

## Research Article

# Community and Personal Responses to Social Interventions against Coronavirus Disease 2019: A Web-Based Survey in Western China

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## Abstract

**Background:** The coronavirus disease (COVID-19) pandemic has posed a huge threat to global public health. The spread, prevention, and control of emergent infectious diseases are associated with several social health determinants. Social interventions addressing the social health determinants are crucial for controlling the transmission of virus.

**Objective:** We aimed to explore the effectiveness of social interventions implemented in Western China to obtain new insights for controlling emergent global infectious diseases.

**Methods:** A web-based study was conducted in March 2020 in Western China. Data on government-implemented social interventions were collected using a structured questionnaire from the perspectives of community residents. Propensity score matching (PSM) analysis was performed to explore the effectiveness of social interventions.

**Results:** A total of 1,450 community residents were included in the current study, and 88 COVID-19 patients were included after PSM. Among 1,450 community residents, >80% reported that community responses to COVID-19 reached them through radio, slogans, and gatekeepers in the community, and almost all of them provided a positive response to social interventions. Residents who positively responded to these interventions were more likely to adopt behaviors that prevent the spread of COVID-19 than COVID-19 patients ( $P < 0.05$ ).

**Conclusion:** Our data suggest that the timely provision of social interventions has been effective in Western China, and these findings could be used to establish international multi-sector collaborative efforts to successfully control COVID-19. We conclude that social interventions provided in the communities are crucial for the control of COVID-19.

**Keywords:** COVID-19; Social interventions; Response; Western China; Web-based survey

## Abbreviations

COVID-19: Novel Coronavirus Disease 2019; NPIs: Non-Pharmaceutical Interventions; SAS: Statistical Analysis System; SARS: Severe Acute Respiratory Syndrome; WHO: World Health Organization

## Background

Emerging infectious diseases threaten human life throughout their evolutionary history [1]. Infectious disease clusters and epidemics, including severe acute respiratory syndrome (SARS), Middle East Respiratory Syndrome (MERS-CoV), H1N1, and Ebola, have recently increased following the rapid changes in the environment and climate [2]. The novel coronavirus disease 2019 (COVID-19), which first emerged in December 2019 in Wuhan, China, became a pandemic in March 2020. It has a reported mortality rate of 113,467,303 and a morbidity rate of 2,520,550 as of March 1, 2021 [3]. The serious consequences of COVID 19 are enormous; the pandemic has caused

major disruptions in the global economy and social affairs [4]. In China, the COVID-19 outbreak peaked in February 2020 and almost leveled off until the end of March, resulting in 82,545 confirmed cases and 3,314 deaths [3].

Effective pharmaceutical interventions, such as vaccines and drugs specifically for COVID-19, were not available within a short period of time as several other diseases have also emerged in 2020 [5]. Therefore, non-pharmaceutical interventions (NPIs) became essential components of the public health response to COVID-19 [5], and for now, NPIs have become the mainstay of response for COVID-19 and are being used across the world to flatten the COVID-19 pandemic [6]. Since COVID-19 emerged in Wuhan, Hubei Province, in December 2019, the local health authorities implemented a series of mandatory measures to prevent and control the transmission of virus, including closure of highways and lockdown of schools, factories, and shopping malls [7]. Similar measures were imposed throughout the country; meanwhile, several measures were imposed by other

provinces/municipalities after Wuhan announced the lockdown of the city on January 23, 2020 [8] (Figure 1). To minimize the potential transmission of virus among people, the Chinese government extended the Chinese New Year holiday and school holidays, public or private social gatherings were not permitted, and mandatory wearing of face masks outdoors was implemented [9]. In addition, the Chinese government encouraged residents to wash their hands frequently, stay at home, reduce unnecessary outdoor activities, and maintain physical distancing [8].

The NPIs included the isolation of COVID-19 patients, contact tracing, quarantine of exposed persons, travel restrictions, cancellation of mass gatherings, and frequent hand washing [5]. Such NPIs were implemented with finance and mobilized resources combined with a strong governance structure, efficient execution, and solidarity of the whole society [10]. Moreover, NPI implementation, along with community engagement, contributed to the successful control of the COVID-19 pandemic.

To confirm the efficacy of social interventions for the control of global emergent infectious disease in the future, the current study surveyed the community residents to assess the community and personal responses to social interventions to control COVID-19 and evaluated the effectiveness of these interventions on the prevention and control of COVID-19 by comparing the personal and community responses to social interventions between community residents and COVID-19 patients in Western China.

## Methods

A web-based survey was conducted in March 2020 in Western China. Data were collected using a structured questionnaire that was distributed through an online platform. The health community residents in Western China were surveyed to investigate the effectiveness of social interventions (mainly including community and personal measures) implemented to prevent or control COVID-19 outbreaks; moreover, COVID-19 patients in Chongqing Public Health Medical Center were selected.

### Study setting

Western China has the most complex geographical environment, including plateaus, basins, and deserts, with a relatively low population density. Western China is an underdeveloped area because of its complicated geography and historical and cultural factors [11]. The per capita net income is much lower in Western China than in Eastern and Central China [12]. In addition, the accessibility and equity of basic health services are unbalanced in China; the medical expenses are high, and the quality and level of primary health care in Western China are far behind those of other regions in China [13,14]. Therefore, we purposely selected nine provinces/municipalities in Western China (Figure 1), including Xinjiang, Tibet, Gansu, Shanxi, Sichuan, Chongqing, Guizhou, Yunnan, and Guangxi, as study areas. This study aimed to investigate the community and personal responses to social interventions and the control measures against COVID-19 outbreaks in these regions, and to provide evidence-based prevention and control measures for pandemics and emerging infectious disease outbreaks.

### Study participants

**Community resident's survey:** A convenient sampling method

was used to select community residents as study participants. Individuals (i) who lived in Western China, (ii) who had good writing and reading abilities, and (iii) who were interested in participating in the study were included in the survey. Meanwhile, those (i) who did not know how to use WeChat, (ii) who declined to participate in this study, and (iii) who were diagnosed with COVID-19 or who were quarantined were excluded.

**COVID-19 patient survey:** Purposive sampling was used to select COVID-19 patients in Chongqing Public Health Medical Center, which is an infectious hospital designated to diagnose and treat COVID-19 patients in Chongqing. Individuals (i) who were admitted to Chongqing Public Health Medical Center, (ii) who had good writing and reading abilities, and (iii) who were interested in participating in the study were included in the survey. Meanwhile, those (i) who did not know how to use WeChat and (ii) who declined to participate in this study were excluded.

### Data collection

A self-administered structural questionnaire for community residents and patients included questions related to the participants' sociodemographic information (age, sex, ethnicity, education, residence, and occupation), accessibility to social interventions (quarantining of exposed persons, wearing of masks, and measurement of body temperature) offered by communities to prevent and control COVID-19, and preventive behaviors (wearing masks, health monitoring, and maintaining social distancing). All patients were asked the behaviours and measures before they were confirmed the infected, which might have some recall bias.

The questionnaire was developed by reviewing existing literature and consulting experts prior to the pilot study. The questionnaire was then pilot tested in 100 participants. The completed questionnaires were checked and examined by trained investigators for quality control.

### Statistical analysis

SAS version 9.4 (SAS Institute Inc., NC, USA) was used to perform all data analyses. Categorical variables were expressed as percentages. Propensity score matching (PSM) is a method of ensuring an even distribution of confounders between groups, thereby increasing between group comparability. PSM analysis is therefore an increasingly applied statistical method in observational studies [15]. In this study, PSM analysis was performed to reduce the heterogeneity between COVID-19 patients and community residents and to calculate the actual effect of social interventions in the community. A 1:1 PSM analysis was performed, with a caliper of 0.01 standard deviation of the propensity scores. Chi-square ( $\chi^2$ ) analyses were performed after PSM to compare the community response and personal response to social interventions between COVID-19 patients and community residents; a two-tailed P-value of <0.05 was considered significant.

## Results

### Sociodemographic characteristics of the participants

A total of 1,532 community residents and 138 COVID-19 patients were surveyed, and 1,450 community residents and 138 patients were included in the analysis. The sociodemographic characteristics of community residents and COVID-19 patients are presented in Table



**Figure 1:** Study place.

This figure presents the study place in this study, including 9 provinces/municipalities in Western China.

1; significant differences were observed in the sociodemographic characteristics between the two study groups. A PSM analysis of the patients' sociodemographic characteristics, including gender, region, ethnicity, age, education, and occupation, was conducted. A total of 88 COVID-19 patients and 88 community residents were selected for further comparative analysis (Appendix 1).

#### **Community and personal responses of community residents to social interventions against COVID-19**

Among 1,450 community residents, >80% reported that the community provided active response to reduce and control the transmission of COVID-19, by propagating quarantine strategies for people from epidemic areas and patients with fever, encouraging all residents to wear masks when staying outdoors, and mandating the measurement of body temperature at the entrance of the residential community. Most of the information was disseminated through radio, slogans, and gatekeepers in the community (Appendix 2).

Meanwhile, almost all community residents responded positively to social interventions for COVID-19. More than 90% of residents demonstrated the appropriate response, including staying at home, avoiding densely populated places, and adopting appropriate behaviors if they developed suspicious symptoms or had a travel

history. However, it was difficult to require everyone to measure their body temperature every day, except for 67.31% of the residents. Furthermore, >90% of community residents took specific measures to avoid acquiring COVID-19; however, only 88.97% of the community residents could maintain a rational diet to increase immunity (Appendix 3).

#### **Effect of community and personal responses to social interventions against COVID-19**

Health community residents had a significantly higher response than COVID-19 patients ( $P < 0.05$ ). Some of the interventions included promoting quarantine strategies for people from epidemic areas and patients with fever, measurement of body temperature at the entrance of the residential community, and wearing masks when staying outdoors (Table 1).

With regard to personal responses to social interventions against COVID-19, COVID-19 patients were more likely to adopt behaviors that prevent the spread of COVID-19 than community residents, including quarantining, wearing masks, and visiting fever outpatient clinics to seek medical services if they had suspicious symptoms and reported to the community if they had suspicious symptoms ( $P < 0.05$ ). Community residents were more likely to be quarantined for 14 days

**Table 1:** Comparison of community response to COVID-19 between community residents and COVID-19 patients.

Items	Community residents		COVID-19 Patients		c <sup>2</sup>	P
	n	%	n	%		
<b>Quarantine for 14 days if came back from Hubei</b>						
Informed by radio by residing community	68	77.27	46	52.27	10.891	0.001
Informed by slogan from community	75	85.23	57	64.77	8.528	0.003
Informed by Gatekeeper of apartments	62	70.45	26	29.55	28.15	<.0001
Informed by Gatekeeper in garage	46	52.27	17	19.32	19.986	<0.0001
Informed by HCWs in PHC sectors	49	55.68	12	13.64	33.265	<0.0001
No	2	2.27	10	11.36	5.928	0.015
Others	8	9.09	10	11.36	0.302	0.583
<b>Wearing masks when went outside</b>						
Informed by radio by residing community	73	82.95	52	59.09	11.523	0.001
Informed by slogan from community	75	85.23	62	70.45	5.017	0.029
Informed by Gatekeeper of apartments	68	77.27	30	34.09	32.509	<0.0001
Informed by Gatekeeper in garage	56	63.64	17	19.32	34.988	<0.0001
Informed by HCWs in PHC sectors	52	59.09	12	13.64	38.698	<0.0001
No	0	0	4	4.55	4.141	0.042
Others	1	1.14	9	10.23	6.885	0.009
<b>Quarantine for fever patients</b>						
Informed by radio by residing community	71	80.68	48	54.55	13.083	<0.0001
Informed by slogan from community	76	86.36	57	64.77	10.423	0.001
Informed by Gatekeeper of apartments	64	72.73	25	28.41	33.876	<0.0001
Informed by Gatekeeper in garage	53	60.23	16	18.18	32.062	<0.0001
Informed by HCWs in PHC sectors	50	56.82	16	18.18	27.501	<0.0001
No	0	0	7	7.95	7.375	0.007
Others	5	5.68	9	10.23	1.292	0.28
<b>Measuring body temperature at resident community entrances</b>						
Informed by radio by residing community	61	69.32	41	46.59	8.4	0.004
Informed by slogan from community	59	67.05	39	44.32	8.323	0.006
Informed by Gatekeeper of apartments	72	81.82	32	36.36	35.995	<0.0001
Informed by Gatekeeper in garage	56	63.64	9	10.23	52.547	<0.0001
Informed by HCWs in PHC sectors	47	53.41	16	18.18	22.811	<0.0001
No	0	0	7	7.95	7.463	0.006
Others	2	2.27	5	5.68	1.413	0.275

Notes: Missing data were excluded.

if they had a history of traveling by trains, cars, buses, and planes than COVID-19 patients (100.00% vs. 91.11%,  $P < 0.05$ ). Compared with COVID-19 patients, community residents were more likely to take preventive measures, including keeping healthy and washing hands, opening the windows to let the fresh air in, maintaining personal hygiene, maintaining a physical distance of  $> 1.5\text{m}$  from other people, avoiding taking a public transportation, and reducing gatherings ( $P < 0.05$ ) (Table 2).

## Discussion

Classical public health measures such as isolation, quarantining of infected individuals and suspected contacts, social distancing, and community containment have been widely and effectively used to

curb infectious disease epidemics for many years [16]. Furthermore, community engagement is considered a fundamental component of communicable disease outbreaks [17,18]. When Ebola outbreaks occurred in West Africa in 2014, multiple community-based social interventions were implemented, including contact tracing, quarantining of suspected contacts and taking personal preventive measures that prevent the Ebola pandemic worldwide [19]. The public health measures in China, such as isolation and quarantine, are extremely effective in controlling the SARS epidemic, which prevented the widespread transmission of SARS in 2003 [20].

In December 2019 and March 2020, a COVID-19 epidemic occurred in China. People around the world were not aware of COVID-19 until the outbreak in Wuhan, Hubei, China. It has

**Table 2:** Comparison of personal response to COVID-19 between community residents and COVID-19 patients.

Items	Community residents		COVID-19 Patients		c <sup>2</sup>	P
	n	%	n	%		
<b>Stay at home and avoid go densely populated places</b>						
Yes	86	100	85	98.83	1.006	0.316
No	0	0	1	1.17		
Unknown	0	0	0	0		
<b>Measuring body temperature everyday</b>						
Always	61	70.11	61	70.93	0.861	0.65
Sometimes	24	27.59	21	24.42		
Never	2	2.3	4	4.65		
<b>Measures if had suspicious symptoms</b>						
Go to the fever outpatient clinics	84	95.45	75	85.23	3.754	0.062
Quarantine	77	87.5	57	64.77	11.064	0.001
Report to community	73	82.95	44	50	19.957	<0.0001
Wearing masks	71	80.68	51	57.95	9.488	0.002
<b>Share previous travel history within 2 weeks with healthcare provider if had suspicious symptoms</b>						
Yes	87	98.86	84	97.67	1.03	0.598
No	1	1.14	1	1.14		
Unknown	0	0.87	1	1.14		
<b>Behaviors to seek medical service if had suspicious symptoms</b>						
Buy medicines at pharmacy	1	1.14	13	15.12	13.885	0.003
Go fever clinic outpatient clinics	87	98.86	71	82.56		
Go privacy clinic	0	0	1	1.16		
No action	0	0	1	1.16		
<b>Measures if had travel history with train, car, bus and plane</b>						
Quarantine for 14 days alone	88	100	81	91.11	5.268	0.028
No action	0	0	5	8.89		
Unknown	0	0	0	0		
Others	0	0	0	0		
<b>Preventive measures</b>						
Rational diet	82	93.18	75	85.23	1.76	0.21
Stay at home and avoid unnecessary go outside	87	98.86	83	94.32	1.071	0.365
Keep healthy and wash hands	88	100	76	86.36	10.856	0.001
Open window and keep fresh air	88	100	78	88.64	8.581	0.003
Maintain personal hygiene	88	100	80	90.91	6.359	0.013
Keep social distance >1.5m	83	94.32	64	72.73	13.138	<.0001
Avoid take public transportation	84	95.45	69	78.41	9.496	0.002
Reduce gathering	83	94.32	75	85.23	2.632	0.122

**Notes:** Missing data were excluded.

been propagandized by the local government and social media, which enhanced the community residents' awareness of COVID-19 [21]. Communities in China actively participated in the fight against COVID-19 and the Chinese government quickly launched various social interventions in multiple sectors to prevent and control COVID-19, and the epidemic levered off soon [22,23]. The current study investigated the different community and personal responses to social interventions in Western China. We found that

the communities took active roles in preventing infection among residents, such as propagandizing on quarantine strategy, wearing masks, and measuring the residents' body temperature in Western China, which has been implemented in other regions in China. We also found that radio, slogans, and gatekeepers in the residential community were often used as media to disseminate information to residents.

Human behavior plays an important role in the spread of

infectious diseases [24]. As regards mitigating emergent infectious diseases, media publicity, which provides guidelines for people's behavior and individuals' positive responses, is critical [24]. The current study demonstrated that most community residents adapted appropriate personal behaviors in response to social interventions, including staying at home, measuring body temperature, wearing masks, adapting correct behaviors when having suspicious symptoms or exposed to high-risk environments, and taking preventive behaviors.

In terms of the effectiveness of social interventions, previous studies indicated that social media can effectively reach large audiences and provide information regarding the public's sentiment and engagement during a disease outbreak [25]. Social interventions focusing on the prevention and control of COVID-19 are the current strategies to limit the spread of COVID-19 [26]. The current study was performed in March 2020, the COVID-19 patients hospitalized had been infected prior to the implementation. On the other hand, the community residents were receiving prevention and control measures at this time. Therefore, it was compared the response differences to social interventions between community residents and the COVID-19 patients to explore the effectiveness of social interventions. We observed that the accessibility of social interventions for community residents was significantly higher than that for COVID-19 patients, supporting the effectiveness of community response to social interventions.

Personal preventive behaviors, such as wearing masks, quarantine strategies, keep social distance >1.5m, and measuring the body temperature, have been proven to be effective in curbing infectious disease epidemics for many years [16,27], such as the control of SARS and Ebola epidemics [19,20]. The current study compared personal behavioral responses to social interventions between community residents and COVID-19 patients and observed that community residents were more likely to actively take specific measures (staying at home, taking personal preventive measures, or appropriate measures if having suspicious symptoms and travel history) than COVID-19 patients. Our data suggest that it is COVID-19 can be effectively prevented when correct personal responses to social interventions are taken.

## Strengthens and Limitations

This study described the responses to social interventions from the perspectives of both communities and residents. We also compared the responses of the patients and residents to determine the effectiveness of social interventions.

This study has several limitations. Firstly, we were unable to conduct a qualitative study, such as in-depth interviews with community residents about the acceptance of these social interventions and suggestions to improve the interventions. Secondly, we did not analyze the cost-effectiveness of these social interventions, which should be considered when selecting social interventions in the future. Thirdly, this survey was conducted and delivered by Wechat and selection bias may exist in this study. Fourthly, at the survey time, the community residents were home quarantined, the COVID-19 patients were in hospitalized. Thus there was possible recall bias for the COVID-19 patients, but for community residents.

## Conclusion

The spread, prevention, and control of emergent infectious diseases are associated with several social health determinants. Social interventions addressing the social health determinants are crucial for controlling the transmission of virus before vaccines and other effective medications are developed, and play a significant role in the rapid decline of COVID-19 cases in Western China. The positive community and personal responses to social interventions together with international multi-sector collaborations would contribute to the success of COVID-19 fight worldwide.

## Declaration

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**Author contributions:** DL: Designed this survey; RZ, LZ, JZ, RD and SL: Collected data; RZ, JZ, DL, SL and YC: Managed and analyzed data; YL and DL: Controlled the quality of data collection and analysis; RZ and YL: Drafted the manuscript; YL and DL: Edited the manuscript. All authors have interpreted the results, revised the report and completed the final version.

**Ethics and consent:** This study has been approved by The Medical Ethics Committee of Army Medical University, Chinese People's Liberation Army (PLA). Written informed consents have been obtained from the participants of the study.

**Paper context:** The spread of COVID-19 is associated with several social health determinants. Social interventions addressing the social health determinants are crucial for controlling the transmission of virus before vaccines and other effective medications are developed. The positive community and personal responses to social interventions together with international multi-sector collaborations play a significant role in the rapid decline of COVID-19 cases in Western China, which would contribute to the success of COVID-19 fight worldwide.

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