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Risk perception, knowledge, information sources and emotional states among COVID-19 patients in Wuhan, China

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ABSTRACT

Background: The rapidly evolving COVID-19 pandemic has become a global health crisis. Several factors influencing risk perception have been identified, including knowledge of the disease, information sources, and emotional states. Prior studies on COVID-19-related risk perception primarily focused on the general public, with little data available on COVID-19 patients.

Purpose: To investigate COVID-19 patients' risk perception, knowledge of the disease, information sources, and emotional states in the epicenter, Wuhan, during the COVID-19 outbreak in China.

Methods: Data were collected online using self-administered electronic questionnaire developed with reference to previous relevant studies and publications by the World Health Organization.

Findings: A higher level of perceived risk was found in relation to COVID-19 as compared to other potential health threats. Knowledge gaps existed regarding transmission and prevention of COVID-19. Additionally, risk perception was negatively related to knowledge and positively related to depressive states. Moreover, social media was a primary source for COVID-19 information, whereas the most trusted sources were health professionals.

Discussion: Realistic perception of risk should be encouraged considering both physical and mental health while developing relevant strategies. Furthermore, risk communication needs to be specifically tailored for various target groups, such as the elderly and mentally vulnerable individuals, with the adoption of popular media platforms.

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Introduction

The coronavirus disease (COVID-19) pandemic has indeed raised intense global attention. The infectious disease is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which is closely related to the 2003 SARS virus (Lai, Shih, Ko, Tang, & Hsueh, 2020). COVID-19 is primarily transmitted through respiratory droplets from infected individuals during cough or sneeze (Lai et al., 2020). It takes around 2 to 14 days from viral exposure to onset of symptoms (Lai et al., 2020). According to Lu et al. (2020), the highly contagious nature and long incubation period of SARS-CoV-2 are the two main reasons contributing to the COVID-19 pandemic.

The COVID-19 outbreak emerged in Wuhan, capital of Hubei province, China in December 2019. It was identified as a Public Health Emergency of International Concern by the World Health Organization (WHO) on January 30, 2020 (World Health Organization, 2020a), and declared as a pandemic on March 11, 2020 (World Health Organization, 2020b). As of July 15, 2020, over 13 million cases have been confirmed globally with more than 570,000 deaths (World Health Organization, 2020c). Before March 2020, a majority of the cases were from Wuhan city, China (World Health Organization, 2020d). In response to the COVID-19 outbreak, the government of China implemented immediate emergency measures in January 2020, including lockdown of major cities, strict health screening, travel restrictions, and home quarantine (Zhang, Zhou, & Zhou, 2020). In the epicenter Wuhan, several newly established medical facilities were in operation to accommodate the infected patients (Burki, 2020). Two emergency specialty field hospitals, Huoshenshan hospital and Leishenshan hospital, were built and started service in early February 2020 with 2,500 beds for treatment of severe COVID-19 cases (Burki, 2020). In addition, 16 makeshift hospitals, referred to as “Fang Cang” hospitals, were developed to admit patients with mild symptoms of infection (Global Times, 2020a). These “square cabin” field hospitals were generally transformed from local sports stadiums, exhibition centers, and cultural complexes with a capacity of nearly 7,000 beds (Global Times, 2020b). They mainly served as temporary quarantine stations where patients not only received efficient medical care but were also isolated from family and friends. Within 36 days in operation from February 4 to March 10, 2020, Fang Cang hospitals successfully treated more than 12,000 patients and contributed significantly to the epidemic control (Global Times, 2020a). The model for makeshift hospitals was pioneered in China during the SARS outbreak in 2003 (Wang & Ruan, 2004). A 1,000-bed prefabricated hospital, also known as “Xiaotangshan” hospital, was constructed within a week, and treated a total of nearly 700 SARS patients in less than 2 months (Wang & Ruan, 2004).

Effective control of COVID-19 epidemic is highly dependent on preventive practice of the public and specific risk groups. Risk perception could be a key factor influencing precautionary behaviors. According to the Protection Motivation Theory, individuals who perceive higher level of risk are more likely to adopt preventive behaviors (Prentice-Dunn & Rogers, 1986). Studies on the 2003 SARS outbreak indicated that the perceived higher risk of SARS infection was associated with engagement in more precautionary behaviors, and compliance with infection control policies (de Zwart et al., 2009; Smith, 2006).

Risk perception in the midst of a growing epidemic can be influenced by several factors, including knowledge of the disease, information sources and emotional aspects. Previous studies have found a positive relationship between disease-related knowledge and perceived risk regarding the Middle East Respiratory Syndrome (MERS) (Kim & Choi, 2016; Kim & Kim, 2018). In addition, reliable information sources are the basis to acquire credible knowledge and build social trust. False or misleading information may lead to exaggerated fears or lack of attention to an emerging threat (Choi, Yoo, Noh, & Park, 2017). Moreover, the psychological stress triggered by a health emergency may also affect risk judgment (Ferrer & Klein, 2015). Ferrer and Klein (2015) investigated the accuracy of risk perception in the context of immediate health threats and suggested that people tend to overestimate the risk of negative outcomes due to excessive emotional stress.

Previous studies on risk perception during epidemics were all in specific contexts, including SARS (Brug et al., 2004; de Zwart et al., 2009; Smith, 2006), MERS (Kim & Kim, 2018), Ebola (Sell et al., 2017), and Avian influenza (Ibuka, Chapman, Meyers, Li, & Galvani, 2010). Currently there is lack of relevant data on the COVID-19 outbreak. The most recent research on COVID-19-related risk perception mainly focused on the general population (Kwok et al., 2020; Li, Yang, Dou, Wang, et al., 2020) and health care workers (Bhagavathula, Aldhaleei, Rahmani, Mahabadi, & Bandari, 2020). There are no data available on COVID-19 patients. Individuals who had direct experience with COVID-19 may have different perspectives on the disease from the public. Their views and perceptions are important information to risk communicators such as health care professionals in encouraging realistic risk perception and improving public response to future epidemics. COVID-19 patients from Wuhan are a special group of infected individuals who witnessed the very early stage of the COVID-19 outbreak when public knowledge about the disease was limited. Their perception of COVID-19-related risk and relevant knowledge may provide valuable information to future risk communication and infection control under similar situations. Therefore, the aim of the study was to explore COVID-19-related risk perception, knowledge, information sources, and emotional states among COVID-19 patients in Wuhan, during COVID-19 outbreak in China.

Methods

Sample and Setting

Questionnaires are useful for investigating the perspectives and attitudes of a population. In this study, an online survey was conducted among COVID-19 patients in one of the Fang Cang hospitals in Wuhan city, China in February 2020. Fang Cang hospitals were in service from early February to early March for the purpose of quarantine and treatment of patients with mild symptoms of COVID-19. Patients in Fang Cang hospitals are typically independent and self-caring. Participants were recruited via convenience sampling.

Data Collection

After obtaining the hospital Ethics Review Board's approval, data were collected by trained nurses who worked in the Fang Cang hospital and they agreed to be involved in this research. Trained nurses administered the online survey by presenting a WeChat Quick Response (QR) code for potential participants to scan after giving informed consent. This WeChat QR code provided access to the preprogrammed online survey developed using Sojump (https://www.wjx.cn/). Participants were then given instructions on how to fill in and submit the questionnaire online. Patients' confidentiality was maintained throughout the research process.

Study Measures

The electronic questionnaire consisted of five sections, including demographic information, COVID-19-related risk perception, knowledge, information sources, and emotional states. Demographic information included age, gender, place of usual residence, profession, and level of education.

Risk perception was assessed using the questionnaire developed based on previous studies (Brug et al., 2004; Vartti et al., 2009). There were three components. Part I contained eight items to measure participants' perceived risk of acquiring COVID-19 and other potential threats including H1N1, influenza, cancer, heart attack, traffic accidents, accidents at home and food poisoning, in the coming year. Part II included eight items to examine participants' perceived likelihood of dying from COVID-19 and other potential threats previously mentioned. Part III consisted of three items for which participants rated how worried they were in relation to COVID-19. Five response categories were used, ranging from 1 = very unlikely to 5 = very likely or 1 = not worried at all to 5 = very worried.

Knowledge of COVID-19 was assessed through 19 items developed according to WHO's advice for the public on face masks use and common myths related to COVID-19 (World Health Organization, 2020e, 2020f). Participants were asked to determine whether statements regarding COVID-19 were correct or not (possible responses were Yes, No, and Not sure). The total knowledge score was calculated by the sum of correct answers to the items (range 0–19).

Ten information sources were identified from which COVID-19-related information could be obtained. Participants responded by rating how much information they acquired from each source and their confidence in the source, ranging from 1 = very little to 5 = very much.

Emotional states were assessed using a modified version of the 20-item Hopkins Symptom Checklist Depression Scale (Derogatis, Lipman, Rickels, Uhlenhuth, & Covi, 1974; Williams, Stellato, Cornell, & Barrett, 2004). One item regarding sexual interest and pleasure was removed from the questionnaire considering the context of the study and two other reasons. First, patients in Fang Cang hospital were quarantined and unable to satisfy their sexual needs. Second, in China, there is a cultural restraint to express opinions regarding sex. The remaining 19 items were rated on a five-point scale ranging from 0 = not at all to 4 = extremely. The resulting scale score for emotional states is the sum of individual item scores (range 0–76).

The questionnaire was tested for comprehensibility by two scholars who were experts in global nursing and infection control. The experts rated 100% of the items as being congruent with the construct. The internal consistency of the questionnaire, measured by the Cronbach's alpha coefficient, was good (alpha ranged from 0.72 to 0.96).

Statistical Analysis

Data were analyzed using Minitab 19. Descriptive analysis was conducted for demographic data, risk perception, knowledge, information sources, and emotional states. Furthermore, Spearman Rank Correlation tests were performed to explore the association between risk perception and other variables including knowledge, emotional states, and demographic characteristics. To investigate the relationship between risk perception and knowledge, and between risk perception and emotional states, an Ordinal Logistic Regression test was conducted with risk perception as the dependent variable. A 95% confidence interval was applied for results to be considered significant.

Findings

Description of Sample Characteristics

A total number of 113 COVID-19 patients in the Fang Cang hospital completed the online survey. Participants' ages ranged from 20 to 69 years (Mean = 42.3, standard deviation = 11.3) with 51 females and 62

males. Over 98% of the participants were local residents of Hubei province, and around 58% reported having finished postsecondary or higher education.

Descriptive Statistics of Risk Perception, Knowledge, Information Sources, and Emotional States

The perceived risk of acquiring COVID-19 (42%) was lower than that of influenza infection (61%) but higher in comparison with other adverse events (Table 1). Middle-aged and older participants (44%) reported slightly higher level of perceived risk of COVID-19 infection as compared to young participants (40%; Table 1). Moreover, the likelihood of death due to COVID-19 was claimed by around 13% of the participants, among whom a larger percentage were young people (Table 1). The perceived risk of death from COVID-19 was ranked second only to traffic accidents in young respondents (17%), and to heart attack in middle-aged and older respondents (8%; Table 1). Furthermore, a substantial proportion of participants were concerned about family members (86%) and other people (77%) contracting COVID-19. Approximately, 84% were worried that their region of residence might be affected by COVID-19.

The COVID-19-related knowledge score ranged from 6 (min) to 18 (max), with a median score of 11 and interquartile range between 10 and 14. The item asking whether spraying alcohol or chlorine on one's body eliminates the new coronavirus had the lowest accuracy rate of 16%. In addition, items about whether antibiotics or other specific medicines were effective in preventing and treating COVID-19 were answered correctly by less than half of the participants. Furthermore, around 42% of the participants were not sure whether pets at home could spread COVID-19, and about 40% were uncertain whether hand dryers were able to kill COVID-19 virus.

The two main means by which COVID-19-related information was obtained were the Internet (84%) and WeChat (80%) (Table 2). The Internet was the primary information source for young participants (89%) whereas middle-aged and older participants relied more on WeChat (85%; Table 2). However, confidence in the two sources was relatively low (Internet: 32%; WeChat: 42%; Table 2). The top two information sources participants felt most confident about were physicians (90%) and nurses (88%; Table 2). Nevertheless, only about half of the participants reported having acquired adequate information from the two sources (Table 2).

The scores for emotional states ranged from 19 (min) to 73(max), with a mean score of 38.7, and standard deviation of 11.5. Roughly 23% of the participants claimed to frequently experience early morning awakening ("quite a bit" or "extremely"). Additionally, feelings of being trapped and lack of energy to a high degree ("quite a bit" or "extremely") were expressed by 19% of the participants.

Risk Perception and Demographic Characteristics

A Spearman's correlation test showed that level of education was negatively associated with degree of worry for family ($r = -0.198$, $p = .036$) and others ($r = -0.204$, $p = .030$) contracting COVID-19. There is no correlation between risk perception and other demographic variables.

Risk Perception and Knowledge

Perceived risk of COVID-19 infection in the coming year was negatively related to knowledge of COVID-19 as indicated by a Spearman correlation test ($r = -0.203$, $p = .031$). An ordinal logistic regression test with risk perception as the dependent variable showed that this negative relationship was statistically significant ($\beta = 0.128$, $z = 2.07$, $p = .039$; Table 3). Moreover, according to Pearson correlation test, there was a negative

Table 1 – Perceived Risk of Being Affected by COVID-19 and Other Potential Threats

	Perceived Risk of Acquiring Diseases or Encountering Accidents						Perceived Risk of Death From the Diseases or Accidents		
	"Likely "or "Very Likely"			"Unlikely" or "Very Unlikely"			"Likely "or "Very Likely"		
	Overall (n = 113)	*Age: 20–44 (n = 65)*	*Age: 45–69 (n = 48)*	*Overall (n = 113)*	*Age: 20–44 (n = 65)*	*Age: 45–69 (n = 48)*	*Overall (n = 113)*	*Age: 20–44 (n = 65)*	*Age: 45–69 (n = 48)*
COVID-19	42%	40%	44%	27%	25%	29%	13%	17%	8%
H1N1	22%	23%	21%	32%	32%	31%	9%	14%	2%
Influenza	61%	62%	60%	8%	9%	6%	9%	9%	8%
Cancer	9%	12%	4%	73%	72%	73%	7%	11%	2%
Heart attack	11%	8%	15%	64%	68%	58%	12%	11%	13%
Traffic accidents	10%	15%	2%	52%	46%	61%	12%	19%	4%
Accidents at home	10%	14%	4%	53%	46%	63%	7%	11%	2%
Food poisoning	7%	11%	2%	69%	66%	73%	8%	12%	2%

Table 2 – Sources of Information About COVID-19 and Confidence in the Sources

Information Sources	Amount of Information "Quite a Bit "or "Very Much"			Confidence in the Information "Quite a Bit "or "Very Much"		
	Overall (n = 113)	*Age: 20–44 (n = 65)*	*Age: 45–69 (n = 48)*	*Overall (n = 113)*	*Age: 20–44 (n = 65)*	*Age: 45–69 (n = 48)*
Internet	84%	89%	77%	32%	31%	33%
WeChat	80%	75%	85%	42%	46%	36%
Family and friends	56%	57%	54%	50%	52%	48%
Physicians	54%	57%	50%	90%	89%	92%
Television	51%	43%	63%	75%	72%	79%
Nurses	50%	54%	44%	88%	88%	88%
Radio	33%	34%	31%	54%	55%	52%
Weibo	31%	38%	21%	32%	35%	27%

Table 3 – Perceived Risk of COVID-19 Infection and Perceived Risk of Death From COVID-19

	Perceived Risk of COVID-19 Infection			Perceived Risk of Death From COVID-19		
	OR	95% CI	*p*Value	OR	95% CI	*p*Value
Knowledge	1.14	1.01–1.28	.039	1.11	0.99–1.26	.083
Emotional states	0.97	0.94–1.00	.048	0.96	0.93–0.99	.011

Note. OR, odds ratio; 95% CI, 95% confidence interval.

association between COVID-19-related knowledge and age ($r = -0.298$, $p = .001$).

Risk Perception and Emotional States

Ordinal logistic regression tests indicated a significant positive relationship between perceived risk of COVID-19 infection and negative emotional states ($\beta = -0.030$, $z = -1.97$, $p = .048$; Table 3), as well as perceived risk of death from COVID-19 and negative emotional states ($\beta = -0.039$, $z = -2.55$, $p = .011$; Table 3). Additionally, negative emotional states were also positively correlated with perceived risk of encountering other potential threats ($r = 0.259$, $p = .006$), and dying from other threats ($r = 0.280$, $p = .003$).

Discussion

In this study, COVID-19 patients in Wuhan reported higher perceived risk of being affected by COVID-19 as compared to most other potential threats. Risk perception was negatively related to knowledge of the disease, and positively related to negative emotional states. Furthermore, there was a discrepancy between sources of information most frequently utilized and most confident about.

Perceptions of both cognitive and affective dimensions of COVID-19-related risk were found high in this study. Similar findings were reported on risk perception of COVID-19 in the Chinese general public (Li, Yang, Dou, Wang, et al., 2020; Wang et al., 2020). Wang et al. (2020) reported that around 75.2% of Chinese were worried about a family member contracting the disease, comparable to 86% in this study. Moreover, the high perceived susceptibility (89%) and severity (97%) in relation to COVID-19 was also found in Hong Kong residents during the early phase of COVID-19 outbreak (Kwok et al., 2020). In contrast to the current finding, a low level of perceived COVID-19-related risk was discovered in adult US population (McFadden, Malik, Aguolu, Willebrand, & Omer, 2020). The discrepancy could be due to different regions where the studies were conducted. In this study, participants were recruited from Wuhan city, the first epicenter of COVID-19 pandemic, where the majority of global COVID-19 cases were from (World Health Organization, 2020d). The challenge faced by the local public health authority and Wuhan residents were unprecedented. Also, for a novel disease with rapid spread, unclear prognosis and no specific treatment (European Centre for Disease Prevention and Control, 2020), it is expected that the perceived risk of COVID-19 may exceed the actual risk due to fear and anxiety. In de Zwart et al. (2009)'s study on SARS outbreak, the perceived threat of SARS was compared with other potential health-related threats, with findings consistent with the current research results. In addition, Yang and Chu (2018)'s research on Ebola indicated that the realistic processing of risk information in the case of an epidemic could be inhibited by fear, anxiety, and other emotional aspects. Therefore, to deal with an emerging epidemic as COVID-19, it is suggested that risk communication strategies should not only emphasize on promoting public awareness and

compliance with precautionary behaviors, but also on psychological well-being of individuals in the face of uncertainty, and maintenance of social trust. In the community level, it is recommended that health officials regularly update information about COVID-19 and provide health advices via various social media channels including WeChat, Weibo, and WhatsApp. Primary health care providers such as general practitioners should be readily approachable to address people's health concerns regarding COVID-19 in a timely manner. They could also provide support and guidance about rational risk considerations in relation to the rapidly evolving COVID-19 situation. Additionally, it is suggested that more community programs that facilitate connectiveness between people be developed using media platforms to help reduce feelings of social isolation and build resilience. For psychologically vulnerable individuals, it is important that online or telephone counselling services are easily accessible to them. Within hospitals, the mental state of COVID-19 patients should be carefully monitored. They should also be guided to avoid extensive media exposure to COVID-19 crisis and only seek information from reliable sources.

There was a significant negative relationship between knowledge of COVID-19 and the perceived risk of infection. Knowledge was also negatively related to age. Inconsistent with the present finding, previous studies on MERS indicated a positive relationship between knowledge and risk perception (Kim & Choi, 2016; Kim & Kim, 2018). One possible explanation for the discrepancy could be the different nature of coronaviruses that caused MERS and COVID-19 (Prompetchara, 2020). COVID-19 had much higher person-to-person transmission rate compared with MERS, despite causing relatively mild symptoms of infection (European Centre for Disease Prevention and Control, 2020). Individuals with more knowledge of COVID-19 might have a greater sense of control over the epidemic situation, thus feeling less threatened by it. Li, Yang, Dou, Wang, et al. (2020) investigated the effect of self-control on perceived severity of disease in the context of COVID-19 outbreak and found that those with low self-control were more likely to have exaggerated perception of the seriousness of COVID-19. Brug et al. (2004)'s research on SARS outbreak also discovered that more disease related knowledge was associated with less perceived risk of SARS becoming a health problem. Moreover, knowledge gaps existed with respect to transmission and prevention of COVID-19. Low level of knowledge was reported among participants regarding whether pets transmit the disease, and whether spraying disinfectants over the body kills the virus. Also, more than half of respondents wrongly believed that antibiotics could be effective in treating COVID-19. These knowledge gaps, if not addressed urgently, may lead to serious consequences for the public, including abandoning pets for fear of contracting COVID-19, and antibiotics abuse. This finding provided important information for risk communicators to understand the specific needs of their stakeholders. Furthermore, insufficient knowledge of COVID-19 was more likely in older participants. The elderly is a special group of people that are more vulnerable to the impact of COVID-19 than others, both physically (Rothan & Byrareddy, 2020) and mentally (Armitage & Nellums, 2020; Yang et al., 2020). It is important that public health interventions incorporate COVID-19-related education specifically tailored for this group. Further research is required to investigate the specific knowledge needs of the elderly individuals in the context of COVID-19 pandemic.

While knowledge about COVID-19 can be acquired by a variety of ways, accessible and credible information sources are critical for effective risk communication. This study found that health professionals (physicians and nurses) were the most trusted sources for COVID-19 information. The finding is in accordance with prior research results of the 2003 SARS outbreak (Vartti et al., 2009) and the 2009 influenza A (H1N1) pandemic (Ferrante et al., 2011; Jehn, Kim, Bradley, & Lant, 2011). However, poor accessibility to these sources was expressed by around half of the respondents. Similar result was also reported in Kwok et al. (2020)'s study on COVID-19 outbreak in the Hong Kong community. In comparison, social media (Internet and WeChat) was identified as a primary information source for COVID-19, but with relatively low credibility. Earlier studies also indicated the predominant role of social media in delivering timely disease related updates during SARS (Vartti et al., 2009) and H1N1 epidemics (Seale et al., 2009; van der Weerd, Timmermans, Beaujean, Oudhoff, & van Steenbergen, 2011). The discrepancy between most accessible and most credible information sources in this study suggests that social media could be used as a tool to facilitate risk communication. Health professionals may adopt popular social networking platforms to provide accurate COVID-19 information, correct misleading information, and educate the public with medical knowledge in an easily understandable way.

Depressive states were found positively related to both perceived risk and perceived severity of COVID-19 infection. Li, Yang, Dou, Wang, et al. (2020)'s study also indicated a positive correlation between negative emotional states and perceived undesirable outcomes of COVID-19. The finding suggests that people with mental health issues, especially depression, could be more vulnerable to the negative impact of COVID-19 outbreak. According to the risk-resilience model (Masten, 2001), individuals who possess sufficient protective factors are less likely to be affected by potential adverse events in the presence of risk factors. In Li, Yang, Dou, and Cheung's (2020) research, self-control was proposed as a moderator of the relationship between mental disorders and perceived seriousness of COVID-19. Other moderator variables that also

function as protective factors for the perceived threat of COVID-19 may exist, which could be a future research direction. This finding has important implications for public health interventions targeting mentally vulnerable individuals at risk of COVID-19 infection. Psychological service such as counselling should be provided for this group in combination with other measures in risk communication.

Limitations

This study has potential limitations. First, the sample may not be representative of the population (COVID-19 patients in the epicenter) due to its small size and self-selection bias resulted from nonprobability sampling. It was challenging to recruit participants under the pandemic circumstances with social distancing restrictions. The data in this study were collected from one of the Fang Cang hospitals which treated the most nonsevere COVID-19 patients from Wuhan. Therefore, the findings of this study should be interpreted with caution concerning the difference between COVID-19 patients with mild symptoms and COVID-19 patients as a whole. Second, the cultural context in which this research was conducted may affect the generalizability of its results to other culturally different societies. As the epicenter of COVID-19 pandemic has shifted to Western countries (Biswas, Khaleque, & Sen, 2020), COVID-19 patients from Western societies may respond to the variables studied differently. A potential research direction could be to compare risk perception of COVID-19 patients from various epicenters and investigate cultural influence on the difference. Third, participants' responses to the research variables could be dynamic in time depending on the specific stage of COVID-19 outbreak. Factors such as increasing public awareness or effectiveness of infection control measures may account for variations in risk perception and knowledge level. A longitudinal study is required to examine the changes over time. Last but not the least, the questionnaire in this study was devised with reference to prior studies, and not based on a theoretic model. The lack of specificity in COVID-19 may affect the sensitivity of the questionnaire. For example, other potential mediator variables that influence the relationship between risk perception and emotional states may exist, which future research may seek to identify.

Conclusion

This study investigated COVID-19 patients' risk perception, knowledge of the disease, information sources, and emotional states during the COVID-19 outbreak in China. A higher level of perceived risk was found regarding COVID-19 in comparison with most other potential threats. Risk perception was negatively associated with knowledge level, and positively associated with depressive states. Social media was a primary source for COVID-19 information, whereas the most trusted information sources were health professionals. This study has important implications for risk communication strategies in response to the COVID-19 pandemic, and other similar public health emergencies in the future.

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