

# The influencing factors of discrimination against recovered Coronavirus disease 2019 (COVID-19) patients in China: a national study

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## ABSTRACT

**Background:** Over 26 million recovered COVID-19 patients will suffer from discrimination in work, education and social interactions. We analyzed the determinants of discrimination against recovered COVID-19 patients and suggest policy recommendations to reduce such discrimination.

**Methods:** Twenty-seven Chinese cities were selected randomly based on their geographical location and GDP rank. One hundred adults were interviewed in each city with an equal number of men and women and three urban residents for every two rural residents. A multiple ordered logistic regression model was used to assess the associations between potential determinants and the COVID-19 discrimination level.

**Results:** Of 2377 participants, 79.76% displayed discrimination toward recovered COVID-19 patients. The female discrimination level was 1.25 times that of males; the discrimination level increased with age; and was occupation-specific, with physicians' (OR = 0.352) and students' (OR = 0.553) discrimination level lower than that of farmers. The discrimination level of participants from the central regions was 1.828 times, and the eastern region 1.504 times, that of participants from western region. The participants' discrimination level was lower when they scored higher in transmission knowledge, prevention knowledge and other COVID-19 knowledge, treatment methods and quarantine time.

**Conclusion:** Sex, age, occupation, infections of relatives and friends, regions and scores on COVID-19 knowledge were determinants of discrimination level against recovered COVID-19 patients. In contrast with qualitative studies, our quantitative study recommends targeted education campaigns, focusing on physicians, women, older people and certain occupations. Only the COVID-19 vaccination program for the whole population will resolve the COVID-19 discrimination problem.

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## Background

In March 2020, the World Health Organization (WHO) announced corona virus disease 2019 (COVID-19) a global pandemic. By 27 September 2020, WHO reported more than 32.7 million worldwide cases, and over 990,000 deaths, causing adverse health outcomes and a global economic recession.<sup>1</sup> The United Nations warned that “fear, rumors and stigma” were key challenges accompanying COVID-19.<sup>2</sup> While it has been estimated that over 26 million COVID-19 patients have recovered, many will suffer long-term COVID-19 after effects, including discrimination in every-day life, at work, in education and during their social interactions. Many more people in China will catch COVID-19 and recover before the population is vaccinated. Discrimination against the recovered COVID-19 patients can cause anxiety, mental health problems and social isolation. Some current COVID-19 patients may conceal their disease, fearing discrimination,<sup>3</sup> which delays their treatment and imposes barriers to COVID-19 control and prevention.<sup>4,5</sup> Excessive fear, and unequal treatment, of recovered COVID-19 patients occurs

in spite of the absence of any evidence that recovered COVID-19 patients infect other people. Discrimination against recovered COVID-19 patients has the potential of morphing into a long-run major social problem, overshadowing previous infectious diseases emergencies, such as hepatitis B virus (HBV), severe acute respiratory syndrome (SARS) and human immunodeficiency virus (HIV). Although the Chinese government enacted laws to protect patients with infectious diseases from discrimination, discrimination continues.

Existing studies on COVID-19 stigma and discrimination are mainly qualitative.<sup>4–12</sup> To counteract COVID-19 stigma, the main recommendation from these studies was to disseminate accurate information about COVID-19 and contain the spread of COVID-19 disinformation and misinformation.<sup>4–6</sup> Public health information geared toward general education about COVID-19, and explaining the rationale for COVID-19 quarantines, aims to reduce stigmatization among the general public.<sup>6–8</sup> Logie<sup>9</sup> suggested the experience of dealing with HIV could be leveraged to understand and address COVID-19 stigma. Baldassarre et al.<sup>10</sup>

argued that an historical review of epidemics could create a solid scientific base for developing coping tools to address COVID-19 stigma and discrimination.<sup>10</sup> Using case studies, Grover et al.<sup>11,12</sup> recommended the dissemination of information about the mode of transmission and the importance of testing to address discrimination between health care workers (HCWs). Surprisingly, there has been no quantitative study of discrimination against recovered COVID-19 patients in China. From previous studies of discrimination against other infectious diseases, such as HBV, hepatitis C virus (HCV) and HIV,<sup>13–17</sup> influencing factors, such as cultural values, education level and vaccination history, have been identified as determinants of discrimination against those suffering infectious diseases.<sup>18–20</sup> For COVID-19, we hypothesize that demographic variables, knowledge on COVID-19 and other potential related variables were significant influences on discrimination against recovered COVID-19 patients. We test this hypothesis and suggest measures and policy recommendations to reduce discrimination.

## Methods

### Data source and sample

We interviewed face-to-face 2700 adults over the age of 18 years old, yielding a sample of 2377 respondents, with a response rate of 88.04%. First, we divided 27 Chinese provinces into eastern, central and western regions. The provinces in each region were stratified into low, medium and high economic level according to their 2019 gross domestic product (GDP) rank. One province was chosen randomly from each economic level. Totally, 9 provinces were selected, comprising Shandong, Jiangsu, Zhejiang (eastern area), Shanxi, Henan, Hubei (central area), and Inner Mongolia, Ningxia and Guangxi (western area). Next, all the cities of each selected province were divided into low, medium and high economic level according to their 2019 GDP rank. One city was randomly chosen from each GDP level, with 27 cities selected from the 9 provinces. We interviewed 100 participants face-to-face in each city in May 2020, with equal numbers of men and women and three urban residents for every two rural residents. Based on previous HBV discrimination surveys,<sup>21,22</sup> a questionnaire was designed to collect COVID-19 information. Online video interviews were used in cities where participants were required to home quarantine. All participants were informed about the purpose of the survey and gave informed consent.

### Definition and measurement of dependent variables

The categorical dependent variable, discrimination level against recovered COVID-19 patients, has three outcomes: mild or no discrimination, medium discrimination and severe discrimination. As shown in Table 1, participants were asked about their attitudes toward six events, which were used to measure the extent of discrimination based on three options for each event: “yes” (0), “it depends” (1) and “no” (2). We calculated a discrimination index score for each participant as the sum of their response scores for the six events, which ranged 0–12. Higher scores indicated greater discrimination. Participants were then categorized into one of three discrimination levels based on their discrimination index

**Table 1.** Six events measuring discrimination.

Events	Yes	It depends	No
1. Are you willing to accept gifts from COVID-19 rehabilitation patients?	0	1	2
2. Are you willing to have dinner with COVID-19 rehabilitation patients?	0	1	2
3. Are you willing to shake hands with or hug COVID-19 rehabilitation patients?	0	1	2
4. Do you think parents should let their children play with COVID-19 rehabilitation children?	0	1	2
5. Do you think parents should accept their child marrying a COVID-19 rehabilitation patient?	0	1	2
6. Are you willing to work together with COVID-19 rehabilitation patients?	0	1	2

score by tertiles: mild or without discrimination level (scores 0–2), medium discrimination level (scores 3–6), and severe discrimination level (scores 7–12).

### Validity of discrimination measurement

The measurement method of discrimination has been shown to be effective in Yu et al. (2016) and Leng et al. (2016). We used confirmatory factor analysis (CFA) to assess the validity of discrimination measurement, where the goodness of fit was perfect (chi-square = 384.29,  $P < .01$ , GFI = 0.948 > 0.9, CFI = 0.95 > 0.9). As shown in Table 2, the standard coefficients of event 1 and 3–6 were greater than 0.7, which indicates that there were strong correlations between the discrimination level and these five assessing events. The standard coefficient of event 2 was 0.639, smaller than 0.7, but greater than 0.4, indicating that there was medium correlation between discrimination and event 2. Average variance extracted (AVE) and composite reliability (CR) were calculated to evaluate the convergent validity as follows:

$$AVE = \frac{(\sum \lambda^2)}{n}$$

where  $\lambda$  is factor loading;  $n$  is the number of events.

where  $\delta$  was residual variances; both  $\lambda$  and  $\delta$  are standardized value.

$$CR = \frac{(\sum \lambda)^2}{[(\sum \lambda)^2 + \sum \delta]}$$

The convergent validity has a relative high level if AVE is greater than 0.5 and CR is greater than 0.7. The AVE was 0.5673 and the CR was 0.8861, indicating that convergent validity of the discrimination measurement was at a high level and the internal consistency reliability was good, with the value of Cronbach's Alpha = 0.885 > 0.7.

**Table 2.** Factor loading coefficient.

Measurement event	Coef.	S.E.	Z	P	Std. Coef.	AVE	CR
Event 1	0.613	0.016	39.010	<0.01	0.718	0.5673	0.8861
Event 2	0.507	0.015	33.418	<0.01	0.639		
Event 3	0.528	0.014	38.443	<0.01	0.711		
Event 4	0.691	0.014	49.719	<0.01	0.849		
Event 5	0.704	0.014	51.186	<0.01	0.865		
Event 6	0.596	0.015	38.482	<0.01	0.711		

## Definition and measurement of independent variables

The independent variables comprised sex, age, urban-rural residence, education level, occupation, monthly income, medical insurance, self-rated health, experience of paying for vaccines, whether their relatives or friends has been infected by COVID-19, east-west-central region, score on knowledge of COVID-19 transmission, prevention and other COVID-19 knowledge.

The participants came from both urban (61.51%) and rural areas (38.49%), reflecting our criteria to interview three urban for two rural participants. Income was the average month income during the past year, categorized into quintiles. Data were collected on the national medical insurance schemes, including urban and rural resident basic medical insurance (URRBMI), urban employee basic medical insurance (UEBMI), free medical care, and those without medical insurance and other category. Self-rated health was a categorical variable, “bad”, “medium” and “good”, based on the question: “How is your health status compared to your peers?”. Whether participants had paid for vaccines for their family members or themselves in the past was scored “never”; “paid in the last year”; and “paid more than one year ago”. Participants were also asked whether their relatives or friends were infected by COVID-19, selecting “no”, “yes” and “not sure”. Education level comprised primary school and below, middle school, high school and above high school.

To measure transmission and prevention knowledge, participants scored a positive (negative) point when identifying the two true (false) COVID-19 transmission routes and two true (false) prevention methods, as shown in Table 3. Participants were asked multiple choice questions about other COVID-19 knowledge, including susceptible population, treatment method and quarantine time, scoring one point for a correct, and zero points for a wrong, answer.

## Statistical analyses

All data were double-inputted using EpiData 3.1 and checked for consistency. Statistical analyses were performed using STATA 12.0. Pearson chi-square test, multiple ordered logistic regression models, and odds ratio (OR) were used to assess the associations between each independent variable and discrimination level of recovered COVID-19 patients.

## Results

### Characteristics of participants

Table 4 displays the detailed characteristics of the participants: 51.45% were female, average age was  $37.08 \pm 15.62$ , and 61.51% were from urban areas. The average monthly income was  $\text{RMB}12379.54 \pm 42163.22$ ; 73.75% of participants were covered by URRBMI and 19.23% by UEBMI, and 1.94% of participants had no medical insurance; 73.2% of participants' self-rated health level was good and only 3.07% was bad; 56.75% had paid for vaccines for their family members or themselves in the past year, and 1.51% participants answered that their relatives or friends had been confirmed COVID-19 sufferers. The over high school educated group accounted for 56.84% of participants and the primary and below educated group 11.44%. Students (26.88%) accounted for the highest occupational group, followed by enterprise staff (13.59%), migrant worker (12.16%) and farmer (11.70%). Table 5 shows that the score of COVID-19 transmission was  $0.54 \pm 0.97$ , prevention was  $2.28 \pm 0.87$  and other COVID-19 knowledge about susceptible populations, treatment methods and quarantine time was  $2.45 \pm 0.69$ .

### Discrimination level

Figure 1 illustrates participants' attitudes toward recovered COVID-19 patients. Considering all participants, 23.64% were unwilling to accept gifts from recovered COVID-19 patients; 33.28% to have dinner; 31.68% to hug; 44.68% to have children play; 36.81% to have children marry; and 21.29% to work together with recovered COVID-19 patients. Roughly 30% of the participants answered “it depends” to all the attitude questions.

The median discrimination score was 6, with only 20.24% of participants displaying no discrimination, 37.86% displaying severe discrimination and 30.16% medium discrimination, as shown in Table 6.

### Pearson chi-square test

Table 7 shows the discrimination level by the independent variables. Chi-square tests indicate that there were significant correlations between the level of discrimination and sex, age,

**Table 3.** Assignment of COVID-19 knowledge scores.

	Descriptions	1	0	-1
Transmissions	COVID-19 can be spread through respiratory droplets such as coughing and sneezing.	pick	not pick	-
	Animals such as cats and dogs that carry the virus can transmit COVID-19.	-	not pick	pick
	Touched an object contaminated with the virus.	pick	not pick	-
Preventions	The virus pollutes the environment by being excreted in the stool, and then infects people through the digestive tract.	-	not pick	pick
	Wear a mask.	pick	not pick	-
	Keep at least 2 meters away from others when talking to them.	pick	not pick	-
	Sunbath.	-	not pick	pick
Other knowledge	Take a hot bath or sauna.	-	not pick	pick
	Disinfect with 75% alcohol	pick	not pick	-
	What kinds of people are more seriously affected by COVID-19? A. Juveniles; B. Young adults; C. Senior citizen; D. everyone same severity	C	A,B,D	-
	What is the current treatment for COVID-19? A. Drugs and treatments specific to COVID-19 B. Symptomatic treatment; C. Use a lot of antibiotics; D. No cure	B	A,C,D	-
	How many days should people in contact with COVID-19 patients be quarantined? A. 1–3 days; B. 5 days; C. 7 days; D. 14 days	D	A,B,C	-

**Table 4.** Descriptive statistics for categorical independent variables.

Variables		N	%
Sex	Male	1,154	48.55
	Female	1,223	51.45
Age	18–44	1,514	63.69
	45–59	656	27.60
	60+	207	8.71
Residence	Urban	1,462	61.51
	Rural	915	38.49
Education	Primary school and below	272	11.44
	Middle school	405	17.04
	High school	349	14.68
	Above high school	1,351	56.84
Occupation	Farmer	278	11.70
	Migrant worker	289	12.16
	Enterprise staff	323	13.59
	Individual industrialist	221	9.30
	Teacher	159	6.69
	Physician	31	1.30
	Civil servant	120	5.05
	Professional and technical staff	75	3.16
	Unemployed	103	4.33
	Student	639	26.88
	Retiree	86	3.62
	Others	53	2.23
	Monthly income	Lowest (<RMB2500)	456
Low (≥RMB2500 & <RMB4000)		350	14.72
Medium (≥RMB4000 & <RMB6000)		514	21.62
High (≥RMB6000 & <RMB10000)		421	17.71
Highest (≥RMB10000)		636	26.76
Medical insurance	URRBMI	1,753	73.75
	UEBMI	457	19.23
	Free medical care	73	3.07
	No medical insurance	46	1.94
Self-rated health	Other	48	2.02
	Bad	73	3.07
	Medium	564	23.73
Paid for vaccine	Good	1,740	73.20
	No	1,028	43.25
	Within last year	329	13.84
Infections of relatives and friends	More than one year ago	1,020	42.91
	No	2,310	97.18
	Yes	36	1.51
Region	Not sure	31	1.30
	Western	943	39.67
	Central	686	28.86
	Eastern	748	31.47

**Table 5.** Score of COVID-19 knowledge.

Knowledge	Mean	SE	Min	Max
Transmission	0.54	0.79	–2	2
Prevention	2.28	0.87	–1	3
Other COVID-19 knowledge	2.45	0.69	0	3

education, occupation, self-rated health, experience with paid vaccines and whether participants' relatives or friends had been infected by COVID-19. Female participants' medium (32.38%) and severe discrimination levels (39.33%) were significantly higher than males medium (27.82%) and severe (36.31%) discrimination ( $P < .01$ ). Older participants (64.25%) displayed higher levels of discrimination than the 45–59 (46.04%) and 18–44 (30.71%) year groups ( $P < .01$ ). The percent of severe discrimination decreased with education level and rose with self-rated health ( $P < .01$ ). The discrimination level of retirees (66.28%) was the highest, followed by the unemployed (60.19%), with physicians (19.35%) and students (19.41%) displaying significantly lower discrimination levels ( $P < .01$ ).

Participants who had paid for vaccines for their family members or themselves in the last year showed a higher discrimination level than participants who never paid for a vaccination ( $P < .01$ ). The percent of medium and severe discrimination level of participants whose relatives or friends had not been COVID-19 infected (68.31%), or not sure whether they had been infected (67.74%) was significantly higher than participants whose relatives or friends (50%) who had been COVID-19 infected ( $P = .068 < 0.1$ ). The percent of severe discrimination in the central region (47.07%) was the highest, followed by the eastern region (40.24%) and western region (29.27%). There were no differences between urban and rural residents, those with different income levels and members of different medical insurance groups.

### Multiple ordered logistic regression

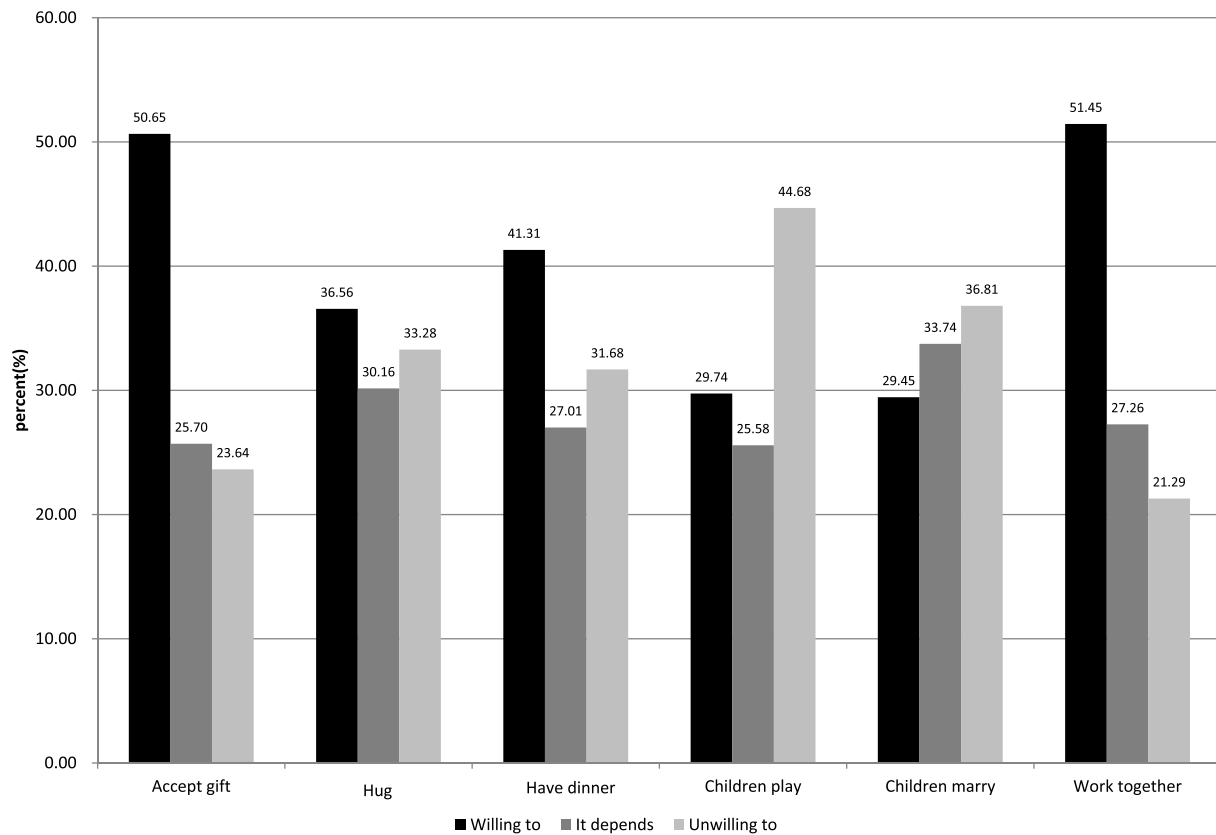
Independent variables with  $P < .1$  in the Pearson chi-square tests were inserted into the multiple ordered logistic regression as shown in Table 8. Sex, age, occupation, COVID-19 infections of relatives and friends and transmission, prevention and other COVID-19 knowledge had a significant influence on the discrimination level ( $P < .05$ ). The female discrimination level was 1.25 times that of males. The discrimination level of participants aged over 60 was 2.144 times and that of participants aged 45–59 was 1.249 times that of participants aged 18–44 year old. Physicians' (OR = 0.352) and students' (OR = 0.553) discrimination level was significantly lower than that of farmers. The discrimination level of participants whose relatives or friends had been COVID-19 infected was 39.6% lower, and 43.3% lower for participants not sure whether their relatives or friends had been COVID-19 infected, than those whose relatives and friends never had COVID-19. The discrimination level of participants from central China was 1.828 times, and the eastern region and 1.504 times that of participants from western provinces. The discrimination level dropped 13.5% with one more point of transmission knowledge, 17.3% with one more point of prevention knowledge and 16.5% with one more point of other COVID-19 knowledge. Participants' discrimination level fell when they scored higher in knowledge about susceptible population, treatment methods and quarantine time.

### Discussion

Discrimination against recovered COVID-19 patients in urban and rural China was widespread, with only 20% of the participants without any prejudice. Previous disease discrimination studies have shown that stigmatized people are shunned, insulted and marginalized in everyday life, education and work, and frequently bear psychological distress.<sup>23,24</sup> Our results show that recovered COVID-19 patients require intervention strategies to address discrimination.

Participants displayed the most severe discrimination in response to 'parents should allow their children to marry recovered COVID-19 patients', with more than 70% answering 'no' or 'it depends'. The second most severe discrimination was 'parents should let their children play with recovered COVID-19 patients, followed by hug, have dinner, willing to accept gifts and work together. Discrimination related to each of these





**Figure 1.** Attitude toward COVID-19 rehabilitation patients.

**Table 6.** Discrimination level.

Discrimination level	Freq.	Percent	Cum.
Mild or no discrimination	760	31.97	31.97
Medium discrimination	717	30.16	62.14
Severe discrimination	900	37.86	100.00
Total	2,377	100.00	100.00

events rose with the degree of intimacy. There were significant correlations between sex, age, occupation, infections of relatives and friends, regions and scores on transmission, prevention and other COVID-19 knowledge and discrimination against recovered COVID-19 patients. Education level, self-rated health and experience of paying for other vaccines were not significant factors in discrimination.

We found that females had higher discrimination scores than men. This finding mirrors a previous study in rural China showing that females had higher discrimination levels toward hepatitis B patients and carriers than men,<sup>21</sup> but inconsistent with previous studies among rural migrants in Beijing, which showed that gender was unassociated with prejudice toward hepatitis B patients and carriers.<sup>22</sup> Our findings suggested that older age participants were positively associated with more severe discrimination against recovered COVID-19 patients than younger participants. Compared with participants aged 18–44 years old, the discrimination level of participants aged 45–59 was 1.249 and those over 60 years old was 2.144 times the younger age group. Assessing the stigma of healthy adults toward HIV infection/Acquired Immuno-Deficiency Syndrome (AIDS), Jain et al.<sup>25</sup> also found older adults (46–55 years old) displayed more stigmas than younger adults (16–25 years old). We speculate that older people were slower to

accept new things than younger people and with less access to the Internet, WeChat, friends and news media than younger people, giving them fewer opportunities to acquire relevant knowledge about diseases.

In China, the evidence on the correlation between education level and discrimination has been contradictory. One study found that individuals with higher education tended to have less severe discrimination against HBV patients or carriers compared with those with less education in rural China,<sup>21</sup> but another study showed that those with a higher medical education tended to show higher levels of discrimination against people with HIV.<sup>26</sup> Our study revealed no statistical correlation between the education level and COVID-19 discrimination, but even the most highly educated participants displayed a high discrimination level: 33.46% of above high school group had medium discrimination, and 32.86% had severe discrimination, with only 33.68% without discrimination.

We found that occupation affected the level of discrimination against recovered COVID-19 patients. Physicians and students exhibited the lowest discrimination level when compared with farmers. Although physicians had the lowest levels of discrimination against recovered COVID-19 patients, physician discrimination was still high. Of the 31 physicians in our sample, only 11 physicians (35.48%) reported no discrimination, while 15 physicians (48.39%) reported medium and severe discrimination. Students were younger and more likely to receive or have access to COVID-19 knowledge than farmers, which explained their lower level of discrimination. But students still discriminated against recovered COVID-19 patients, with 19.41% with high levels and 37.72% medium levels of discrimination.

**Table 7.** Discrimination level by independent variables.

Variables	Mild/No		Medium		Severe		$\chi^2$	P		
	N	%	N	%	N	%				
Sex	Male	414	35.88	321	27.82	419	36.31	16.21	<b>&lt;0.01</b>	
	Female	346	28.29	396	32.38	481	39.33			
Age	18–44	541	35.73	508	33.55	465	30.71	113.23	<b>&lt;0.01</b>	
	45–59	178	27.13	176	26.83	302	46.04			
	60+	41	19.81	33	15.94	133	64.25			
Residence	Urban	472	32.28	453	30.98	537	36.73	2.25	0.325	
	Rural	288	31.48	264	28.85	363	39.67			
Education	Primary school and below	73	26.84	66	24.26	133	48.90	50.69	<b>&lt;0.01</b>	
	Middle school	107	26.42	102	25.19	196	48.40			
	High school	125	35.82	97	27.79	127	36.39			
	Above high school	455	33.68	452	33.46	444	32.86			
Occupation	Farmer	84	30.22	62	22.30	132	47.48	182.04	<b>&lt;0.01</b>	
	Migrant worker	78	26.99	89	30.80	122	42.21			
	Enterprise staff	94	29.10	102	31.58	127	39.32			
	Individual industrialist	56	25.34	65	29.41	100	45.25			
	Teacher	54	33.96	38	23.90	67	42.14			
	Physician	16	51.61	9	29.03	6	19.35			
	Civil servant	34	28.33	37	30.83	49	40.83			
	Professional and technical staff	20	26.67	25	33.33	30	40.00			
	Unemployed	23	22.33	18	17.48	62	60.19			
	Student	274	42.88	241	37.72	124	19.41			
	Retiree	14	16.28	15	17.44	57	66.28			
	Others	13	24.53	16	30.19	24	45.28			
	Monthly income	Lowest (<RMB2500)	168	36.84	130	28.51	158	34.65	9.22	0.324
		Low (<RMB4000&≥RMB2500)	100	28.57	108	30.86	142	40.57		
Medium (<RMB6000&≥RMB4000)		158	30.74	151	29.38	205	39.88			
High (<RMB10000&≥RMB6000)		132	31.35	125	29.69	164	38.95			
Highest (≥RMB10000)		202	31.76	203	31.92	231	36.32			
Medical insurance	URBMI	587	33.49	529	30.18	637	36.34	12.32	0.137	
	UEBMI	120	26.26	141	30.85	196	42.89			
	Free medical care	27	36.99	19	26.03	27	36.99			
	No medical insurance	12	26.09	14	30.43	20	43.48			
	Others	14	29.17	14	29.17	20	41.67			
Self-rated health	Bad	16	21.92	18	24.66	39	53.42	23.33	<b>&lt;0.01</b>	
	Medium	161	28.55	153	27.13	250	44.33			
	Good	583	33.51	546	31.38	611	35.11			
Paid for vaccine	No	354	34.44	321	31.23	353	34.34	26.11	<b>&lt;0.01</b>	
	Within last year	123	37.39	101	30.70	105	31.91			
	More than one year ago	283	27.75	295	28.92	442	43.33			
Infections of relatives and friends	No	732	31.69	698	30.22	880	38.10	8.74	<b>0.068</b>	
	Yes	18	50.00	6	16.67	12	33.33			
	Not sure	10	32.26	13	41.94	8	25.81			
Region	Western	355	37.65	312	33.09	276	29.27	58.08	<b>&lt;0.01</b>	
	Central	177	25.80	186	27.11	323	47.08			
	Eastern	228	30.48	219	29.28	301	40.24			

The degree of discrimination decreased when participants' relatives or friends had been infected by COVID-19. Perhaps these participants developed empathy when their relatives and friends had COVID-19 or sought out and paid more attention to information about COVID-19. There were geographical differences in COVID-19 discrimination. Participants from central China displayed the most severe discrimination, followed by the eastern region, with discrimination lowest in the western region. The central region participants may have better information about COVID-19 since it was the region from where COVID-19 originated in China. The western region also had more minority people, so ethnicity should be studied in future research.

The mean of knowledge score of transmission was only 0.54, 1.46 off the full mark on the -2 to 2 scale. The transmission score was lower than the average score of prevention (mean 2.28, scale -1 to 3) and other knowledge (mean 2.45, scale 0 to 3). More than half the participants scored full marks in prevention (51.62%) and other COVID-19 knowledge (55.15%), while only 13.55% scored full marks for transmission knowledge. Transmission via droplet

respiratory particles when sneezing or coughing was well known by participants (98.57%), but 22.84% did not believe transmission through hands. The prevention knowledge score had the greatest influence on COVID-19 discrimination, followed by other COVID-19 knowledge and transmission.

Previous disease discrimination studies have noted that ignorance about HBV, HCV and HIV infection was a main cause of discrimination, recommending public information campaigns.<sup>15,21,22</sup> COVID-19 qualitative studies have also suggested knowledge campaigns to address COVID-19 discrimination. We recommend COVID-19 information campaigns, but with major differences from previous studies. First, information campaigns should focus on non-airborne COVID-19 transmission. Second, information campaigns should target those occupations with the lowest COVID-19 knowledge, such as farmers. Third, education campaigns should target women and older people. Finally, physicians should be an information campaign target. Surprisingly, physician showed high levels of discrimination against recovered COVID-19 patients. Although physicians scored higher in prevention ( $2.387 \pm 0.844$ ) and other COVID-19

**Table 8.** Multiple ordered logistic regression of discrimination level by independent variables.

Variables		$\beta$	SE	z	P	95%CI	Odds Ratio (OR)
Sex	Male				(Reference group)		
	Female	0.225	0.079	2.86	<b>0.004</b>	0.071 0.379	1.252
Age	18–44				(Reference group)		
	45–59	0.223	0.107	2.08	<b>0.037</b>	0.013 0.432	1.249
	60+	0.763	0.195	3.91	<b>&lt;0.01</b>	0.380 1.145	2.144
Education	Primary school and below				(Reference group)		
	Middle school	0.151	0.163	0.93	0.353	–0.168 0.470	1.163
	High school	0.229	0.186	1.23	0.219	–0.136 0.594	1.257
	Above high school	0.186	0.176	1.05	0.293	–0.160 0.531	1.204
Occupation	Farmer				(Reference group)		
	Migrant worker	0.157	0.169	0.93	0.352	–0.173 0.487	1.170
	Enterprise staff	0.073	0.181	0.40	0.686	–0.282 0.429	1.076
	Individual industrialist	0.205	0.185	1.11	0.268	–0.158 0.569	1.228
	Teacher	–0.122	0.221	–0.55	0.582	–0.555 0.311	0.885
	Physician	–1.044	0.385	–2.71	<b>0.007</b>	–1.798 –0.290	0.352
	Civil servant	0.014	0.228	0.06	0.951	–0.433 0.461	1.014
	Professional and technical staff	0.224	0.266	0.84	0.398	–0.296 0.745	1.252
	Unemployed	0.374	0.239	1.56	0.118	–0.095 0.843	1.454
	Student	–0.593	0.177	–3.35	<b>0.001</b>	–0.940 –0.246	0.553
	Retiree	0.517	0.277	1.87	0.062	–0.025 1.060	1.677
	Others	0.075	0.294	0.25	0.799	–0.502 0.652	1.078
Self-rated health	Bad				(Reference group)		
	Medium	–0.099	0.254	–0.39	0.696	–0.598 0.399	0.905
	Good	–0.277	0.251	–1.11	0.269	–0.769 0.214	0.758
Paid for vaccine	No				(Reference group)		
	Within last year	–0.204	0.124	–1.65	0.100	–0.446 0.039	0.816
	More than one year ago	0.065	0.091	0.72	0.473	–0.113 0.244	1.067
Infections of relatives and friends	No				(Reference group)		
	Yes	–0.837	0.354	–2.36	<b>0.018</b>	–1.530 –0.143	0.433
	Not sure	–0.622	0.340	–1.83	0.068	–1.290 0.045	0.537
Region	Western				(Reference group)		
	Central	0.603	0.098	6.15	<b>&lt;0.01</b>	0.411 0.796	1.828
	Eastern	0.408	0.094	4.34	<b>&lt;0.01</b>	0.224 0.592	1.504
Transmission		–0.145	0.050	–2.88	<b>0.004</b>	–0.243 –0.046	0.865
Prevention		–0.190	0.047	–4.02	<b>&lt;0.01</b>	–0.283 –0.098	0.827
Other COVID-19 knowledge		–0.181	0.060	–3.02	<b>0.003</b>	–0.298 –0.063	0.835

knowledge ( $2.581 \pm 0.564$ ) than farmers (prevention  $2.104 \pm 0.89$ ; other  $2.277 \pm 0.778$ ), the differences were small. Physicians scored low in transmission knowledge ( $0.516 \pm 0.724$ ) and physicians scored on prevention ( $2.387 \pm 0.844$ ), transmission ( $0.516 \pm 0.724$ ) and other COVID-19 knowledge ( $2.581 \pm 0.564$ ) about the same as students (prevention ( $0.513 \pm 0.823$ ); transition ( $2.351 \pm 0.869$ ); other COVID-19 knowledge ( $2.524 \pm 0.625$ )). Physicians should be the main source for COVID-19 information to their patients and local communities not only for the treatment of patients, but to inform their patients about safe behavior. COVID-19 knowledge training for doctors requires urgent attention, especially the knowledge of transmission routes.

Also, COVID-19 information campaigns that address disseminating knowledge must not only ensure correct knowledge and correct opinions, like information campaigns for other diseases,<sup>4,5</sup> but mobilize the media to play a central role in the spread of COVID-19 knowledge, and importantly constraining the spread of COVID-19 misinformation.<sup>27</sup>

### Strengths and limitations

This is the first quantitative study to assess the discrimination level against recovered COVID-19 patients in China. The sample is nationwide, involving both urban and rural residents, and three regions in China. There are several limitations. First,

only one hundred participants were interviewed in each city. While our sample covered the whole country, future studies might expand the sample size and geographical scope. Second, we used participants' attitude toward six events to evaluate the COVID-19 discrimination in our questionnaire. While six events are consistent with similar studies,<sup>21,22</sup> future research might include a larger number of events. Third, other potential influencing factors, such as fear of being infected, were not included in our questionnaire.

### Conclusion

We found that discrimination against recovered COVID-19 patients in urban and rural China was a serious problem, with 79.76% of participants displaying some level of discrimination. We hypothesize that demographic variables, knowledge on COVID-19 and other potential related variables were significant influences on discrimination against recovered COVID-19 patients. Confirming our hypothesis, sex, age, occupation, infections of relatives and friends, regions and scores on transmission, prevention and other COVID-19 knowledge were associated with discrimination against recovered COVID-19 patients. Lacking knowledge about COVID-19, including transmission and prevention, was one of the main factors associated with COVID-19-related discrimination. COVID-19 information campaigns need to be tailored by sex, age and occupation. Doctors displayed high

levels of discrimination and a lack of knowledge about COVID-19. As sources of information on diseases, physicians need tailored education campaigns on COVID-19 transmission and prevention as a matter of urgency. Vaccination of the whole population against COVID-19 will eliminate the COVID-19 discrimination problem. By June 2021, at least 40% of the Chinese population is expected to be inoculated against COVID-19. Vaccinations will significantly reduce COVID-19 cases and the number of people potentially subject to discrimination, but the COVID-19 discrimination problem will remain until the whole population is vaccinated against COVID-19.

## Authors' contributions

Rugang Liu: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Roles/Writing - original draft, Writing - review & editing. Stephen Nicholas: Conceptualization, Funding acquisition, Methodology, Supervision, Validation, Visualization, Writing - review & editing. Anli Leng: Data curation, Investigation, Methodology, Project administration, Resources, Supervision. Dongfu Qian: Methodology, Resources, Software, Supervision, Writing - review & editing. Elizabeth Maitland: Methodology, Supervision, Validation, Visualization, Writing - review & editing. Jian Wang: Conceptualization, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing - review & editing.

## Disclosure of potential conflicts of interest

No potential conflicts of interest were disclosed.

## Ethics

The study was approved by the Ethics Committee of Nanjing Medical University and consent was obtained from all eligible participants. The study was carried out in accordance with the principles of the Declaration of Helsinki.

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