2.67)	0.25	0.805
Unknown	0.64 (0.27-1.51)	-1.02	0.307
Time from symptom onset to laboratory confirmation			
<=6 days	ref	/	/
>6 days	1.30 (0.58-2.90)	0.63	0.527
Unknown	2.79 (1.13-6.90)	2.22	0.027

[a] East: Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan provinces; Central: Shanxi, Anhui, Jiangxi, Henan, and Hunan provinces; West: Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang; Northeast: Heilongjiang, Jilin and Liaoning. /not applicable.

Figure legend

Figure 1. Case-fatality risk (mean) by clinical categories (mild, moderate, severe and critical patients) (mean, 95%CI).

Figure 2. Case-fatality risk over time in mainland China (%) (mean, 95%CI).

Figure 1

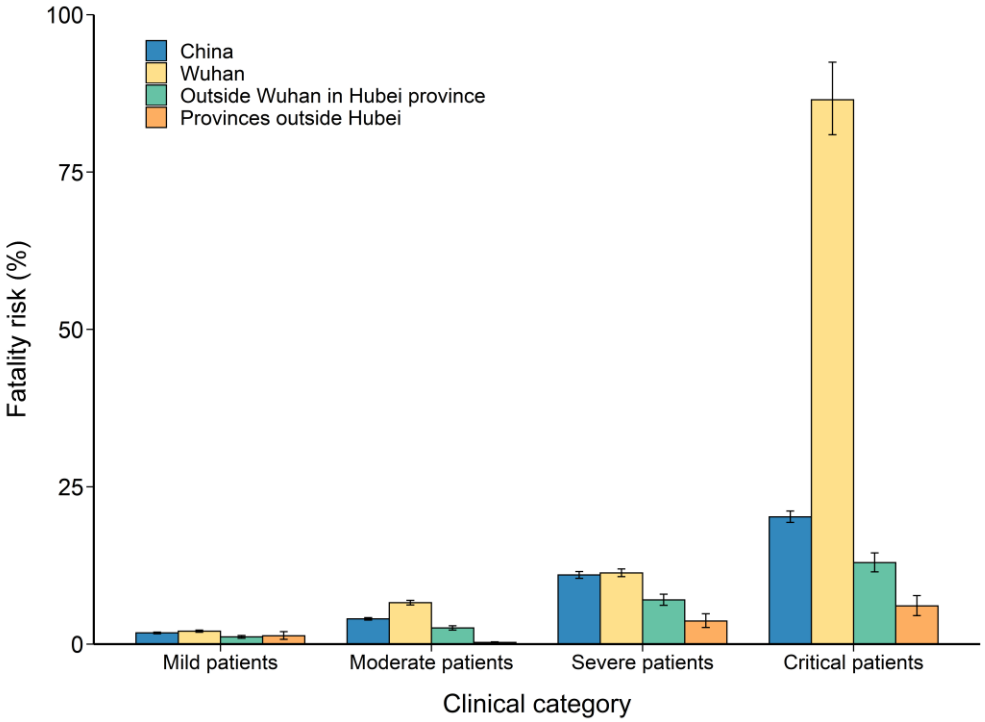

Figure 2