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COVID-19-related stigma and its influencing factors: a nationwide cross-sectional study in China

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Note: Xiaomin Wang and Hui Zhu made equal contribution to this article and are both corresponding authors.

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Abstract

Objectives： To describe the situation of COVID-19-related stigma towards COVID-19 patients and people from the city of Wuhan in China. To assess the association of COVID-19-related stigma, health literacy, and sociodemographic characteristics.

Design: A cross-sectional online survey.

Setting: This study surveyed 31 provinces in China.

Participants: This study surveyed 5,039 respondents in 31 provinces in China.

Outcome measures: The questionnaire related to stigma towards COVID-19 patients and Wuhan residents was used. Binary logistic regressions were used to identify the factors associated with COVID-19-related stigma.

Results： Among the participants, 122 (2.4%) reported themselves and 254 (5.0%) reported the communities they lived in held a stigmatizing attitude towards COVID-19 patients, respectively. Additionally, 114 (2.5%) and 475 (10.3%) reported that themselves and the communities they lived in, respectively, held a stigma against people from Wuhan, where was the most severely affected area in China. People aged over 40, lived in areas with severe epidemics (aOR=2.15, 95% CI [1.12-4.13]), and who felt it difficult to find and understand information about COVID-19 (aOR=1.91, 95% CI [1.08-3.27]; aOR=1.88, 95% CI [1.08-3.29]) were more likely to stigmatize COVID-19 patients. People who were male, aged 41 to 50, and had difficulty understanding information (aOR=2.08, 95% CI [1.17-3.69]) were more likely to stigmatize people from Wuhan.

Conclusions： COVID-19 patients and Wuhan residents suffered stigma at both the individual and community levels. There was a correlation between better health literacy and lower stigma during the COVID-19 outbreak. Tailored interventions were encouraged to improve health literacy and consequently to reduce COVID-19-related stigma.

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Article Summary

Strengths and limitations of this study

This was a rapid study to described the situation of COVID-19-related stigma during the COVID-19 outbreak in China and assessed the association of stigma, health literacy and other factors.

This is a cross-sectional study with an over sample of minorities and a balance of urban and rural residents.

The survey data relies on self-reporting and participants' responses may be biased due to social desirability.

Introduction

Stigma can be defined as a social label associating an individual with characteristics of prejudice and discrimination.[1 2] Individuals suffering from stigma often feel shamed, stressed and isolated, leading to negative changes in their health behaviors.[3 4] For example, individuals being stigmatized for a health condition may delay or avoid treatment, and may not seek access to health services, which compromises the outcome of their medical condition.[5]

In the field of infectious disease, stigma has been recognized as a global issue.[6] In recent decades, many studies concerning stigma related to infectious diseases have been conducted, including but not limited to human immunodeficiency virus (HIV),[7-9] tuberculosis (TB)[10-12] and severe acute respiratory syndrome (SARS).[13 14] The relationship between knowledge and stigma is well-documented for infectious diseases prevention measures that do not require social distancing. For example, people with higher education levels and HIV-related knowledge were less likely to stigmatize HIV patients.[7,15] This may be due to the fact that people with more HIV-related knowledge had a better understanding that they were not likely to get infected with HIV through social interactions (such as handshake, hug, and cheek kiss). However, emerging infectious diseases that are evolving in nature and have uncertain transmission patterns often cause panic among individuals and communities, as was seen with SARS, H1N1, and COVID-

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19. The transmission of certain infectious diseases through social interaction can ignite stigma towards disease-related groups[14] following the introduction of social-distancing policies to prevent such diseases. Previous studies have noted that social distancing measures may affect the attitudes of individuals and communities towards people with stigmatizing conditions, and may lead to stigma.[14 16] In studies on COVID-19-related stigma, attention has been focused on the stigma towards health care workers or residents in areas with COVID-19 outbreaks.[17,18] However, few studies have shed light on the relationship between knowledge and stigma in emerging infectious diseases that require social distancing.

Health literacy is usually defined as an individual's ability to obtain and process health information and take appropriate action.[19] Knowledge is an important dimension of health literacy.[20] Previous studies investigating the relationship between health literacy and stigma have mostly focused on mental illnesses and chronic diseases, and have shown that patients with low health literacy were more likely to feel stigmatized.[21-23] Few studies have investigated the relationship between health literacy and stigma towards infectious diseases that require social distancing in China.

Studies on stigma related to infectious diseases have revealed that it is not only individual patients who face stigma from infectious diseases, but can also be entire racial or ethnic groups who have or are perceived as having a higher likelihood of being infected.[24] Wuhan, the capital of Hubei Province, was the most severely affected area during the COVID-19 epidemic in China. In order to control the spread of COVID-19, the Chinese government took unprecedented measures, including locking down Wuhan, and requiring all Wuhan residents who migrated to other provinces before Wuhan was locked down to receive nucleic acid tests. Among the confirmed COVID-19 cases in many provinces, a considerable portion were imported cases from Wuhan.[25] Despite the government and media calling for tolerance, the development of a stigmatization towards residents of Wuhan was inevitable. For example, in some communities, residents of Wuhan were not allowed to enter and suffered unfair treatment. Therefore, this study aims to investigate both stigma faced by COVID-19 patients and stigma faced by residents of Wuhan.

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The aims of this study are 1) to describe the situation of COVID-19-related stigma during the COVID-19 outbreak in China and 2) to assess the association of stigma, health literacy, and sociodemographic characteristics during the COVID-19 epidemic.

Methods

Study design and participants

This was a national cross-sectional survey conducted in 31 provinces, municipalities, and autonomous regions in China (except Hong Kong, Macao, and Taiwan). The questionnaire used in this survey was developed for this study (Additional file 1). Tools to measure stigma in this study were referred to a previous study published.[26] Two online focus groups were conducted to discuss the questionnaire design, with six people with public health and medical backgrounds in each group. Two independent experts with background in public health reviewed and further developed the questionnaire. We conducted 30 online face-to-face interviews with respondents of different ages and education levels to pre-test the questionnaire. The questionnaire included sociodemographic characteristics, COVID-19-related stigma, and health literacy during COVID-19 epidemic. We set up logic questions to check the validity of the data.

Sample selection

The respondents included in this study were aged over 16 years old and could read Mandarin. We conducted convenience sampling in 31 provinces, and 100-200 families were selected from each province. The family member from each family whose birthday was closest to the survey date was asked to fill in the questionnaire to ensure randomness in sampling. We encouraged younger family members to assist elderly family members in completing the questionnaire, if necessary. We conducted over-sampling for ethnic minority groups. We also over-sampled for Wuhan, as it was the epidemic outbreak center. We intentionally balanced respondents from urban and rural areas while conducting this survey. The final effective sample size from all 31 provinces was 5,039.

Patient and public involvement

Patients were not involved in the design, management or reporting of this study.

Data collection

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Data were collected using the web-based questionnaire that was refined by the focus groups and pre-testing process. The survey was administered from March 1 to March 16, 2020. Before the investigation, investigators received online trainings, and thusly they were responsible for quality control. Respondents could fill in the questionnaire by scanning QR codes or clicking the questionnaire link on smartphones, tablets and other mobile devices. Before filling in the questionnaire, respondents were informed that this was an anonymous study and they could participate voluntarily. This investigation did not provide compensation to the respondents. The Ethics Committee of the School of Public Health at Zhejiang University reviewed and approved this study.

Data analysis

All data were analyzed using IBM SPSS Statistics Version 23.0 for Windows. Descriptive analyses included means for continuous variables and percentages for categorical data. Chi-square tests were conducted to compare COVID-19-related stigma between groups. Binary logistic regression analysis was used to examine the association of the independent variables with COVID-19-related stigma. All comparisons were two tailed. The significance threshold was p-value < 0.05.

Measurements

Health literacy

Questions on health literacy about COVID-19 were adapted from previous studies[27 28] and measured using two questions: (1) Do you agree that "it is difficult for me to find correct and comprehensive information about COVID-19", (2) Do you agree that "it is difficult for me to understand information I got about COVID-19". Each question was answered using a 5-point Likert scale ranging from 1 to 5 (1=Strongly disagree; 2=Disagree; 3=Fair; 4=Agree; 5=Strongly agree).

Stigma

Questions on COVID-19-related stigma were adapted from previous studies.[26 29] Four questions, including stigma towards COVID-19 patients and residents of Wuhan at the individual and community levels were used, respectively. The study participants who chose

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options “Infection is their own problem…” and “I am afraid of them…” were classified as “stigmatized”, those who chose options “I sympathize with them and hope to help them”, “I sympathize with them, but tend to stay away from them” and “I have no special feelings” were classified as “not stigmatized”.[26] People who lived in Wuhan were automatically exempted from stigma questions related to residents of Wuhan.

Social demographic characteristics

The sociodemographic characteristics comprised gender, age, education, ethnicity, urbanicity, and monthly household income. According to the data of confirmed COVID-19 cases in 31 provinces officially announced by the Chinese government as of March 1, the 31 provinces were divided into four areas: low case areas, low-medium case areas, medium case areas, and high case areas.

Results

A total of 5,039 participants (Table 1) with an average age of 33.0 (SD=12.5) were included for analysis. Most of them were female, were of Han ethnicity, received senior high school education, had a monthly household income above 705 United States dollars (USD), and lived in a medium case area.

At the individual level (Table 2), the majority (70.2%) of participants reported they felt compassion for and desired to help COVID-19 patients, 1,045 (20.7%) reported they felt compassion for COVID-19 patients but tended to avoid them, 29(0.6%) expressed their unwillingness to help COVID-19 patients, and 93(1.8%) expressed fear of COVID-19 patients. Less than one percent of participants expressed their unwillingness to help residents of Wuhan and 74(1.6%) expressed fear of residents of Wuhan. At the community level, 254(5.0%) participants reported their communities rejected COVID-19 patients, and 475(10.3%) participants reported residents of Wuhan were rejected by their communities. Approximately one-third of participants reported that they had difficulties finding comprehensive and correct information about COVID-19, and 759(15.0%) of the participants reported that it was difficult to understand the information they received about COVID-19.

Figure 1 shows the number of cumulative confirmed COVID-19 cases from the 31

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provinces on the investigation data (March 1, 2020). Figure 2 illustrates the proportion of individual stigma towards COVID-19 patients in each province. People living in Hubei, Anhui, Guizhou, Tianjin and Yunnan provinces had a relatively high stigma percentage of over 4% of the population. Figure 3 shows that more than 4% of the respondents living in Guizhou, Yunnan, and Qinghai provinces expressed a stigma towards residents of Wuhan. The proportion of reported stigma towards residents of Wuhan in Henan, Shanxi, Ningxia, Chongqing and Zhejiang provinces was between 3% and 4%.

As shown in Table 3, the prevalence of stigma towards COVID-19 patients among people over 50 was significantly higher than that of people under 20 (5.1% vs. 1.2%, $p < 0.001$). Compared with people who had a junior high school or lower degree, people with a college or higher degree reported lower levels of stigma towards COVID-19 patients (2.0% vs. 4.0%, p=0.01). Minorities showed a higher level of (3.6% vs. 2.2%, p=0.024) stigma towards COVID-19 patients than did Han respondents. Participants who felt it was easy to find and understand information about COVID-19 expressed lower stigma towards COVID-19 patients than did those who felt it was difficult (1.4% vs. 3.7%, $p < 0.001$; 1.5% vs. 4.5%, $p < 0.001$). Individual stigma towards residents of Wuhan was more prevalent among male than female respondents (3.4% vs. 1.8%, $p < 0.001$) and was relatively high among those who felt it was hard to understand COVID-19-related information (4.4% vs. 1.8%, $p < 0.001$).

Logistic regression (Table 4) indicated that participants aged over 40, who were ethnic minorities (aOR=2.71, 95% CI [1.67-4.38]), and who felt it was difficult to find and understand information about COVID-19 (aOR=1.91, 95% CI [1.08-3.27]; aOR=1.88, 95% CI [1.08-3.29]) were more likely to stigmatize COVID-19 patients. Compared with people living in low case areas, people living in low-medium case areas and high case areas were 1.74 and 2.03 times more likely to stigmatize COVID-19 patients, respectively. Females were found to be less likely to stigmatize residents of Wuhan when compared with males (aOR=0.55, 95% CI [0.38-0.81]). Participants aged 41 to 50 and those with difficulty understanding information (aOR=2.08, 95%

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CI [1.17-3.69]) were more likely to stigmatize residents of Wuhan.

Discussion

To our knowledge, this is the first nationwide study investigating COVID-19-related stigma in China. Our study described the situation of stigma towards COVID-19 patients and residents of Wuhan at both the individual and community levels during the epidemic. Consequently, our results verified the correlation between better health literacy and lower stigma during emerging infectious diseases outbreaks and showed the difference in stigma in regions with different COVID-19 epidemic severities on a large scale across the country. Additionally, we found that socio-demographic factors, such as residency, gender, age, and ethnicity, affected COVID-19-related stigma.

Overall, the prevalence of stigma was low in China during the COVID-19 pandemic and most participants had a positive attitude towards COVID-19 patients and residents of Wuhan people. Noticeably, our study showed that participants reported stigma from communities was significantly higher than individual stigma, which might be affected by the social desirability effect, meaning that participants' responses concerning themselves may be biased in order to meet social expectations and moral standards. Social desirability has been identified in previous studies on measuring individual stigma towards people with mental illness.[30 31] Stigma from communities is not unique to China, but has also been reported in the United States, Australia, Nepal and other countries[17], which deserves more attention in future studies.

Our study added to the literature by exposing the negative association between health literacy and stigma during an emerging infectious disease. Our findings verified that, during the COVID-19 pandemic, there was a significant association between health literacy and COVID-19-related stigma. Higher COVID-19-related health literacy, specifically, a better ability to find and understand information, might help reduce stigma towards COVID-19 patients and residents of Wuhan. Our findings are consistent with previous studies, which identified a correlation between health literacy and stigma on mental disease.[32 33] Consequently, in the field of infectious diseases, higher literacy concerning one disease may possibly help eliminate stigma. Additionally, it has been suggested that health literacy interventions, such as

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educational lectures to improve public knowledge and literacy, could help reduce stigma in the field of mental health.[34] Thus, further studies are needed to verify effective measures, such as information campaigns from health services or the media, sessions in the workplace or in schools, to reduce stigma during an emerging infectious disease.

In addition to health literacy, our research found that people in different regions held differing degrees of stigma towards COVID-19 patients. In general, provinces which were close to Wuhan, such as Anhui and Chongqing, and provinces with more ethnic minorities, such as Yunnan and Guizhou, had higher levels of stigma towards COVID-19 patients. Similarly, the proportion of respondents who held stigma towards residents of Wuhan was relatively high in provinces close to Wuhan, such as Henan, Chongqing and Shanxi, and provinces with more ethnic minorities such as Qinghai, Yunnan, Guizhou and Ningxia. The danger appraisal hypothesis states that an individuals' perception of danger would make them choose a safer social distance.[35] Another study on SARS-related stigma conducted in Hong Kong showed that living in a geographical location which was close to an area with a large number of cases could increase stigmatizing attitudes.[36] Specifically, residents living on the block with the most SARS patients reported holding the highest level of stigmatizing attitudes.[37] Similarly, in our study, people living in areas severely affected by the COVID-19 pandemic were at higher risk of social interaction with potential COVID-19 patients. Thus, they might expect to maintain a longer social distance and have less social interaction with potential COVID-19 patients, and therefore may hold higher levels of stigma.

Our study showed the influence of sociodemographic characteristics on COVID-19-related stigma, which might help identify subgroups who were more likely to stigmatize others during an infectious disease epidemic. In our study, females were more tolerant towards residents of Wuhan, while people over 40 years old and ethnic minorities were more likely to stigmatize COVID-19 patients, which is consistent with previous studies.[15 31 38] A previous study revealed that groups with higher education and income levels had lower levels of stigma towards patients with related diseases.[22] However, this difference was not found in our study. One possible reason for this may be that, during COVID-19 pandemic, China conducted a large-scale

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publicity campaign through traditional and social media, such as China Central Television (CCTV), WeChat official accounts and short video platforms[39], which may have helped reduce barriers related to education and economic status in accessing adequate information concerning COVID-19.

There are some limitations in this study. First, this is a cross-sectional study, so it can not verify the causal relationship between the stigma-related variables. Second, the research data relies on the self-reporting of survey participants. Participants' responses regarding their stigma attitudes may be biased due to social desirability.[30] Third, we chose a snowball sampling method rather than a representative sampling method, due to the social-distancing policies in place during our investigation. However, we over-sampled ethnic minorities and ensured both the balance of urban-rural samples and the randomness of each sample in each household during the survey to reduce related bias. Fourth, this study does not differentiate in the participants their profession or relationship to the disease. It is possible that health personnel or those who have probably been discriminated against and know the reality of the virus showed different responses, as well as people who have been infected may also show less stigma, although this part of the population in the surveyed population was low.

Conclusion

In summary, our findings suggest that COVID-19 patients and residents of Wuhan suffered stigma at both the individual and community levels, although the proportion of respondents holding stigma was not high. Provinces closer to Wuhan had relatively higher levels of stigma towards COVID-19 patients and residents of Wuhan. There was a correlation between better health literacy and lower levels of stigma during the COVID-19 outbreak. Tailored interventions are encouraged to improve health literacy and consequently to reduce COVID-19-related stigma at both the individual and community levels, respectively.

Declarations

Contributors

XZ, XW, and HZ made substantial contributions to the study design and supervised the data collection. TJ, LL, YZ, and YP contributed to the data collection and interpretation. TJ wrote

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the substantial parts of manuscript. All authors critically revised, reviewed, and approved the final version the manuscript.

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The funding body has no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Patient consent for publication

Not required.

Data sharing statement

Data are available from the corresponding author on reasonable request.

Competing interests

The authors declare no conflict of interest.

Ethics approval and consent to participate

The protocol for this study was approved by the Ethics Committee of the School of Public Health, Zhejiang University. All participants were informed of the background, aims, anonymous nature and length of the survey. Participants were well informed that completing the questionnaire signified their informed consent.

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Table 1 Sample characteristics (n=5,039)

Variables	N	%
Age		
≤20	774	15.4
21-30	1,914	38.0
31-40	885	17.6
41-50	959	19.0
≥51	507	10.1
Gender		
Male	2,090	41.5
Female	2,949	58.5
Education level		
Junior high school or less	668	13.3
Senior high school	2,528	50.2
College or above	1,843	36.6
Ethnicity		
Han	4,234	84.0
Minorities	805	16.0
Urbanicity		
Urban	2,492	49.5
Rural	2,547	50.5
Monthly household income (USD)		
＜422	846	16.8
422-704	1,485	29.5
705-1,407	1,422	28.2
1,408-2,815	858	17.0
＞2,815	428	8.5
Province by confirmed patients		
Low case area	1,374	27.3
Low-medium case area	1,386	27.5
Medium case area	1,681	33.4
High case area	598	11.9

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Table 2 Stigma and health literacy during COVID-19 epidemic

Variables	N	%
Stigma towards COVID-19 patients (n=5,039)		
Statement closest to your feeling about people with COVID-19		
I feel compassion and desire to help	3,536	70.2
I feel compassion but tend to stay away from them	1,045	20.7
It is their problem and I don't want to get COVID-19 by trying to help them	29	0.6
I fear them because they may infect me	93	1.8
I have no particular feeling	336	6.7
How was COVID-19 patient usually regarded/treated in your community?		
Most people reject him/her	254	5.0
Most people are friendly, but they generally try to avoid	1,141	22.6
The community mostly supports and helps him/her	725	14.4
I don't have the experience	2,919	57.9
Stigma towards Wuhan people (n=4,628) *		
Statement closest to your feeling about Wuhan people		
I feel compassion and desire to help	3,323	71.8
I feel compassion but tend to stay away from them	883	19.1
It is their problem and I don't want to get COVID-19 by trying to help them	40	0.9
I fear them because they may infect me	74	1.6
I have no particular feeling	308	6.7
How was Wuhan people usually regarded/treated in your community?		
Most people reject him/her	475	10.3
Most people are friendly, but they generally try to avoid	1,784	38.6
The community mostly supports and helps him/her	2,097	45.3
I don't have the experience	272	5.9
Health literacy (n=5,039)		
It is difficult for me to find correct and comprehensive information about COVID-19		
Strongly disagree	218	4.3
Disagree	1,541	30.6
Neutral	1,679	33.3
Agree	1,230	24.4
Strongly agree	371	7.4
It is difficult for me to understand information I got about COVID-19		
Strongly disagree	348	6.9
Disagree	2,471	49.0
Neutral	1,461	29.0
Agree	587	11.6
Strongly agree	172	3.4

* Participants who lived in Wuhan were automatically exempted from stigma questions related to residents of Wuhan.

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Table 3 Univariate analysis of individual stigma towards COVID-19 patients and Wuhan residents

	COVID-19 patients (n = 5,039)			Wuhan residents (n = 4,628) *		
Variables	**Stigma**	**χ^2**	**p-value**	**Stigma**	**χ^2**	**p-value**
Gender		3.742	0.062		12.25	<0.001
Male	61(2.9)			66(3.4)		
Female	61(2.1)			48(1.8)		
Age		32.43	<0.001		4.053	0.399
≤20	9(1.2)			11(1.5)		
21-30	34(1.8)			43(2.4)		
31-40	17(1.9)			20(2.6)		
41-50	36(3.8)			26(3.0)		
≥51	26(5.1)			14(3.0)		
Education level		9.216	0.010		2.606	0.272
Junior high school or less	27(4.0)			21(3.3)		
Senior high school	59(2.3)			59(2.5)		
College or above	36(2.0)			34(2.1)		
Ethnicity		5.660	0.024		1.174	0.279
Han	93(2.2)			90(2.4)		
Minorities	29(3.6)			24(3.0)		
Urbanicity		0.060	0.855		0.129	0.720
Urban	59(2.4)			51(2.4)		
Rural	63(2.5)			63(2.5)		
Monthly household Income (USD)		5.875	0.209		0.481	0.975
<422	20(2.4)			20(2.4)		
422-704	47(3.2)			38(2.7)		
705-1407	27(1.9)			31(2.4)		
1408-2815	17(2.0)			17(2.3)		
>2815	11(2.6)			8(2.2)		
Province by confirmed patients		4.169	0.244		2.374	0.498
Low case area	24(1.7)			30(2.2)		
Low-medium case area	38(2.7)			41(3.0)		
Medium case area	42(2.5)			39(2.3)		
High case area	18(3.0)			4(1.9)		
It is difficult for me to find correct and comprehensive information about COVID-19		19.21	<0.001		5.448	0.066
Disagree	24(1.4)			30(1.8)		
Neutral	39(2.3)			39(2.5)		
Agree	59(3.7)			45(3.1)		
It is difficult for me to understand information I got about COVID-19		25.87	<0.001		16.17	<0.001
Disagree	43(1.5)			46(1.8)		
Neutral	45(3.1)			37(2.8)		
Agree	34(4.5)			31(4.4)		

* Participants who lived in Wuhan were automatically exempted from stigma questions related to residents of Wuhan.

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Table 4 Factors associated with COVID-19-related stigma

	Individual stigma towards COVID-19 patients (n = 5,039)		Individual stigma towards Wuhan residents (n = 4,628) [a]	
	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)
Gender (Ref: Male)				
Female	0.73(0.51-1.05)	0.79(0.55-1.15)	0.52 (0.36-0.76) **	0.55 (0.38-0.81) **
Age (Ref: ≤20)				
21-30	1.77(0.81-3.83)	1.67(0.77-3.64)	1.87 (0.93-3.77)	1.80 (0.89-3.64)
31-40	2.11(0.88-5.05)	2.08(0.87-5.01)	2.17 (0.97-4.87)	2.14 (0.95-4.81)
41-50	4.00(1.82-8.79) **	3.99(1.81-8.83) **	2.34 (1.09-5.04) *	2.34 (1.09-5.05) *
≥51	5.21(2.31-11.73) ***	5.28(2.34-11.94) ***	2.05 (0.88-4.76)	2.03 (0.87-4.74)
Educational level (Ref: Junior high school or less)				
Senior high school	0.85(0.51-1.42)	0.96(0.57-1.60)	0.94 (0.54-1.65)	1.06 (0.60-1.85)
College or above	0.67(0.37-1.22)	0.82(0.45-1.51)	0.64 (0.34-1.21)	0.76 (0.40-1.45)
Ethnicity (Ref: Han)				
Minorities	2.68(1.66-4.32) ***	2.71(1.67-4.38) ***	1.52 (0.93-2.50)	1.52 (0.93-2.50)
Urbanicity (Ref: Urban)				
Rural	0.86(0.58-1.28)	0.87(0.58-1.30)	0.97 (0.65-1.45)	0.96 (0.64-1.44)
Monthly household income (USD) (Ref:＜422)				
422-704	1.36(0.79-2.34)	1.52(0.88-2.63)	1.11 (0.64-1.95)	1.18 (0.67-2.07)
705-1407	0.82(0.44-1.52)	0.95(0.51-1.77)	1.01 (0.56-1.83)	1.11 (0.61-2.03)
1408-2815	0.92(0.45-1.88)	1.08(0.53-2.21)	1.02 (0.51-2.06)	1.14 (0.56-2.31)
＞2815	1.23(0.55-2.76)	1.55(0.68-3.50)	1.00 (0.41-2.41)	1.15 (0.48-2.80)
Province by confirmed patients (Ref: Low case area)				
Low-medium case area	1.77(1.04-3.00) *	1.74(1.02-2.96) *	1.44 (0.88-2.34)	1.40 (0.86-2.29)
Medium case area	1.64(0.96-2.79)	1.61(0.94-2.74)	1.10 (0.67-1.81)	1.09 (0.66-1.80)
High case area	2.15(1.12-4.13) *	2.03(1.05-3.92) *	0.78 (0.26-2.29)	0.78 (0.26-2.29)
It is difficult for me to find correct and comprehensive information about COVID-19 (Ref: Disagree)				
Neutral		1.49(0.85-2.62)		1.20 (0.70-2.06)
Agree		1.91(1.08-3.37) *		1.12 (0.64-1.98)
It is difficult for me to understand information I got about COVID-19 (Ref: Disagree)				
Neutral		1.62(1.01-2.61) *		1.40 (0.86-2.29)
Agree		1.88(1.08-3.29) *		2.08 (1.17-3.69) *

[a] Participants who lived in Wuhan were automatically exempted from stigma questions related to residents of Wuhan.
* p<0.05, ** p<0.01, *** p<0.001.

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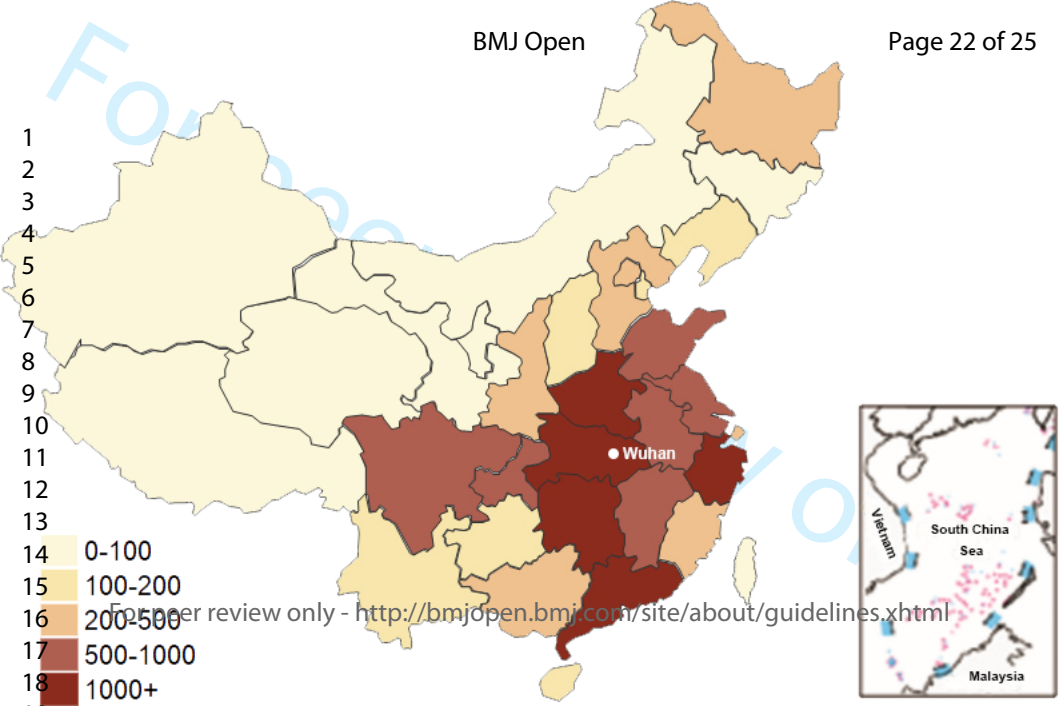

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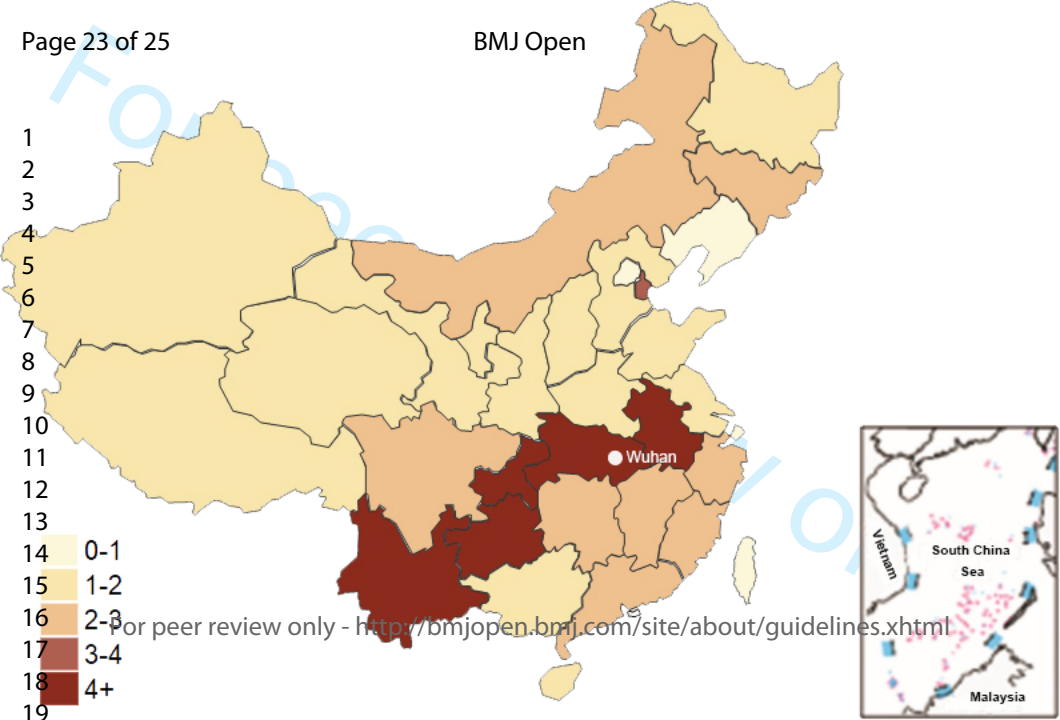

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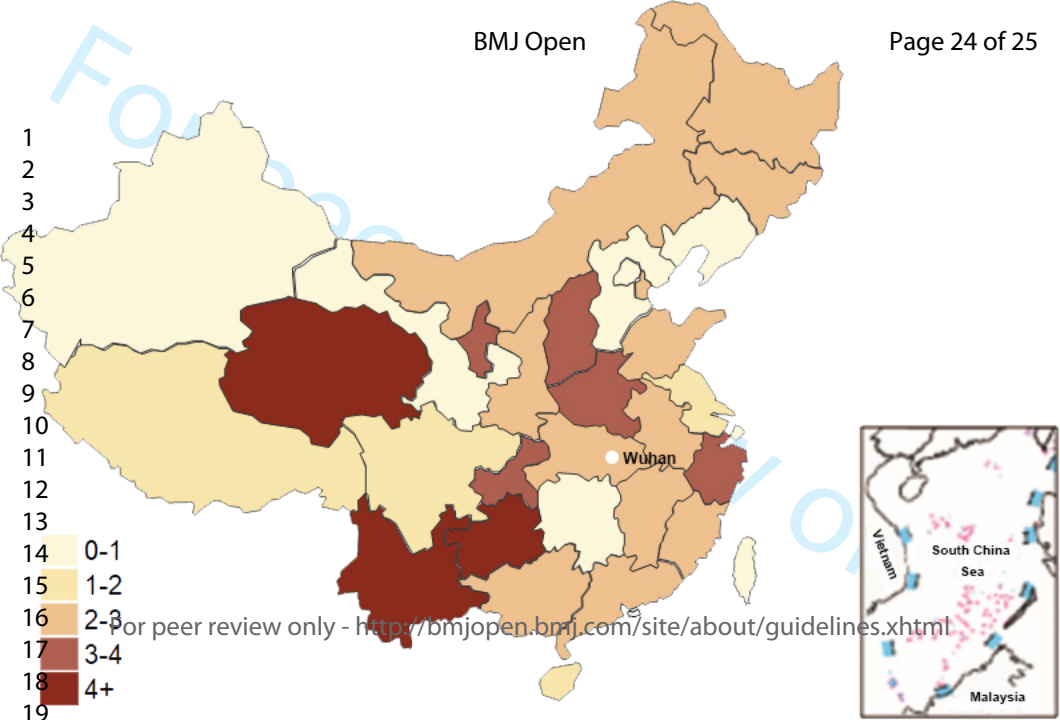

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4-5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6
Bias	9	Describe any efforts to address potential sources of bias	*5-6*
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6-7
		(*b*) Describe any methods used to examine subgroups and interactions	6-7
		(*c*) Explain how missing data were addressed	NA
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6-7
		(*e*) Describe any sensitivity analyses	NA
Results			

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7-8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	7-8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7-8
		(*b*) Report category boundaries when continuous variables were categorized	7-8
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	8-10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	11-12

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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COVID-19-related stigma and its influencing factors: a nationwide cross-sectional study during the early stage of the pandemic in China

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COVID-19-related stigma and its influencing factors: a nationwide cross-sectional study during the early stage of the pandemic in China

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Abstract

Objectives： To describe the situation of COVID-19-related stigma towards COVID-19 patients and people from the city of Wuhan in China and to assess the associations between COVID-19-related stigma, health literacy, and sociodemographic characteristics during March 2020, the early stage of the pandemic.

Design: A cross-sectional online survey.

Setting: The study surveyed 31 provinces in China.

Participants: This study surveyed 5,039 respondents in China.

Outcome measures: Public stigma towards both COVID-19 patients and Wuhan residents was measured. Binary logistic regression was used to identify the factors associated with public COVID-19-related stigma.

Results： Among the participants, 122 (2.4%) reported themselves and 254 (5.0%) reported the communities they lived as holding a stigmatizing attitude towards COVID-19 patients, respectively. Additionally, 114 (2.5%) and 475 (10.3%) reported that themselves and the communities they lived in, respectively, held a stigma against people from Wuhan, which was the most severely affected area in China. People aged over 40, lived in areas with severe epidemics (aOR=2.03, 95% CI [1.05-3.92]), and who felt it difficult to find and understand information about COVID-19 (aOR=1.91, 95% CI [1.08-3.37]; aOR=1.88, 95% CI [1.08-3.29]) were more likely to stigmatize COVID-19 patients. People who were male, aged 41 to 50, and had difficulty understanding information (aOR=2.08, 95% CI [1.17-3.69]) were more likely to stigmatize people from Wuhan.

Conclusions： COVID-19 patients and Wuhan residents suffered stigma at both the individual and community levels. Those who had low health literacy, who lived in areas with a large number of COVID-19 cases, and who were ethnic minorities were more likely to stigmatize others. Tailored interventions are encouraged to improve health literacy and consequently to

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reduce public COVID-19-related stigma.

Article Summary

Strengths and limitations of this study

This was a rapid study to describe the situation of public COVID-19-related stigma during the early stage of the pandemic in China and assess the associations between stigma, health literacy and other factors.

This is a cross-sectional study with an over sampling of ethnic minorities and a balance of urban and rural residents.

The survey data relies on self-reporting, and therefore participants' responses may be biased due to social desirability.

Introduction

Stigma can be defined as a social label associating an individual with characteristics of prejudice and discrimination.[1,2] Individuals suffering from stigma often feel shamed, stressed and isolated, leading to negative changes in their health behaviors.[3,4] For example, individuals being stigmatized for a health condition may delay or avoid treatment, and may not seek access to health services, which compromises the outcome of their medical condition.[5]

In the field of infectious disease, stigma has been recognized as a global issue.[6] In recent decades, many studies concerning stigma as related to infectious diseases have been conducted, including but not limited to human immunodeficiency virus (HIV),[7-9] tuberculosis (TB)[10-12] and severe acute respiratory syndrome (SARS).[13,14] The relationship between knowledge and stigma is well-documented for infectious diseases prevention measures that do not require social distancing. For example, people with higher education levels and HIV-related knowledge were less likely to stigmatize HIV patients.[7,15] This may be due to the fact that people with more HIV-related knowledge had a better understanding that they were not likely to get infected with HIV through social interactions (such as handshake, hug, and cheek kiss). However, emerging infectious diseases that are evolving in nature and have uncertain transmission patterns often cause panic among individuals and communities, as was seen with SARS, H1N1, and COVID-

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19. The transmission of certain infectious diseases through social interactions can ignite public stigma towards disease-related groups[14] following the introduction of social-distancing policies to prevent such diseases. Previous studies have noted that social distancing measures may affect the attitudes of individuals and communities towards people with stigmatizing conditions, and may lead to stigma.[14,16] In studies on COVID-19-related stigma, attention has been focused on stigma facing health care workers or residents in areas affected by the COVID-19 pandemic.[17,18] However, few studies have explored the relationship between knowledge and stigma in emerging infectious diseases that require social distancing.

Health literacy is usually defined as an individual's ability to obtain and process health information and take appropriate action.[19] Knowledge is an important dimension of health literacy.[20] Previous studies investigating the relationship between health literacy and stigma have mostly focused on mental illnesses and chronic diseases, and have shown that patients with low health literacy were more likely to feel stigmatized.[21-23] Few studies have investigated the relationship between health literacy and stigma towards infectious diseases that require social distancing in China.

Studies on stigma related to infectious diseases have revealed that it is not only individual patients who face stigma from infectious diseases, but that entire racial or ethnic groups who have or are perceived as having a higher likelihood of being infected can face stigmatiziation.[24] Wuhan, the capital of Hubei Province, was the most severely affected area during the COVID-19 pandemic in China. In order to control the spread of COVID-19, the Chinese government took unprecedented measures, including locking down Wuhan, and requiring all Wuhan residents who migrated to other provinces before Wuhan was locked down to receive nucleic acid tests. A considerable portion of confirmed COVID-19 cases in many provinces were imported cases from Wuhan.[25] Despite the government and media calling for tolerance, the development of a stigma towards residents of Wuhan was inevitable. For example, in some communities, residents of Wuhan were not allowed to enter and suffered unfair treatment. Therefore, this study explores the situation of stigma faced by COVID-19 patients and stigma faced by residents of Wuhan.

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The aims of this study are 1) to describe the situation of public COVID-19-related stigma during the early stage of the COVID-19 pandemic in China and 2) to assess the associations between stigma, health literacy, and sociodemographic characteristics.

Methods

Study design and participants

The World Health Organization (WHO) declared COVID-19 as a pandemic in March 2020, and our study was conducted between 1 March and 16 March, 2020. As of 16 March, 2020, there were more than 80,000 confirmed cases in China and more than 100,000 cases globally, and during this time people in China were under strict social-distancing policies. This was a national cross-sectional survey conducted in 31 provinces, municipalities, and autonomous regions (hereafter, provinces) in China, except for Hong Kong, Macao, and Taiwan.

The questionnaire was developed for this study (Additional file 1). Tools to measure public COVID-19-related stigma were adapted from a previous study.[26] Two online focus groups were conducted to discuss the questionnaire design, with six people with public health and medical backgrounds in each group. Two independent experts with backgrounds in public health and risk communication reviewed and further developed the questionnaire. We conducted 30 online one-to-one interviews with respondents of different ages and education levels to pre-test the questionnaire. The final questionnaire included sociodemographic characteristics, public COVID-19-related stigma, and health literacy during the COVID-19 pandemic. Logic questions were set up to verify the validity of the data.

The respondents included in this study were aged over 16 years old and could read Mandarin. We conducted convenience sampling in 31 provinces, and 100-200 families were selected from each province. The member from each household whose birth date was closest to the survey date was invited to complete the questionnaire to ensure randomness in sampling. Younger family members were encouraged to assist elderly family members in completing the questionnaire, if necessary. Before the investigation, investigators received online trainings, and thusly they were responsible for quality control. Respondents could fill in the questionnaire by scanning QR codes or clicking the questionnaire link on smartphones, tablets and other

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mobile devices. A sample size of 3,062 was estimated based on a prevalence estimate of 50%, the ±2% margin of error and upward adjusted by 20% considering potential non-response. We set up a target sample for ethnic minorities residents and over-sampled respondents who lived in Wuhan, as it was the center of the pandemic. We intentionally balanced respondents from urban and rural areas while conducting this survey. Before completing the questionnaire, respondents were informed in the consent statement that this was an anonymous and voluntary survey. No compensation was provided to respondents. The Ethics Committee of the School of Public Health at Zhejiang University reviewed and approved this study (No. ZGL202002-3).

Patient and public involvement

Patients were not involved in the design, management or reporting of this study.

Measurements

Sociodemographic characteristics

The sociodemographic characteristics comprised gender, age, education, ethnicity, urbanicity, and monthly household income. According to the data of confirmed COVID-19 cases in 31 provinces officially announced by the Chinese government as of 1 March, 2020, the 31 provinces were divided into four groups. Hubei province, the statistical outlier with the highest number of confirmed cases, was classified as the high-risk group. The rest of the 30 provinces were divided into three groups (low-risk group, medium-risk group and medium-high-risk group), with each group containing 10 provinces based on their ranking of number of confirmed cases.

Health literacy

Questions on health literacy about COVID-19 were adapted from previous studies[27,28] and measured using two questions: (1) To what extent do you agree with the following statements "it is difficult for me to find correct and comprehensive information about COVID-19," (2) To what extent do you agree with the following statements "it is difficult for me to understand information I got about COVID-19." Each question was answered using a 5-point Likert scale ranging from 1 to 5 (1=Strongly disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly agree).

Stigma

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Questions on public COVID-19-related stigma were adapted from previous studies.[26,29] Four questions, including public stigma towards COVID-19 patients and residents of Wuhan at the individual and community levels were used, respectively. The study participants who chose the following options: "It is their problem and I don't want to get COVID-19 by trying to help them," and "I am afraid of them and avoid them because they may infect me," were classified as "stigmatized," those who chose options "I feel compassion and desire to help," "I feel compassion but tend to stay away from them," and "I have no particular feeling," were classified as "not stigmatized."[26] People who lived in Wuhan were automatically exempted from stigma questions related to residents of Wuhan.

Data analysis

All data were analyzed using IBM SPSS Statistics Version 23.0 for Windows. Descriptive analyses included means for continuous variables and percentages for categorical data. Chi-square tests were conducted to compare COVID-19-related stigma between groups. Binary Logistic regression analysis was used to examine the association of the independent variables with COVID-19-related stigma. All comparisons were two-tailed. The significance threshold was p-value < 0.05.

Results

The response rate of this survey was 94.7%. Of the 5,124 participants who completed the questionnaire, 85(1.7%) were excluded because they were younger than 16 years old or answered logical questions incorrectly. A total of 5,039 participants (Table 1) with an average age of 33.0 (SD=12.5) were included for analysis. Most of them were female, were of Han ethnicity, received senior high school education, had a monthly household income above 705 United States dollars (USD), and lived in a medium case area.

At the individual level (Table 2), the majority (70.2%) of participants reported they felt compassion for and desired to help COVID-19 patients, 1,045 (20.7%) reported they felt compassion for COVID-19 patients but tended to avoid them, 29(0.6%) expressed their unwillingness to help COVID-19 patients, and 93(1.8%) expressed fear of COVID-19 patients. Less than one percent of participants expressed their unwillingness to help residents of Wuhan

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and 74(1.6%) expressed fear of residents of Wuhan. At the community level, 254(5.0%) participants reported their communities rejected COVID-19 patients, and 475(10.3%) participants reported residents of Wuhan were rejected by their communities. Approximately one-third of participants reported that they had difficulties finding comprehensive and correct information about COVID-19, and 759(15.0%) of the participants reported that it was difficult to understand the information they received about COVID-19.

Figure 1 shows the number of cumulative confirmed COVID-19 cases from the 31 provinces on the investigation data (March 1, 2020). Figure 2 illustrates the proportion of individual stigma towards COVID-19 patients in each province. People living in Hubei, Anhui, Guizhou, Tianjin and Yunnan provinces had a relatively high stigma percentage of over 4% of the population. Figure 3 shows that more than 4% of the respondents living in Guizhou, Yunnan, and Qinghai provinces expressed a stigma towards residents of Wuhan. The proportion of reported stigma towards residents of Wuhan in Henan, Shanxi, Ningxia, Chongqing and Zhejiang provinces was between 3% and 4%.

As shown in Table 3, the prevalence of stigma towards COVID-19 patients among people over 50 was significantly higher than that of people under 20 (5.1% vs. 1.2%, $p < 0.001$). Compared with people who had a junior high school or lower degree, people with a college or higher degree reported lower levels of stigma towards COVID-19 patients (2.0% vs. 4.0%, $p=0.01$). Ethnic minorities showed a higher level of (3.6% vs. 2.2%, $p=0.024$) stigma towards COVID-19 patients than did Han respondents. Participants who felt it was easy to find and understand information about COVID-19 expressed lower stigma towards COVID-19 patients than did those who felt it was difficult (1.4% vs. 3.7%, $p < 0.001$; 1.5% vs. 4.5%, $p < 0.001$). Individual stigma towards residents of Wuhan was more prevalent among male than female respondents (3.4% vs. 1.8%, $p < 0.001$) and was relatively high among those who felt it was hard to understand COVID-19-related information (4.4% vs. 1.8%, $p < 0.001$).

Logistic regression (Table 4) indicated that participants aged over 40, who were ethnic

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minorities (aOR=2.71, 95% CI [1.67-4.38]), and who felt it was difficult to find and understand information about COVID-19 (aOR=1.91, 95% CI [1.08-3.37]; aOR=1.88, 95% CI [1.08-3.29]) were more likely to stigmatize COVID-19 patients. Compared with people living in low case areas, people living in low-medium and high case areas were 1.74 and 2.03 times more likely to stigmatize COVID-19 patients, respectively. Females were found to be less likely to stigmatize residents of Wuhan when compared with males (aOR=0.55, 95% CI [0.38-0.81]). Participants aged 41 to 50 and those with difficulty understanding information (aOR=2.08, 95% CI [1.17-3.69]) were more likely to stigmatize residents of Wuhan.

Discussion

To our knowledge, there are currently few studies investigating public COVID-19-related stigma during the early stage of the pandemic in China. Our study described the situation of stigma towards COVID-19 patients and residents of Wuhan at both the individual and community levels. Consequently, our results verified the correlation between better health literacy and lower stigma during a pandemic of an emerging infectious disease and showed the difference in stigma in regions with different COVID-19 epidemic severities on a large scale across China. Additionally, we identified that sociodemographic factors, such as gender, age, and ethnicity, affected public COVID-19-related stigma.

Historically, infectious diseases have long been associated with stigma. During the early stage of the COVID-19 pandemic, potentially deadly conditions, the lack of effective treatments, and rumors increased the risk of stigmatization. The stigma associated with COVID-19 threatens the physical and mental health of COVID-19 patients and residents of Wuhan. In the long run, stigmatization also damages the cultural fabric of society and undermines efforts to control pandemics, creating an atmosphere of fear and distrust. Previous studies identified COVID-19-related public stigma as more prevalent and severe when compared with our findings. According to a global survey involving 173 countries, nearly a third of participants believed that people talked badly or gossiped about other people who were thought to associated with COVID-19, and 21.9% of participants believed people who had COVID-19 were not respected by the community.[30] An online survey in February 2020 in China also showed that

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about half of participants reported they would avoid people from Hubei and 16.9% would even try to expel them from their communities.[31] The low prevalence of stigma in our study may be partly explained by the fact that the Chinese government began campaigns in the media to reduce stigma towards COVID-19 patients and people from Wuhan during the early stage of the pandemic.[31] COVID-19-related stigma is not unique to China, and has been reported in the United States, Australia, Nepal and other countries.[17] These facts should remind health policy makers to attach more importance to community-based stigma reduction interventions and campaigns.

Our study added to the literature by exposing the negative association between health literacy and COVID-19-related stigma. Stigma can be understood as a human instinct to protect themselves from potentially fatal infectious diseases,[32] even though this instinctual response often leads to bias.[33] Lack of knowledge has been shown to be a major driver of these biases and stigmatizations. Previous studies on mental disease identified a negative correlation between health literacy and stigma.[34,35] Consequently, in the field of infectious diseases, higher literacy concerning one disease may possibly help reduce disease-related stigma. Our study suggested that higher COVID-19-related health literacy, specifically, a better ability to find and understand COVID-19 information, might help reduce stigma towards COVID-19 patients and residents of Wuhan. Additionally, it has been suggested that health literacy interventions, such as educational lectures to improve public knowledge and literacy, could help reduce stigma in the field of mental health.[36] Thus, further studies are needed to verify effective measures to reduce stigma during an emerging infectious disease, such as information campaigns from health services or the media, and sessions in workplaces and schools.

To reduce stigma, this study described the geographic distribution of stigma during the early stage of the pandemic to improve intervention precision by allowing for the targeting of high-stigma areas. Our research found that people in different regions held differing degrees of stigmatization. In general, provinces which were close to Wuhan, such as Anhui and Chongqing, and provinces with more ethnic minorities, such as Yunnan and Guizhou, had higher levels of stigma towards COVID-19 patients. Similarly, the proportion of respondents who held stigma

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towards residents of Wuhan was relatively high in provinces close to Wuhan, such as Henan, Chongqing and Shanxi, and provinces with more ethnic minorities such as Qinghai, Yunnan, Guizhou and Ningxia. A study using South Korean data revealed that the risk of COVID-19 increased with higher area morbidity,[37] and the danger appraisal hypothesis stated that an individuals' perception of danger would make them choose a safer social distance.[38] Another study on SARS-related stigma conducted in Hong Kong showed that living in a geographical location with a large number of cases could increase stigmatizing attitudes. Specifically, residents living on the block with the most SARS patients reported holding the highest level of stigmatizing attitudes.[13] During the COVID-19 pandemic, most countries around the world reported high risk perceptions.[39] Similarly, in our study, people living in areas severely affected by the COVID-19 pandemic were at higher risk of social interaction with potential COVID-19 patients. Thus, they might have higher risk perceptions, expect to have less social interaction with potential COVID-19 patients, and therefore may hold higher levels of stigma. Interestingly, there was no significant regional differences in attitudes towards residents of Wuhan. A possible reason was that the public perceived the risk posed by COVID-19 patients to be higher than that posed by residents of Wuhan.

Our study also showed the influence of sociodemographic characteristics on public COVID-19-related stigma, which might help identify subgroups that are more likely to stigmatize others during the pandemic. Consistent with previous studies, we found females were more tolerant towards residents of Wuhan, while people over 40 years old and ethnic minorities were more likely to stigmatize COVID-19 patients.[15,40] The elderly were more likely to progress to severe disease after infection or suffer complications from COVID-19 than younger adults, and had higher perceived susceptibility and perceived severity during the pandemic,[41] which might explain why the elderly were more likely to hold stigmatizing attitudes. The majority of ethnic minorities in China live in less developed mountainous inland or border districts in the western region, and possess relatively low levels of education and income, which have been identified as negative influencing factors for stigma in previous studies and may partially explain their higher levels of stigmatization.[42,43] A previous study

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revealed that groups with higher education and income levels had lower levels of stigma towards patients with related diseases.[22] However, this difference was not found in our study. One possible reason for this may be that, during the COVID-19 pandemic, China conducted a large-scale publicity campaign through traditional and social media, such as China Central Television (CCTV), WeChat official accounts and short video platforms,[44] which may have helped reduce barriers related to education and economic status in accessing adequate information concerning COVID-19.

There are some limitations to this study. First, this is a cross-sectional study, so it cannot verify the causal relationship between stigma-related variables. Second, this is an online survey, and people who did not have access to the Internet were not included, which may result in selection bias. However, as of December 2020, China's Internet penetration rate was 70.4%, and most people in China had access to the Internet via smartphones.[45] Third, health literacy and stigmatizing attitudes rely on self-reporting, and may thus lead to an underestimation of the impact of health literacy on stigma.[46] Fourth, we chose a snowball sampling method rather than a representative sampling method, due to the social-distancing policies in place during our investigation. However, we ensured both the balance of urban-rural samples and the randomness of each sample in each household during the survey to reduce related bias. Fifth, this study does not differentiate among participants by their profession or relationship to the disease. It is possible that health personnel or those who have been discriminated against and know the reality of the virus offered different responses, just as people who have been infected may also show less stigma (although the number of people reporting infection in our surveyed population was low).

Conclusion

COVID-19 patients and residents of Wuhan have suffered stigma at both the individual and community levels. Those who had low health literacy, who lived in areas with a large number of COVID-19 cases, and who were ethnic minorities were more likely to stigmatize others in the early stage of the pandemic. Although a COVID-19 vaccine is available globally, it will still take time to achieve herd immunity. Before COVID-19 can be controlled globally,

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tailored interventions are encouraged to improve health literacy and consequently to reduce public COVID-19-related stigma at both the individual and community levels.

Declarations

Contributors

XZ, XW, and HZ made substantial contributions to the study design and supervised the data collection. TJ, LL, YZ, and YP contributed to the data collection and interpretation. TJ wrote the substantial parts of manuscript. All authors critically revised, reviewed, and approved the final version the manuscript.

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Patient consent for publication

Not required.

Data sharing statement

Data are available from the corresponding author on reasonable request.

Competing interests

The authors declare no conflict of interest.

Ethics approval and consent to participate

The protocol for this study was approved by the Ethics Committee of the School of Public Health, Zhejiang University. No. ZGL202002-3.

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Figure legends

Figure 1 title: Number of confirmed COVID-19 cases by province

Figure 1 legend: The location of Wuhan was marked on the map.

Figure 2 title: Proportion of stigma reported towards COVID-19 patients by province (%)

Figure 2 legend: The location of Wuhan was marked on the map.

Figure 3 title: Proportion of stigma reported towards Wuhan residents by province (%)

Figure 3 legend: The location of Wuhan was marked on the map.

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Table 1 Sample characteristics (n=5,039)

Variables	N	%
Age		
≤20	774	15.4
21-30	1,914	38.0
31-40	885	17.6
41-50	959	19.0
≥51	507	10.1
Gender		
Male	2,090	41.5
Female	2,949	58.5
Education level		
Junior high school or less	668	13.3
Senior high school and junior college	2,528	50.2
College and above	1,843	36.6
Ethnicity		
Han	4,234	84.0
Minorities	805	16.0
Urbanicity		
Urban	2,492	49.5
Rural	2,547	50.5
Monthly household income (USD)		
＜422	846	16.8
422-704	1,485	29.5
705-1,407	1,422	28.2
1,408-2,815	858	17.0
＞2,815	428	8.5
Province by confirmed patients		
Low case area	1,374	27.3
Low-medium case area	1,386	27.5
Medium case area	1,681	33.4
High case area	598	11.9

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Table 2 Stigma and health literacy during COVID-19 epidemic

Variables	N	%
Stigma towards COVID-19 patients (n=5,039)		
Statement closest to your feeling about people with COVID-19		
I feel compassion and desire to help	3,536	70.2
I feel compassion but tend to stay away from them	1,045	20.7
It is their problem and I don't want to get COVID-19 by trying to help them	29	0.6
I am afraid of them and avoid them because they may infect me	93	1.8
I have no particular feeling	336	6.7
How was COVID-19 patient usually regarded/treated in your community?		
Most people reject him/her	254	5.0
Most people are friendly, but they generally try to avoid	1,141	22.6
The community mostly supports and helps him/her	725	14.4
I don't have the experience	2,919	57.9
Stigma towards Wuhan people (n=4,628) *		
Statement closest to your feeling about Wuhan people		
I feel compassion and desire to help	3,323	71.8
I feel compassion but tend to stay away from them	883	19.1
It is their problem and I don't want to get COVID-19 by trying to help them	40	0.9
I am afraid of them and avoid them because they may infect me	74	1.6
I have no particular feeling	308	6.7
How was Wuhan people usually regarded/treated in your community?		
Most people reject him/her	475	10.3
Most people are friendly, but they generally try to avoid	1,784	38.6
The community mostly supports and helps him/her	2,097	45.3
I don't have the experience	272	5.9
Health literacy (n=5,039)		
It is difficult for me to find correct and comprehensive information about COVID-19		
Strongly disagree	218	4.3
Disagree	1,541	30.6
Neutral	1,679	33.3
Agree	1,230	24.4
Strongly agree	371	7.4
It is difficult for me to understand information I got about COVID-19		
Strongly disagree	348	6.9
Disagree	2,471	49.0
Neutral	1,461	29.0
Agree	587	11.6
Strongly agree	172	3.4

* Participants who lived in Wuhan were automatically exempted from stigma questions related to residents of Wuhan.

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Table 3 Univariate analysis of individual stigma towards COVID-19 patients and Wuhan residents

Variables	COVID-19 patients (n = 5,039)			Wuhan residents (n = 4,628) *		
	Stigma	χ^2	p-value	Stigma	χ^2	p-value
Gender		3.742	0.053		12.25	<0.001
Male	61(2.9)			66(3.4)		
Female	61(2.1)			48(1.8)		
Age		32.43	<0.001		4.053	0.399
≤20	9(1.2)			11(1.5)		
21-30	34(1.8)			43(2.4)		
31-40	17(1.9)			20(2.6)		
41-50	36(3.8)			26(3.0)		
≥51	26(5.1)			14(3.0)		
Education level		9.216	0.010		2.606	0.272
Junior high school or less	27(4.0)			21(3.3)		
Senior high school and junior college	59(2.3)			59(2.5)		
College and above	36(2.0)			34(2.1)		
Ethnicity		5.660	0.017		1.174	0.279
Han	93(2.2)			90(2.4)		
Minorities	29(3.6)			24(3.0)		
Urbanicity		0.060	0.807		0.129	0.720
Urban	59(2.4)			51(2.4)		
Rural	63(2.5)			63(2.5)		
Monthly household Income (USD)		5.875	0.209		0.481	0.975
<422	20(2.4)			20(2.4)		
422-704	47(3.2)			38(2.7)		
705-1407	27(1.9)			31(2.4)		
1408-2815	17(2.0)			17(2.3)		
>2815	11(2.6)			8(2.2)		
Province by confirmed patients		4.169	0.244		2.374	0.498
Low case area	24(1.7)			30(2.2)		
Low-medium case area	38(2.7)			41(3.0)		
Medium case area	42(2.5)			39(2.3)		
High case area	18(3.0)			4(1.9)		
It is difficult for me to find correct and comprehensive information about COVID-19		19.21	<0.001		5.448	0.066
Disagree	24(1.4)			30(1.8)		
Neutral	39(2.3)			39(2.5)		
Agree	59(3.7)			45(3.1)		
It is difficult for me to understand information I got about COVID-19		25.87	<0.001		16.17	<0.001
Disagree	43(1.5)			46(1.8)		
Neutral	45(3.1)			37(2.8)		
Agree	34(4.5)			31(4.4)		

* Participants who lived in Wuhan were automatically exempted from stigma questions related to residents of Wuhan.

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Table 4 Factors associated with COVID-19-related stigma

	Individual stigma towards COVID-19 patients (n = 5,039)		Individual stigma towards Wuhan residents (n = 4,628)[a]	
	Model 1[b] aOR (95% CI)	Model 2[c] aOR (95% CI)	Model 1[b] aOR (95% CI)	Model 2[c] aOR (95% CI)
Gender (Ref: Male)				
Female	0.73(0.51-1.05)	0.79(0.55-1.15)	0.52 (0.36-0.76) **	0.55 (0.38-0.81) **
Age (Ref: ≤20)				
21-30	1.77(0.81-3.83)	1.67(0.77-3.64)	1.87 (0.93-3.77)	1.80 (0.89-3.64)
31-40	2.11(0.88-5.05)	2.08(0.87-5.01)	2.17 (0.97-4.87)	2.14 (0.95-4.81)
41-50	4.00(1.82-8.79) **	3.99(1.81-8.83) **	2.34 (1.09-5.04) *	2.34 (1.09-5.05) *
≥51	5.21(2.31-11.73) ***	5.28(2.34-11.94) ***	2.05 (0.88-4.76)	2.03 (0.87-4.74)
Educational level (Ref: Junior high school or less)				
Senior high school and junior college	0.85(0.51-1.42)	0.96(0.57-1.60)	0.94 (0.54-1.65)	1.06 (0.60-1.85)
College and above	0.67(0.37-1.22)	0.82(0.45-1.51)	0.64 (0.34-1.21)	0.76 (0.40-1.45)
Ethnicity (Ref: Han)				
Minorities	2.68(1.66-4.32) ***	2.71(1.67-4.38) ***	1.52 (0.93-2.50)	1.52 (0.93-2.50)
Urbanicity (Ref: Urban)				
Rural	0.86(0.58-1.28)	0.87(0.58-1.30)	0.97 (0.65-1.45)	0.96 (0.64-1.44)
Monthly household income (USD) (Ref:＜422)				
422-704	1.36(0.79-2.34)	1.52(0.88-2.63)	1.11 (0.64-1.95)	1.18 (0.67-2.07)
705-1407	0.82(0.44-1.52)	0.95(0.51-1.77)	1.01 (0.56-1.83)	1.11 (0.61-2.03)
1408-2815	0.92(0.45-1.88)	1.08(0.53-2.21)	1.02 (0.51-2.06)	1.14 (0.56-2.31)
＞2815	1.23(0.55-2.76)	1.55(0.68-3.50)	1.00 (0.41-2.41)	1.15 (0.48-2.80)
Province by confirmed patients (Ref: Low case area)				
Low-medium case area	1.77(1.04-3.00) *	1.74(1.02-2.96) *	1.44 (0.88-2.34)	1.40 (0.86-2.29)
Medium case area	1.64(0.96-2.79)	1.61(0.94-2.74)	1.10 (0.67-1.81)	1.09 (0.66-1.80)
High case area	2.15(1.12-4.13) *	2.03(1.05-3.92) *	0.78 (0.26-2.29)	0.78 (0.26-2.29)
It is difficult for me to find correct and comprehensive information about COVID-19 (Ref: Disagree)				
Neutral		1.49(0.85-2.62)		1.20 (0.70-2.06)
Agree		1.91(1.08-3.37) *		1.12 (0.64-1.98)
It is difficult for me to understand information I got about COVID-19 (Ref: Disagree)				
Neutral		1.62(1.01-2.61) *		1.40 (0.86-2.29)
Agree		1.88(1.08-3.29) *		2.08 (1.17-3.69) *

[a]Participants who lived in Wuhan were automatically exempted from stigma questions related to residents of Wuhan. [b]Model 1 was a Logistic regression analysis without considering the health literacy. [c]Model 2 included the health literacy to see the possible impact of health literacy on stigmatizing attitudes. * p<0.05, ** p<0.01, *** p<0.001.

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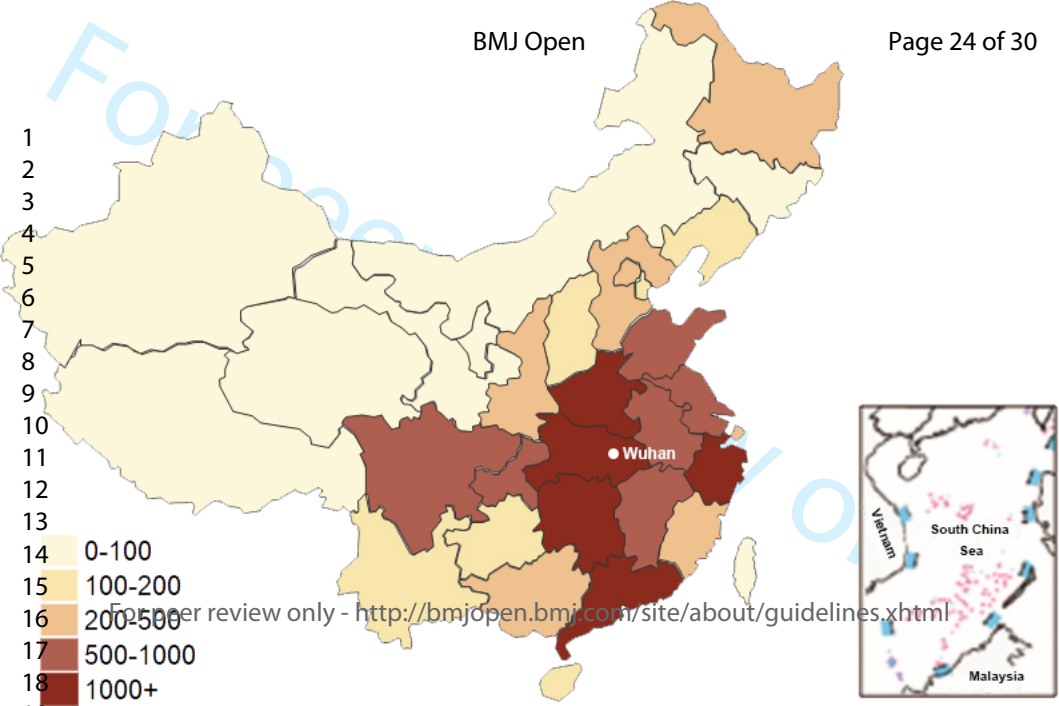

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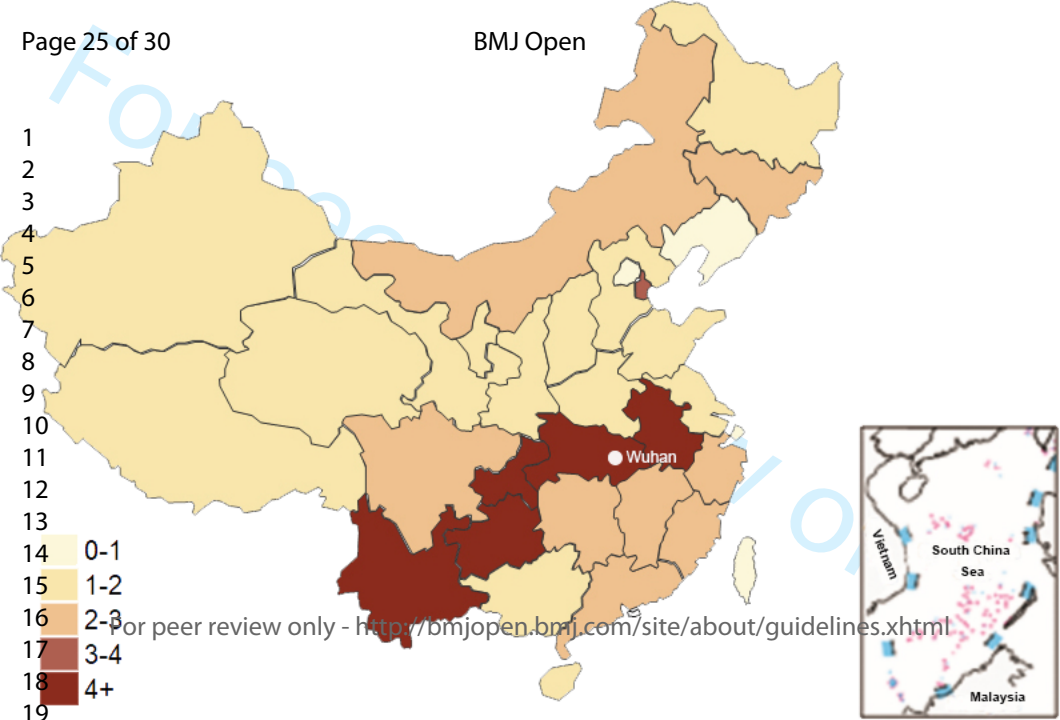

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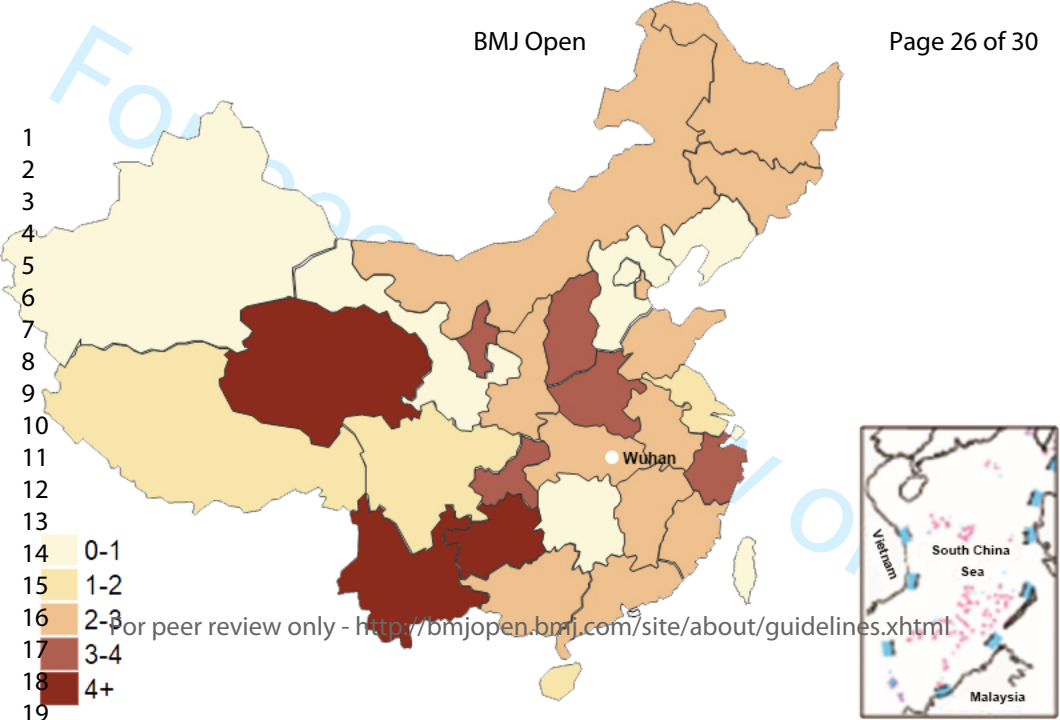

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The Questionnaire

Part 1: The General Information

1. Gender: ☐Male ☐Female

2. Age: _____

3. Province of residence

☐Anhui ☐Beijing ☐Fujian ☐Gansu ☐Guangdong ☐Guangxi

☐Guizhou ☐Hainan ☐Hebei ☐Henan ☐Heilongjiang ☐Hubei (except Wuhan)

☐Wuhan ☐Hunan ☐Jilin ☐Jiangsu ☐Jiangxi ☐Liaoning

☐Inner Mongolia ☐Ningxia ☐Qinghai ☐Shandong ☐Shanxi ☐Shaanxi

☐Shanghai ☐Sichuan ☐Tianjin ☐Tibet ☐Xinjiang ☐Yunnan

☐Zhejiang ☐Chongqing

4. Urbanicity: ☐Urban ☐Rural

5. Ethnicity: ☐Han ☐Minorities

6. Education level: ☐Junior school or less ☐Junior high school ☐Senior high school

☐Junior college ☐College and above

7. Monthly household income: ☐＜3000 yuan ☐3000-5000 yuan ☐5001-10000 yuan

☐10001-20000 yuan ☐>20000 yuan

Part 2: Health literacy

To what extent do you agree with the following statements?

8. It is difficult for me to find correct and comprehensive information about COVID-19.

☐Strongly disagree ☐Disagree ☐Neutral ☐Agree ☐Strongly agree

9. It is difficult for me to understand information I got about COVID-19.

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☐Strongly disagree ☐Disagree ☐Neutral ☐Agree ☐Strongly agree

Part 3: COVID-19-related stigma

10. Please choose a statement that closest to your feeling about COVID-19 patients.

☐I feel compassion and desire to help

☐I feel compassion but tend to stay away from them

☐It is their problem and I don't want to get COVID-19 by trying to help them

☐I am afraid of them and avoid them because they may infect me

☐I have no particular feeling

11. How was COVID-19 patient usually regarded/treated in your community?

☐Most people reject him/her

☐Most people are friendly, but they generally try to avoid

☐The community mostly supports and helps him/her

☐I don't have the experience

12. Please choose a statement that closest to your feeling about Wuhan people.

☐I feel compassion and desire to help

☐I feel compassion but tend to stay away from them

☐It is their problem and I don't want to get COVID-19 by trying to help them

☐I am afraid of them and avoid them because they may infect me

☐I have no particular feeling

13. How was Wuhan people usually regarded/treated in your community?

☐Most people reject him/her

☐Most people are friendly, but they generally try to avoid

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☐The community mostly supports and helps him/her

☐I don't have the experience

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4-5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6
Bias	9	Describe any efforts to address potential sources of bias	*5-6*
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6-7
		(*b*) Describe any methods used to examine subgroups and interactions	6-7
		(*c*) Explain how missing data were addressed	NA
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6-7
		(*e*) Describe any sensitivity analyses	NA
Results			

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7-8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	7-8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7-8
		(*b*) Report category boundaries when continuous variables were categorized	7-8
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	8-10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	11-12

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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COVID-19-related stigma and its influencing factors: a nationwide cross-sectional study during the early stage of the pandemic in China

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COVID-19-related stigma and its influencing factors: a nationwide cross-sectional study during the early stage of the pandemic in China

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Abstract

Objectives : To describe the situation of COVID-19-related stigma towards COVID-19 patients and people from the city of Wuhan in China and to assess the associations between COVID-19-related stigma, health literacy, and sociodemographic characteristics during March 2020, the early stage of the pandemic.

Design: A cross-sectional online survey.

Setting: The study surveyed 31 provinces in China.

Participants: This study surveyed 5,039 respondents in China.

Outcome measures: Public stigma towards both COVID-19 patients and Wuhan residents was measured. Binary logistic regression was used to identify the factors associated with public COVID-19-related stigma.

Results : Among the participants, 122 (2.4%) reported themselves and 254 (5.0%) reported the communities they lived in as holding a stigmatizing attitude towards COVID-19 patients, respectively. Additionally, 114 (2.5%) and 475 (10.3%) reported that themselves and the communities they lived in, respectively, held a stigma against people from Wuhan, which was the most severely affected area in China. People aged over 40, lived in areas with severe epidemics (aOR=2.03, 95% CI [1.05-3.92]), and who felt it difficult to find and understand information about COVID-19 (aOR=1.91, 95% CI [1.08-3.37]; aOR=1.88, 95% CI [1.08-3.29]) were more likely to stigmatize COVID-19 patients. People who were male, aged 41 to 50, and had difficulty understanding information (aOR=2.08, 95% CI [1.17-3.69]) were more likely to stigmatize people from Wuhan.

Conclusions : COVID-19 patients and Wuhan residents suffered stigma at both the individual and community levels. Those who had low health literacy, who lived in areas with a large number of COVID-19 cases, and who were ethnic minorities were more likely to stigmatize others. Tailored interventions are encouraged to improve health literacy and consequently to reduce public COVID-19-related stigma.

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Article Summary

Strengths and limitations of this study

- This was a rapid study to describe the situation of public COVID-19-related stigma during the early stage of the pandemic in China and assess the associations between stigma, health literacy and other factors.
- This is a cross-sectional study with an over sampling of ethnic minorities and a balance of urban and rural residents.
- The survey data relies on self-reporting, and therefore participants' responses may be biased due to social desirability.

Introduction

Stigma can be defined as a social label associating an individual with characteristics of prejudice and discrimination.[1,2] Individuals suffering from stigma often feel shamed, stressed and isolated, leading to negative changes in their health behaviors.[3,4] For example, individuals being stigmatized for a health condition may delay or avoid treatment, and may not seek access to health services, which compromises the outcome of their medical condition.[5]

In the field of infectious disease, stigma has been recognized as a global issue.[6] In recent decades, many studies concerning stigma as related to infectious diseases have been conducted, including but not limited to human immunodeficiency virus (HIV),[7-9] tuberculosis (TB)[10-12] and severe acute respiratory syndrome (SARS).[13,14] The relationship between knowledge and stigma is well-documented for infectious diseases prevention measures that do not require social distancing. For example, people with higher education levels and HIV-related knowledge were less likely to stigmatize HIV patients.[7,15] This may be due to the fact that people with more HIV-related knowledge had a better understanding that they were not likely to get infected with HIV through social interactions (such as handshake, hug, and cheek kiss). However, emerging infectious diseases that are evolving in nature and have uncertain transmission patterns often cause panic among individuals and communities, as was seen with SARS, H1N1, and COVID-19. The transmission of certain infectious diseases through social interactions can ignite public

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stigma towards disease-related groups[14] following the introduction of social-distancing policies to prevent such diseases. Previous studies have noted that social distancing measures may affect the attitudes of individuals and communities towards people with stigmatizing conditions, and may lead to stigma.[14,16] In studies on COVID-19-related stigma, attention has been focused on stigma facing health care workers or residents in areas affected by the COVID-19 pandemic.[17,18] However, few studies have explored the relationship between knowledge and stigma in emerging infectious diseases that require social distancing.

Health literacy is usually defined as an individual's ability to obtain and process health information and take appropriate action.[19] Knowledge is an important dimension of health literacy.[20] Previous studies investigating the relationship between health literacy and stigma have mostly focused on mental illnesses and chronic diseases, and have shown that patients with low health literacy were more likely to feel stigmatized.[21-23] Few studies have investigated the relationship between health literacy and stigma towards infectious diseases that require social distancing in China.

Studies on stigma related to infectious diseases have revealed that it is not only individual patients who face stigma from infectious diseases, but that entire racial or ethnic groups who have or are perceived as having a higher likelihood of being infected can face stigmatiziation.[24] Wuhan, the capital of Hubei Province, was the most severely affected area during the COVID-19 pandemic in China. In order to control the spread of COVID-19, the Chinese government took unprecedented measures, including locking down Wuhan, and requiring all Wuhan residents who migrated to other provinces before Wuhan was locked down to receive nucleic acid tests. A considerable portion of confirmed COVID-19 cases in many provinces were imported cases from Wuhan.[25] Despite the government and media calling for tolerance, the development of a stigma towards residents of Wuhan was inevitable. For example, in some communities, residents of Wuhan were not allowed to enter and suffered unfair treatment. Therefore, this study explores the situation of stigma faced by COVID-19 patients and stigma faced by residents of Wuhan.

The aims of this study are 1) to describe the situation of public COVID-19-related stigma

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during the early stage of the COVID-19 pandemic in China and 2) to assess the associations between stigma, health literacy, and sociodemographic characteristics.

Methods

Study design and participants

The World Health Organization (WHO) declared COVID-19 as a pandemic in March 2020, and our study was conducted between 1 March and 16 March, 2020. As of 16 March, 2020, there were more than 80,000 confirmed cases in China and more than 100,000 cases globally, and during this time people in China were under strict social-distancing policies. This was a national cross-sectional survey conducted in 31 provinces, municipalities, and autonomous regions (hereafter, provinces) in China, except for Hong Kong, Macao, and Taiwan.

The questionnaire was developed for this study (Additional file 1). Tools to measure public COVID-19-related stigma were adapted from a previous study.[26] Two online focus groups were conducted to discuss the questionnaire design, with six people with public health and medical backgrounds in each group. Two independent experts with backgrounds in public health and risk communication reviewed and further developed the questionnaire. We conducted 30 online one-to-one interviews with respondents of different ages and education levels to pre-test the questionnaire. The final questionnaire included sociodemographic characteristics, public COVID-19-related stigma, and health literacy during the COVID-19 pandemic. Logic questions were set up to verify the validity of the data.

The respondents included in this study were aged over 16 years old and could read Mandarin. We conducted convenience sampling in 31 provinces, and 100-200 families were selected from each province. The member from each household whose birth date was closest to the survey date was invited to complete the questionnaire to ensure randomness in sampling. Younger family members were encouraged to assist elderly family members in completing the questionnaire, if necessary. Before the investigation, investigators received online trainings, and thusly they were responsible for quality control. Respondents could fill in the questionnaire by scanning QR codes or clicking the questionnaire link on smartphones, tablets and other mobile devices. A sample size of 3,062 was estimated based on a prevalence estimate of 50%,

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the ±2% margin of error and upward adjusted by 20% considering potential non-response. We set up a target sample for ethnic minorities residents and over-sampled respondents who lived in Wuhan, as it was the center of the pandemic. We intentionally balanced respondents from urban and rural areas while conducting this survey. Before completing the questionnaire, respondents were informed in the consent statement that this was an anonymous and voluntary survey. No compensation was provided to respondents. The Ethics Committee of the School of Public Health at Zhejiang University reviewed and approved this study (No. ZGL202002-3).

Patient and public involvement

Patients were not involved in the design, management or reporting of this study.

Measurements

Sociodemographic characteristics

The sociodemographic characteristics comprised gender, age, education, ethnicity, urbanicity, and monthly household income. According to the data of confirmed COVID-19 cases in 31 provinces officially announced by the Chinese government as of 1 March, 2020, the 31 provinces were divided into four groups. Hubei province, the statistical outlier with the highest number of confirmed cases, was classified as the high-risk group. The rest of the 30 provinces were divided into three groups (low-risk group, medium-risk group and medium-high-risk group), with each group containing 10 provinces based on their ranking of number of confirmed cases.

Health literacy

Questions on health literacy about COVID-19 were adapted from previous studies[27,28] and measured using two questions: (1) To what extent do you agree with the following statements "it is difficult for me to find correct and comprehensive information about COVID-19," (2) To what extent do you agree with the following statements "it is difficult for me to understand information I got about COVID-19." Each question was answered using a 5-point Likert scale ranging from 1 to 5 (1=Strongly disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly agree).

Stigma

Questions on public COVID-19-related stigma were adapted from previous studies.[26,29]

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Four questions, including public stigma towards COVID-19 patients and residents of Wuhan at the individual and community levels were used, respectively. The study participants who chose the following options: "It is their problem and I don't want to get COVID-19 by trying to help them," and "I am afraid of them and avoid them because they may infect me," were classified as "stigmatized," those who chose options "I feel compassion and desire to help," "I feel compassion but tend to stay away from them," and "I have no particular feeling," were classified as "not stigmatized."[26] People who lived in Wuhan were automatically exempted from stigma questions related to residents of Wuhan.

Data analysis

All data were analyzed using IBM SPSS Statistics Version 23.0 for Windows. Descriptive analyses included means for continuous variables and percentages for categorical data. Chi-square tests were conducted to compare COVID-19-related stigma between groups. Binary logistic regression analysis was used to examine the association of the independent variables with COVID-19-related stigma. All comparisons were two-tailed. The significance threshold was p-value < 0.05.

Results

The response rate of this survey was 94.7%. Of the 5,124 participants who completed the questionnaire, 85(1.7%) were excluded because they were younger than 16 years old or answered logical questions incorrectly. A total of 5,039 participants (Table 1) with an average age of 33.0 (SD=12.5) were included for analysis. Most of them were female, were of Han ethnicity, received senior high school education, had a monthly household income above 705 United States dollars (USD), and lived in a medium case area.

At the individual level (Table 2), the majority (70.2%) of participants reported they felt compassion for and desired to help COVID-19 patients, 1,045 (20.7%) reported they felt compassion for COVID-19 patients but tended to avoid them, 29(0.6%) expressed their unwillingness to help COVID-19 patients, and 93(1.8%) expressed fear of COVID-19 patients. Less than one percent of participants expressed their unwillingness to help residents of Wuhan and 74(1.6%) expressed fear of residents of Wuhan. At the community level, 254(5.0%)

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participants reported their communities rejected COVID-19 patients, and 475(10.3%) participants reported residents of Wuhan were rejected by their communities. Approximately one-third of participants reported that they had difficulties finding comprehensive and correct information about COVID-19, and 759(15.0%) of the participants reported that it was difficult to understand the information they received about COVID-19.

Figure 1 shows the number of cumulative confirmed COVID-19 cases from the 31 provinces on the investigation data (March 1, 2020). Figure 2 illustrates the proportion of individual stigma towards COVID-19 patients in each province. People living in Hubei, Anhui, Guizhou, Tianjin and Yunnan provinces had a relatively high stigma percentage of over 4% of the population. Figure 3 shows that more than 4% of the respondents living in Guizhou, Yunnan, and Qinghai provinces expressed a stigma towards residents of Wuhan. The proportion of reported stigma towards residents of Wuhan in Henan, Shanxi, Ningxia, Chongqing and Zhejiang provinces was between 3% and 4%.

As shown in Table 3, the prevalence of stigma towards COVID-19 patients among people over 50 was significantly higher than that of people under 20 (5.1% vs. 1.2%, $p < 0.001$). Compared with people who had a junior high school or lower degree, people with a college or higher degree reported lower levels of stigma towards COVID-19 patients (2.0% vs. 4.0%, p=0.01). Ethnic minorities showed a higher level of (3.6% vs. 2.2%, p=0.024) stigma towards COVID-19 patients than did Han respondents. Participants who felt it was easy to find and understand information about COVID-19 expressed lower stigma towards COVID-19 patients than did those who felt it was difficult (1.4% vs. 3.7%, $p < 0.001$; 1.5% vs. 4.5%, $p < 0.001$). Individual stigma towards residents of Wuhan was more prevalent among male than female respondents (3.4% vs. 1.8%, $p < 0.001$) and was relatively high among those who felt it was hard to understand COVID-19-related information (4.4% vs. 1.8%, $p < 0.001$).

Logistic regression (Table 4) indicated that participants aged over 40, who were ethnic minorities (aOR=2.71, 95% CI [1.67-4.38]), and who felt it was difficult to find and understand information about COVID-19 (aOR=1.91, 95% CI [1.08-3.37]; aOR=1.88, 95% CI [1.08-3.29])

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were more likely to stigmatize COVID-19 patients. Compared with people living in low case areas, people living in low-medium and high case areas were 1.74 and 2.03 times more likely to stigmatize COVID-19 patients, respectively. Females were found to be less likely to stigmatize residents of Wuhan when compared with males (aOR=0.55, 95% CI [0.38-0.81]). Participants aged 41 to 50 and those with difficulty understanding information (aOR=2.08, 95% CI [1.17-3.69]) were more likely to stigmatize residents of Wuhan.

Discussion

To our knowledge, there are currently few studies investigating public COVID-19-related stigma during the early stage of the pandemic in China. Our study described the situation of stigma towards COVID-19 patients and residents of Wuhan at both the individual and community levels. Consequently, our results verified the correlation between better health literacy and lower stigma during a pandemic of an emerging infectious disease and showed the difference in stigma in regions with different COVID-19 epidemic severities on a large scale across China. Additionally, we identified that sociodemographic factors, such as gender, age, and ethnicity, affected public COVID-19-related stigma.

Historically, infectious diseases have long been associated with stigma. During the early stage of the COVID-19 pandemic, potentially deadly conditions, the lack of effective treatments, and rumors increased the risk of stigmatization. The stigma associated with COVID-19 threatens the physical and mental health of COVID-19 patients and residents of Wuhan. In the long run, stigmatization also damages the cultural fabric of society and undermines efforts to control pandemics, creating an atmosphere of fear and distrust. Previous studies identified COVID-19-related public stigma as more prevalent and severe when compared with our findings. According to a global survey involving 173 countries, nearly a third of participants believed that people talked badly or gossiped about other people who were thought to associated with COVID-19, and 21.9% of participants believed people who had COVID-19 were not respected by the community.[30] An online survey in February 2020 in China also showed that about half of participants reported they would avoid people from Hubei and 16.9% would even try to expel them from their communities.[31] The low prevalence of stigma in our study may be

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partly explained by the fact that the Chinese government began campaigns in the media to reduce stigma towards COVID-19 patients and people from Wuhan during the early stage of the pandemic.[31] COVID-19-related stigma is not unique to China, and has been reported in the United States, Australia, Nepal and other countries.[17] These facts should remind health policy makers to attach more importance to community-based stigma reduction interventions and campaigns.

Our study added to the literature by exposing the negative association between health literacy and COVID-19-related stigma. Stigma can be understood as a human instinct to protect themselves from potentially fatal infectious diseases,[32] even though this instinctual response often leads to bias.[33] Lack of knowledge has been shown to be a major driver of these biases and stigmatizations. Previous studies on mental disease identified a negative correlation between health literacy and stigma.[34,35] Consequently, in the field of infectious diseases, higher literacy concerning one disease may possibly help reduce disease-related stigma. Our study suggested that higher COVID-19-related health literacy, specifically, a better ability to find and understand COVID-19 information, might help reduce stigma towards COVID-19 patients and residents of Wuhan. Additionally, it has been suggested that health literacy interventions, such as educational lectures to improve public knowledge and literacy, could help reduce stigma in the field of mental health.[36] Thus, further studies are needed to verify effective measures to reduce stigma during an emerging infectious disease, such as information campaigns from health services or the media, and sessions in workplaces and schools.

To reduce stigma, this study described the geographic distribution of stigma during the early stage of the pandemic to improve intervention precision by allowing for the targeting of high-stigma areas. Our research found that people in different regions held differing degrees of stigmatization. In general, provinces which were close to Wuhan, such as Anhui and Chongqing, and provinces with more ethnic minorities, such as Yunnan and Guizhou, had higher levels of stigma towards COVID-19 patients. Similarly, the proportion of respondents who held stigma towards residents of Wuhan was relatively high in provinces close to Wuhan, such as Henan, Chongqing and Shanxi, and provinces with more ethnic minorities such as Qinghai, Yunnan,

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Guizhou and Ningxia. A study using South Korean data revealed that the risk of COVID-19 increased with higher area morbidity,[37] and the danger appraisal hypothesis stated that an individuals' perception of danger would make them choose a safer social distance.[38] Another study on SARS-related stigma conducted in Hong Kong showed that living in a geographical location with a large number of cases could increase stigmatizing attitudes. Specifically, residents living on the block with the most SARS patients reported holding the highest level of stigmatizing attitudes.[13] During the COVID-19 pandemic, most countries around the world reported high risk perceptions.[39] Similarly, in our study, people living in areas severely affected by the COVID-19 pandemic were at higher risk of social interaction with potential COVID-19 patients. Thus, they might have higher risk perceptions, expect to have less social interaction with potential COVID-19 patients, and therefore may hold higher levels of stigma. Interestingly, there was no significant regional differences in attitudes towards residents of Wuhan. A possible reason was that the public perceived the risk posed by COVID-19 patients to be higher than that posed by residents of Wuhan.

Our study also showed the influence of sociodemographic characteristics on public COVID-19-related stigma, which might help identify subgroups that are more likely to stigmatize others during the pandemic. Consistent with previous studies, we found females were more tolerant towards residents of Wuhan, while people over 40 years old and ethnic minorities were more likely to stigmatize COVID-19 patients.[15,40] The elderly were more likely to progress to severe disease after infection or suffer complications from COVID-19 than younger adults, and had higher perceived susceptibility and perceived severity during the pandemic,[41] which might explain why the elderly were more likely to hold stigmatizing attitudes. The majority of ethnic minorities in China live in less developed mountainous inland or border districts in the western region, and possess relatively low levels of education and income, which have been identified as negative influencing factors for stigma in previous studies and may partially explain their higher levels of stigmatization.[42,43] A previous study revealed that groups with higher education and income levels had lower levels of stigma towards patients with related diseases.[22] However, this difference was not found in our study.

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One possible reason for this may be that, during the COVID-19 pandemic, China conducted a large-scale publicity campaign through traditional and social media, such as China Central Television (CCTV), WeChat official accounts and short video platforms,[44] which may have helped reduce barriers related to education and economic status in accessing adequate information concerning COVID-19.

There are some limitations to this study. First, this is a cross-sectional study, so it cannot verify the causal relationship between stigma-related variables. Second, this is an online survey, and people who did not have access to the Internet were not included, which may result in selection bias. However, as of December 2020, China's Internet penetration rate was 70.4%, and most people in China had access to the Internet via smartphones.[45] Third, health literacy and stigmatizing attitudes rely on self-reporting, and may thus lead to an underestimation of the impact of health literacy on stigma.[46] Fourth, we chose a snowball sampling method rather than a representative sampling method, due to the social-distancing policies in place during our investigation. However, we ensured both the balance of urban-rural samples and the randomness of each sample in each household during the survey to reduce related bias. Fifth, this study does not differentiate among participants by their profession or relationship to the disease. It is possible that health personnel or those who have been discriminated against and know the reality of the virus offered different responses, just as people who have been infected may also show less stigma (although the number of people reporting infection in our surveyed population was low).

Conclusion

COVID-19 patients and residents of Wuhan have suffered stigma at both the individual and community levels. Those who had low health literacy, who lived in areas with a large number of COVID-19 cases, and who were ethnic minorities were more likely to stigmatize others in the early stage of the pandemic. Although a COVID-19 vaccine is available globally, it will still take time to achieve herd immunity. We recommend joint actions of all sectors of our society, including but not limited to governments, health institutions, and public figures, such as athletes, communicators and social influencers to reduce the COVID-19-related

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stigmatization. Health policy makers should include early prevention and elimination of stigma into emergency preparedness plans for infectious diseases. Community-based stigma reduction interventions targeted the ethnic minorities and those lived near the epidemic center are encouraged to support the most stigmatized groups. In addition, information campaigns to offer a better access and easy understandable messages thus to increase public health literacy of infectious diseases by medical authorities and the media are recommended.

Declarations

Contributors

XZ, XW, and HZ made substantial contributions to the study design and supervised the data collection. TJ, LL, YZ, and YP contributed to the data collection and interpretation. TJ wrote the substantial parts of manuscript. All authors critically revised, reviewed, and approved the final version the manuscript.

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Patient consent for publication

Not required.

Data sharing statement

Data are available from the corresponding author on reasonable request.

Competing interests

The authors declare no conflict of interest.

Ethics approval and consent to participate

The protocol for this study was approved by the Ethics Committee of the School of Public Health, Zhejiang University. No. ZGL202002-3.

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Figure legends

Figure 1: Number of confirmed COVID-19 cases by province

Figure 2: Proportion of stigma reported towards COVID-19 patients by province (%)

Figure 3: Proportion of stigma reported towards Wuhan residents by province (%)

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Table 1 Sample characteristics (n=5,039)

Variables	N	%
Age		
≤20	774	15.4

21-30	1,914	38.0
31-40	885	17.6
41-50	959	19.0
≥51	507	10.1
Gender		
Male	2,090	41.5
Female	2,949	58.5
Education level		
Junior high school or less	668	13.3
Senior high school and junior college	2,528	50.2
College and above	1,843	36.6
Ethnicity		
Han	4,234	84.0
Minorities	805	16.0
Urbanicity		
Urban	2,492	49.5
Rural	2,547	50.5
Monthly household income (USD)		
＜422	846	16.8
422-704	1,485	29.5
705-1,407	1,422	28.2
1,408-2,815	858	17.0
＞2,815	428	8.5
Province by confirmed patients		
Low case area	1,374	27.3
Low-medium case area	1,386	27.5
Medium case area	1,681	33.4
High case area	598	11.9

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Table 2 Stigma and health literacy during COVID-19 epidemic

Variables	N	%
Stigma towards COVID-19 patients (n=5,039)		
Statement closest to your feeling about people with COVID-19		

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I feel compassion and desire to help	3,536	70.2
I feel compassion but tend to stay away from them	1,045	20.7
It is their problem and I don't want to get COVID-19 by trying to help them	29	0.6
I am afraid of them and avoid them because they may infect me	93	1.8
I have no particular feeling	336	6.7
How was COVID-19 patient usually regarded/treated in your community?		
Most people reject him/her	254	5.0
Most people are friendly, but they generally try to avoid	1,141	22.6
The community mostly supports and helps him/her	725	14.4
I don't have the experience	2,919	57.9
Stigma towards Wuhan people (n=4,628) *		
Statement closest to your feeling about Wuhan people		
I feel compassion and desire to help	3,323	71.8
I feel compassion but tend to stay away from them	883	19.1
It is their problem and I don't want to get COVID-19 by trying to help them	40	0.9
I am afraid of them and avoid them because they may infect me	74	1.6
I have no particular feeling	308	6.7
How was Wuhan people usually regarded/treated in your community?		
Most people reject him/her	475	10.3
Most people are friendly, but they generally try to avoid	1,784	38.6
The community mostly supports and helps him/her	2,097	45.3
I don't have the experience	272	5.9
Health literacy (n=5,039)		
It is difficult for me to find correct and comprehensive information about COVID-19		
Strongly disagree	218	4.3
Disagree	1,541	30.6
Neutral	1,679	33.3
Agree	1,230	24.4
Strongly agree	371	7.4
It is difficult for me to understand information I got about COVID-19		
Strongly disagree	348	6.9
Disagree	2,471	49.0
Neutral	1,461	29.0
Agree	587	11.6
Strongly agree	172	3.4

* Participants who lived in Wuhan were automatically exempted from stigma questions related to residents of Wuhan.

Table 3 Univariate analysis of individual stigma towards COVID-19 patients and Wuhan residents

	COVID-19 patients (n = 5,039)			Wuhan residents (n = 4,628) *		
Variables	**Stigma**	**χ^2**	**p-value**	**Stigma**	**χ^2**	**p-value**

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Gender		3.742	0.053		12.25	<0.001
Male	61(2.9)			66(3.4)		
Female	61(2.1)			48(1.8)		
Age		32.43	<0.001		4.053	0.399
≤20	9(1.2)			11(1.5)		
21-30	34(1.8)			43(2.4)		
31-40	17(1.9)			20(2.6)		
41-50	36(3.8)			26(3.0)		
≥51	26(5.1)			14(3.0)		
Education level		9.216	0.010		2.606	0.272
Junior high school or less	27(4.0)			21(3.3)		
Senior high school and junior college	59(2.3)			59(2.5)		
College and above	36(2.0)			34(2.1)		
Ethnicity		5.660	0.017		1.174	0.279
Han	93(2.2)			90(2.4)		
Minorities	29(3.6)			24(3.0)		
Urbanicity		0.060	0.807		0.129	0.720
Urban	59(2.4)			51(2.4)		
Rural	63(2.5)			63(2.5)		
Monthly household Income (USD)		5.875	0.209		0.481	0.975
<422	20(2.4)			20(2.4)		
422-704	47(3.2)			38(2.7)		
705-1407	27(1.9)			31(2.4)		
1408-2815	17(2.0)			17(2.3)		
>2815	11(2.6)			8(2.2)		
Province by confirmed patients		4.169	0.244		2.374	0.498
Low case area	24(1.7)			30(2.2)		
Low-medium case area	38(2.7)			41(3.0)		
Medium case area	42(2.5)			39(2.3)		
High case area	18(3.0)			4(1.9)		
It is difficult for me to find correct and comprehensive information about COVID-19		19.21	<0.001		5.448	0.066
Disagree	24(1.4)			30(1.8)		
Neutral	39(2.3)			39(2.5)		
Agree	59(3.7)			45(3.1)		
It is difficult for me to understand information I got about COVID-19		25.87	<0.001		16.17	<0.001
Disagree	43(1.5)			46(1.8)		
Neutral	45(3.1)			37(2.8)		
Agree	34(4.5)			31(4.4)		

* Participants who lived in Wuhan were automatically exempted from stigma questions related to residents of Wuhan.

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Table 4 Factors associated with COVID-19-related stigma

	Individual stigma towards COVID-19 patients (n = 5,039)		Individual stigma towards Wuhan residents (n = 4,628)[a]	
	Model 1[b] aOR (95% CI)	Model 2[c] aOR (95% CI)	Model 1[b] aOR (95% CI)	Model 2[c] aOR (95% CI)
Gender (Ref: Male)				
Female	0.73(0.51-1.05)	0.79(0.55-1.15)	0.52 (0.36-0.76) **	0.55 (0.38-0.81) **
Age (Ref: ≤20)				
21-30	1.77(0.81-3.83)	1.67(0.77-3.64)	1.87 (0.93-3.77)	1.80 (0.89-3.64)
31-40	2.11(0.88-5.05)	2.08(0.87-5.01)	2.17 (0.97-4.87)	2.14 (0.95-4.81)
41-50	4.00(1.82-8.79) **	3.99(1.81-8.83) **	2.34 (1.09-5.04) *	2.34 (1.09-5.05) *
≥51	5.21(2.31-11.73) ***	5.28(2.34-11.94) ***	2.05 (0.88-4.76)	2.03 (0.87-4.74)
Educational level (Ref: Junior high school or less)				
Senior high school and junior college	0.85(0.51-1.42)	0.96(0.57-1.60)	0.94 (0.54-1.65)	1.06 (0.60-1.85)
College and above	0.67(0.37-1.22)	0.82(0.45-1.51)	0.64 (0.34-1.21)	0.76 (0.40-1.45)
Ethnicity (Ref: Han)				
Minorities	2.68(1.66-4.32) ***	2.71(1.67-4.38) ***	1.52 (0.93-2.50)	1.52 (0.93-2.50)
Urbanicity (Ref: Urban)				
Rural	0.86(0.58-1.28)	0.87(0.58-1.30)	0.97 (0.65-1.45)	0.96 (0.64-1.44)
Monthly household income (USD) (Ref:＜422)				
422-704	1.36(0.79-2.34)	1.52(0.88-2.63)	1.11 (0.64-1.95)	1.18 (0.67-2.07)
705-1407	0.82(0.44-1.52)	0.95(0.51-1.77)	1.01 (0.56-1.83)	1.11 (0.61-2.03)
1408-2815	0.92(0.45-1.88)	1.08(0.53-2.21)	1.02 (0.51-2.06)	1.14 (0.56-2.31)
＞2815	1.23(0.55-2.76)	1.55(0.68-3.50)	1.00 (0.41-2.41)	1.15 (0.48-2.80)
Province by confirmed patients (Ref: Low case area)				
Low-medium case area	1.77(1.04-3.00) *	1.74(1.02-2.96) *	1.44 (0.88-2.34)	1.40 (0.86-2.29)
Medium case area	1.64(0.96-2.79)	1.61(0.94-2.74)	1.10 (0.67-1.81)	1.09 (0.66-1.80)
High case area	2.15(1.12-4.13) *	2.03(1.05-3.92) *	0.78 (0.26-2.29)	0.78 (0.26-2.29)
It is difficult for me to find correct and comprehensive information about COVID-19 (Ref: Disagree)				
Neutral		1.49(0.85-2.62)		1.20 (0.70-2.06)
Agree		1.91(1.08-3.37) *		1.12 (0.64-1.98)
It is difficult for me to understand information I got about COVID-19 (Ref: Disagree)				
Neutral		1.62(1.01-2.61) *		1.40 (0.86-2.29)
Agree		1.88(1.08-3.29) *		2.08 (1.17-3.69) *

[a]Participants who lived in Wuhan were automatically exempted from stigma questions related to residents of Wuhan. [b]Model 1 was a Logistic regression analysis without considering the health literacy. [c]Model 2 included the health literacy to see the possible impact of health literacy on stigmatizing attitudes. * p<0.05, ** p<0.01, *** p<0.001.

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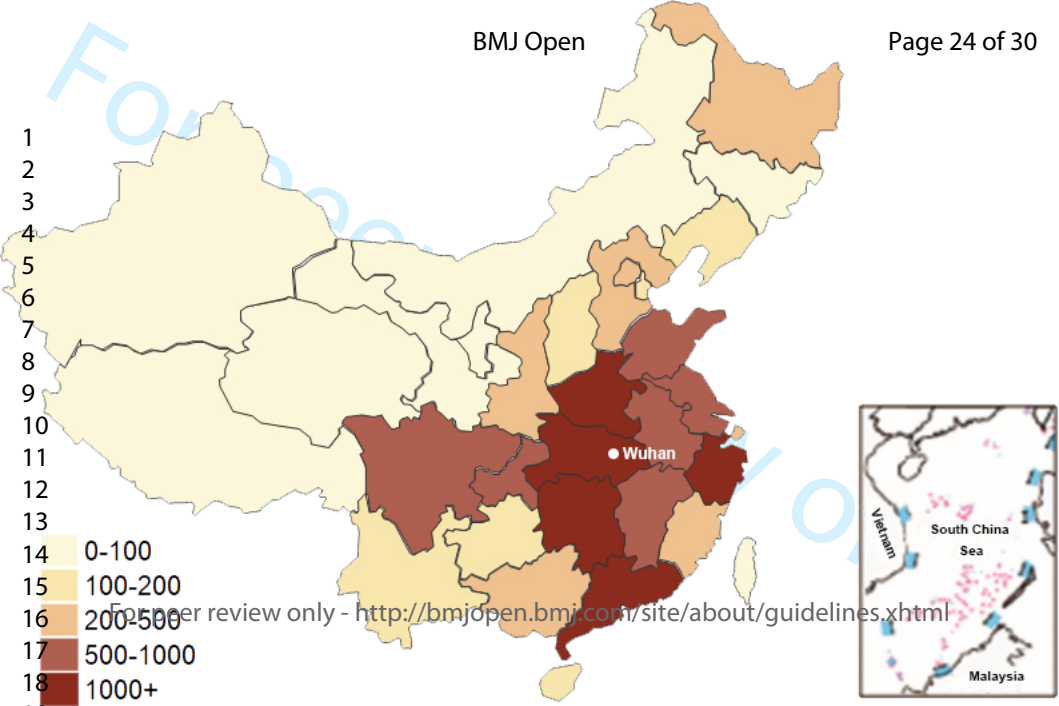

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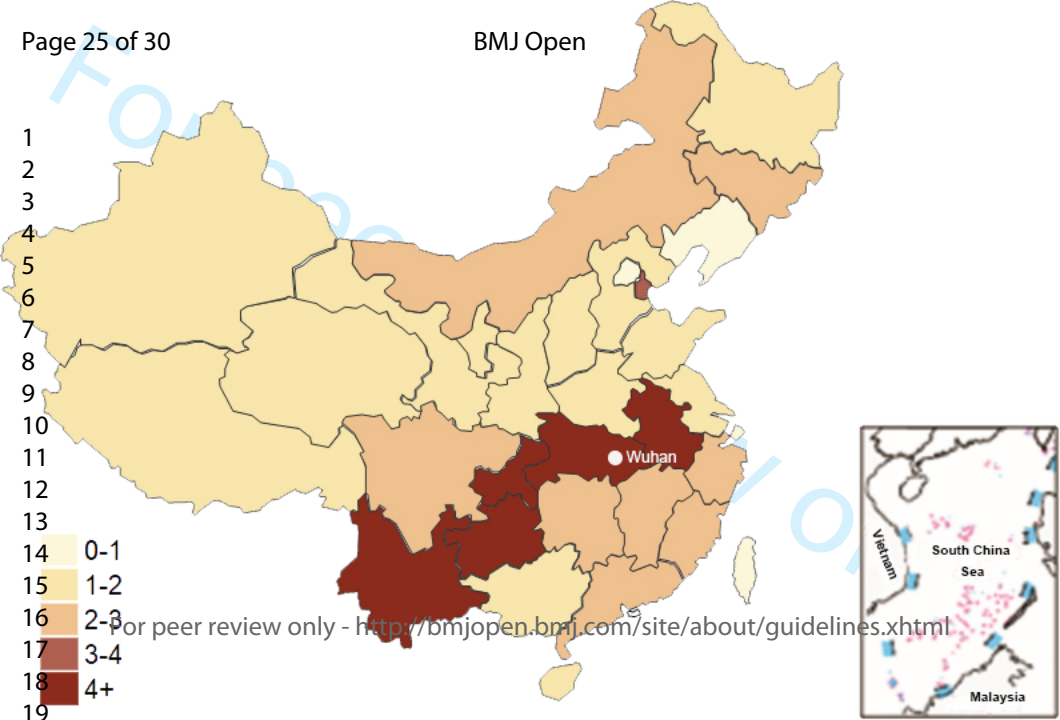

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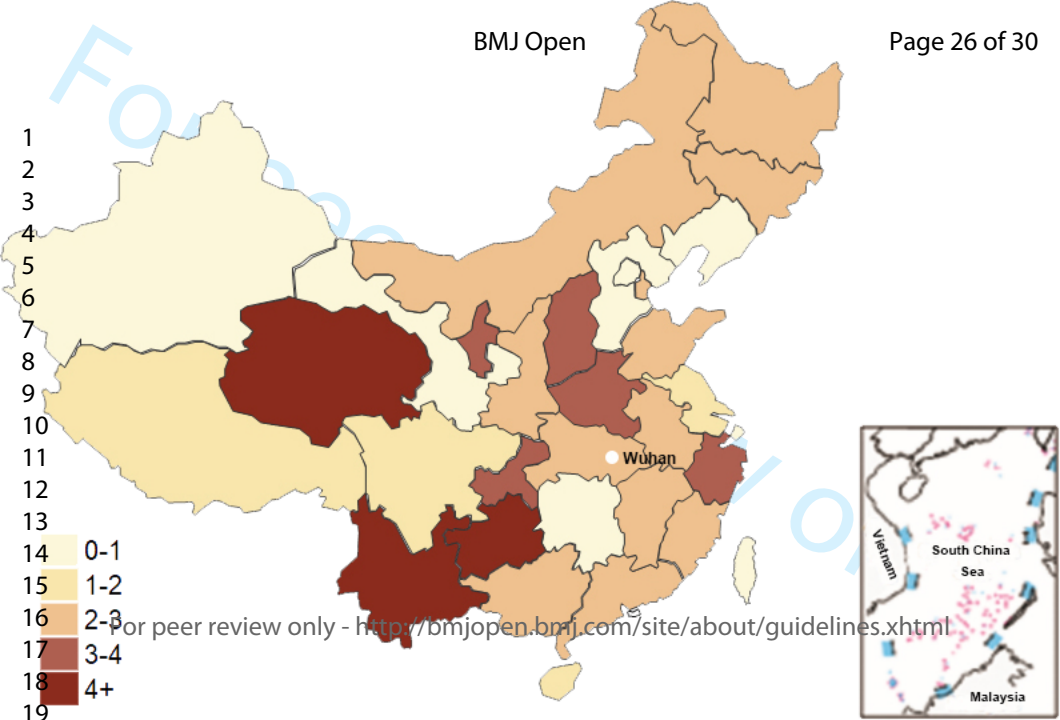

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The Questionnaire

Part 1: The General Information

1. Gender: ☐Male ☐Female

2. Age: _____

3. Province of residence

☐Anhui ☐Beijing ☐Fujian ☐Gansu ☐Guangdong ☐Guangxi

☐Guizhou ☐Hainan ☐Hebei ☐Henan ☐Heilongjiang ☐Hubei (except Wuhan)

☐Wuhan ☐Hunan ☐Jilin ☐Jiangsu ☐Jiangxi ☐Liaoning

☐Inner Mongolia ☐Ningxia ☐Qinghai ☐Shandong ☐Shanxi ☐Shaanxi

☐Shanghai ☐Sichuan ☐Tianjin ☐Tibet ☐Xinjiang ☐Yunnan

☐Zhejiang ☐Chongqing

4. Urbanicity: ☐Urban ☐Rural

5. Ethnicity: ☐Han ☐Minorities

6. Education level: ☐Junior school or less ☐Junior high school ☐Senior high school

☐Junior college ☐College and above

7. Monthly household income: ☐＜3000 yuan ☐3000-5000 yuan ☐5001-10000 yuan

☐10001-20000 yuan ☐>20000 yuan

Part 2: Health literacy

To what extent do you agree with the following statements?

8. It is difficult for me to find correct and comprehensive information about COVID-19.

☐Strongly disagree ☐Disagree ☐Neutral ☐Agree ☐Strongly agree

9. It is difficult for me to understand information I got about COVID-19.

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☐Strongly disagree ☐Disagree ☐Neutral ☐Agree ☐Strongly agree

Part 3: COVID-19-related stigma

10. Please choose a statement that closest to your feeling about COVID-19 patients.

☐I feel compassion and desire to help

☐I feel compassion but tend to stay away from them

☐It is their problem and I don't want to get COVID-19 by trying to help them

☐I am afraid of them and avoid them because they may infect me

☐I have no particular feeling

11. How was COVID-19 patient usually regarded/treated in your community?

☐Most people reject him/her

☐Most people are friendly, but they generally try to avoid

☐The community mostly supports and helps him/her

☐I don't have the experience

12. Please choose a statement that closest to your feeling about Wuhan people.

☐I feel compassion and desire to help

☐I feel compassion but tend to stay away from them

☐It is their problem and I don't want to get COVID-19 by trying to help them

☐I am afraid of them and avoid them because they may infect me

☐I have no particular feeling

13. How was Wuhan people usually regarded/treated in your community?

☐Most people reject him/her

☐Most people are friendly, but they generally try to avoid

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☐The community mostly supports and helps him/her

☐I don't have the experience

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4-5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6
Bias	9	Describe any efforts to address potential sources of bias	*5-6*
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6-7
		(*b*) Describe any methods used to examine subgroups and interactions	6-7
		(*c*) Explain how missing data were addressed	NA
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6-7
		(*e*) Describe any sensitivity analyses	NA
Results			

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7-8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	7-8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7-8
		(*b*) Report category boundaries when continuous variables were categorized	7-8
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	8-10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	11-12

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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