Mediating Effects of Attitudes, Risk Perceptions, and Negative Emotions on Coping Behaviors: Evidence From a Survey of Older Chinese Adults

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ABSTRACT

Based on the perspectives of social risk amplification and the knowledge-attitudes-practice model, this study aimed to test how the level of knowledge about COVID-19 and information sources can predict people's behavioral changes and to examine the effect mechanisms through the mediating roles of attitude, risk perception, and negative emotions in a survey of 498 older Chinese adults. The results showed that (1) older people had a lower level of factual knowledge regarding the variant strains and vaccines; (2) in the information sources-behavior, information sources had a critical influence on elderly individuals' coping behaviors; and (3) in the knowledge-behavior, factual knowledge had a significant effect on elderly individuals' coping behaviors. Specifically, for prevention behaviors, both risk perception and negative emotions played full mediating roles. The findings have significant implications for the development of an effective COVID-19 prevention program to older adults coping with pandemic conditions.

KEYWORDS

Coping Behavior, COVID-19, Healthcare Management, Information Sources, Knowledge, Older Adults

1. INTRODUCTION

In the ongoing COVID-19 pandemic, information from multiple sources can result in information overload and cause anxiety and distress (Sakurai & Chughtai, 2020) and thus create negative psychological and behavioral responses (Soroya et al., 2021). Some individuals, particularly older adults, feel distressed by information overload; therefore, they tend to ignore health information and...
pandemic knowledge, which has been shown to undermine compliance with prevention behaviors in many health domains (Pian et al., 2021).

As they enter old age, elderly people present health characteristics that are different from those of the general population, such as nutritional deficiencies, frailty, susceptibility to infectious diseases, coexistence of chronic diseases and significant mental health problems. As immune function declines, elderly individuals become more susceptible to infectious COVID-19 (McAuliffe et al., 2020; The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team, 2020).

Uncovering the cognitive and perceptual patterns of elderly people in the process of risk communication during COVID-19 is important for guiding prevention programs for older adults as well as the development of psychological health communication theories (Heydari et al., 2021). Until specific treatments for COVID-19 are available, prevention is critical to protect high-risk elderly populations; however, few works have been done to explore these factors, such as knowledge, risk perception, and negative emotions, which promote prevention behaviors in this population (Yu et al., 2021).

Existing studies have examined older adults’ knowledge, beliefs, risk perceptions, attitudes, and coping behaviors regarding COVID-19, where adequate knowledge and positive beliefs have been shown to be strongly associated with coping behaviors (Saadatjoo et al., 2021). These findings have important implications for improving the effectiveness of COVID-19 treatment programs targeting older populations (Chen et al., 2020).

Although studies have already focused on factors affecting the older population during the COVID-19 pandemic on their preventive behaviors, few researchers have explored this issue from an internal mechanism perspective (Chen et al., 2020; Duan et al., 2021). The question of whether these factors are related and what effect they have on older adults’ preventive behaviors remains unresolved (Duan et al., 2021). Having enough knowledge about COVID-19 can affect the perception and prevention measures adopted by older adults, while low levels of cognition and negative practices could increase the risk of infectious diseases. Therefore, understanding the knowledge, risk perception and coping behaviors (KRBs) of older adults and knowing the potential factors can help to improve COVID-19 prevention and treatment (Saadatjoo et al., 2021).

Some classical models, such as Social Amplification of Risk Framework (SARF) and the Knowledge Attitude Practice model (KAP), have been applied to explore the relationship among knowledge, attitudes and preventive behaviors concerned with SARS, H1N1, H7N9 and COVID-19. Those studies demonstrate associations between patterns and social-demographic predictors, but the relationship between knowledge, risk perception, and coping behavior remains unclear (Rimal & Real, 2003; Chan et al., 2020). Although many works have focused on the role of negative emotions and attitudes and examined when they can promote behavior changes, the literature assessing this relationship in older adults during COVID-19 is limited.

Therefore, we conducted this study to evaluate the relationship among knowledge, information sources and behavioral responses of elderly individuals and to investigate the effect of knowledge level and information sources on risk perceptions, negative emotions and attitudes, and their interference with the adoption of prevention behavior. According to Shi et al. (2002), we examined four types of coping behaviors, namely herding behavior, avoidance behavior, prevention behavior, and superstitious behavior.

Our contributions are twofold. First, according to the SARF model, we explored the characteristics of information sources, attitudes and coping behaviors of Chinese elders and analyzed the potential risk factors that influence behavior changes. Second, with the help of KAP instruments, we developed a conceptual model to examine the mediating role of risk perceptions and negative emotions on the coping behaviors pathway.
2. THEORETICAL FRAMEWORKS AND HYPOTHESES

2.1 Social Amplification of Risk Framework (SARF)

SARF is a conceptual model that supports sociological scholars in exploring how message framing can produce wider impacts that inspire novel approaches to risk governance (Kasperson et al., 1992). Under SARF, message framing, as interpretive signals, is decoded by audiences to reshape the truth and inform the risks (Marsden et al., 2006; Thiesse, 2007; Kutsch et al., 2013; Kammerer et al., 2015). SARF argues that most risk information is transmitted indirectly through television, newspapers and magazines, and social media, etc. The dissemination process is influenced by social, cultural, and psychological factors, resulting in amplification or reduction of risk, thus creating different degrees of risk salience (Kasperson et al., 1992).

Risk information can be amplified in two stages: the process of transmitting risk information (i.e., information mechanism) and the process of responding to social mechanisms (i.e., response mechanism) (Adekola, 2020). In the information mechanism, signals can be generated either through direct personal risk experience or through the reception of information about risk. In the second stage, the response mechanism, mainly through social relations, signal values, individual and group beliefs, and stigma, etc., the social amplification of risk will eventually generate many behavioral responses, which in turn will generate secondary effects, mainly including market impact, loss of trust, and normative needs, etc. Immediately afterwards, the secondary effects spread outward to trigger the “ripple effect” (Rooke, 2021). Recent studies applying SARF have focused on various contexts, such as pandemic outbreaks (Rossmann & Schulz, 2018; Wirz et al., 2018), health-related topics (Chong & Choy, 2018) and disaster risks (Smith et al., 2018).

2.2 Knowledge, Attitudes and Practice (KAP) Model

As a classical theory of health communication area, the Knowledge, Attitudes and Practice (KAP) model aims to explain the mechanism by which individuals’ knowledge and attitudes influence behavior changes (Pärna et al., 2005). The KAP model constructs a basic model from cognitive revision to belief establishment and behavior changes and analyzes the progressive relationship among knowledge, attitudes and behaviors (Cleary & Dowling, 2009). It addresses that knowledge is the basis for behavior changes, and beliefs and attitudes are the motivation for behavior changes. When people have acquired related knowledge and have positive thinking, as well as strong positive perceptions, can beliefs be gradually generated, and knowledge can be transferred into beliefs.

Recently, the KAP model has been applied in the field of medical care, especially in research on protective behaviors during the COVID-19 pandemic, which has achieved significant results (Zehra et al., 2020; Lee et al., 2021; Qin et al., 2021). Such studies have explored elderly people’s knowledge, attitudes and practices regarding COVID-19 (Saadatjoo et al., 2021). Most studies indicated that higher knowledge level about COVID-19 was associated with prevention behaviors (Chen et al., 2020; Gallè et al., 2021; Gonçalves et al., 2021; Yu et al., 2021). Identifying key correlates of prevention behaviors that are modifiable through intervention is a recognized priority (Duan et al., 2021; Kwok, 2021). Although previous studies have explored the relationship among knowledge, attitudes and preventive behaviors during the COVID-19 pandemic, studies focusing on behavioral changes in seniors remain scarce despite the increased vulnerability among this population (Chen et al., 2020).

2.3 Role of Attitudes in Information Sources and Behaviors

Information sources are important for people to gain knowledge, shape risk perceptions, and change prevention behaviors (Huang et al., 2071; Zhang, et al., 2017; Chang et al., 2021). Various sources are delivered through a platform for the public to interact extensively, which influences their risk perceptions and knowledge, forms their attitudes toward government policies, and encourages
adherence to government recommendations (Renn et al., 1992). For example, Balkhy et al. (2010) found that public concern played an important role in controlling H1N1 through adherence to preventive behaviors.

Scholars have mostly focused on the mechanism of information seeking (Savolainen & Kari, 2004; Lu et al., 2020) and information sharing behaviors in the context of certain information sources (Lu et al., 2021; Zhang & Cozma, 2022) and investigate the influence of information source characteristics, including the content, channel, and type, on the willingness to perform these behaviors (Guo et al., 2022). For example, based on the SARF model, Zhang & Cozma (2022) examined the factors affecting information sharing behaviors. Their empirical results confirmed that people who participated in COVID-19 online discussions were more willing to share information related to the virus, but rarely communicated with their friends face-to-face. Those who actively sought risk information were more willing to disseminate outbreak-related information on social networking sites. In addition, some scholars have already focused on the impact of source trust on public behaviors (Mun et al., 2013; Zha et al., 2018; Bearth & Siegris, 2021; Lu et al., 2021; Zhang & Cozma, 2022). They showed that when blind trust in social media sources and inconsistency of risk information earlier in the epidemic reduce the public’s misjudgment of epidemic risk, generate low levels of risk knowledge, and lead to to the adoption of irrational preventive behaviors (Johnson & Kaye, 2013; Woko et al., 2020; Piltch-Loeb et al., 2021).

Studies have argued that information sources are critical for risk communication and message framing, which affect how risk is perceived and what public attitudes are formed toward the risks by the public (Kasperson et al., 1992; Kim et al., 2018). However, the literature has mostly focused on information behaviors (e.g., seeking behaviors and sharing behaviors) and less on prevention behaviors in the context of pandemics (Chang & Huang, 2020). Meanwhile, where people obtain information and how different information sources affect attitude formation and behavior adoption are important but underexplored aspects of risk communication.

The literature, including the SARF and previous studies applying the SARF, has suggested that a number of factors, including information sources and attitudes, may contribute to behavior changes (van Goudoever et al., 2021). Applying these assumptions during the pandemic outbreak in China, this study proposed the following hypotheses:

**H1:** Information sources can indirectly affect coping behaviors by influencing attitudes.
**H2:** Information sources can directly affect coping behaviors.

### 2.4 Role of Risk Perception in Knowledge and Behaviors

Risk perception is an important indicator of public psychological panic, which refers to the subjective perception, judgment and evaluation of risk by individuals through the perception and cognition of objective risk (Slovic, 1987). People’s perceptions of risk are not only related to the evaluation of the risk itself but also consider people’s social backgrounds, cultural backgrounds, and knowledge levels, etc. (So et al., 2004; Turel, 2021). Based on the KAP framework, several primary studies have investigated the state of public knowledge, attitudes, and preventive measures during a pandemic, and found that low knowledge levels affect the risk perception and the uptake of certain preventive behaviors (So et al., 2004; Majid et al., 2020). There is a significant correlation between the prevention behaviors of the participants and their risk perceptions and knowledge, and a strong correlation between their knowledge and risk perceptions (Cihan et al., 2020; Lu & Shelley, 2021). For example, when individuals have a high level of knowledge and risk perception, their likelihood of complying with active prevention behaviors increases (Lu & Shelley, 2021). Through a cross-sectional telephone survey, Chan et al. (2020) found that older adults with low levels of education (65 years or older) were less likely to take preventive measures because of their relatively low knowledge of COVID-19. Similarly, Lu et al. (2021) showed that knowledge level was significantly related to risk perception,
with higher levels of knowledge triggering higher risk perceptions and thus a greater likelihood of adherence to preventive behaviors. Then, we proposed the following hypotheses:

H3: Knowledge level can indirectly affect coping behaviors by influencing risk perception.
H4: Knowledge level can directly affect coping behaviors.

2.5 Role of Emotion in Knowledge and Behavior

Intensive media coverage about risk events increased people’s knowledge about the virus (Yu & Shen, 2021). Meanwhile, the message framing about disease-related knowledge may induce, or even aggravate, collective public negative emotions such as loneliness, fear, anger, and sadness (Nicola et al., 2020; Chou & Budenz, 2020; Jungmann & Witthöft, 2020; Lwin et al., 2020; Muñoz-Navarro et al., 2021; Zhong et al., 2021). During infectious disease outbreaks, knowledge levels and emotional variables still play important roles in predicting behavioral responses (Gan et al., 2021; Rattay et al., 2021). Compared with knowledge levels, emotional factors (especially negative emotions) demonstrated stronger explanatory power in predicting behavioral responses to health risks (Min et al., 2020; Pakpour & Griffiths, 2020).

Numerous studies have demonstrated that negative emotions are strong predictors of preventive behaviors, and found that willingness to adopt preventive behaviors was positively associated with higher levels of knowledge, perceived severity of risk, negative emotions, and attention to official government media (Ning et al., 2020; Oh et al., 2021).

Overall, the relationships between emotional factors and prevention behaviors, particularly the moderating effects of negative emotions in conditioning the relationship between knowledge and prevention behaviors, are still an understudied area (Gan et al., 2021). A future study design should consider monitoring and assessing changes in knowledge, negative emotions and behavior responses. Therefore, this study proposed the following hypothesis:

H5: Emotion can directly affect prevention behaviors.

According to the SARF model, a person’s overall perception of an outbreak is amplified or diminished by personal cognition, informal social networks, and professional information dissemination. Based on this, this paper combined both personal cognition and social communication to jointly explore the mechanisms influencing the behavioral responses of the elderly population during the COVID-19 pandemic.

Inspired by the SARF model, we built our research framework with the help of KAP instruments. As shown in Fig. 1, from a social communication channel perspective, we investigated the impact of different information sources, i.e., government units, social networks, family and friends, on behavioral responses and their influencing mechanisms. From the perspective of personal cognition, we explored the relationships between COVID-19 knowledge and coping behaviors, which contributes to explanations of how knowledge, risk perceptions, and negative emotions influence Chinese elders’ coping behaviors in the COVID-19 epidemic and examinations of the mediating effects of risk perceptions and emotions on the above relationships.

3. MATERIALS AND METHODS

3.1 Study Design and Participants

An anonymous web-based questionnaire was administered from September 11 to September 27, 2021, among older Chinese people. Participants were chosen via convenience sampling. The inclusion criteria were (1) 50 years old and (2) agreement to participate in the survey. For elderly individuals who could
not read or use smartphones, family members were asked to assist in filling out the questionnaire to ensure the authenticity of the content. The questionnaires were distributed with the help of a professional data collection platform. Before participating this survey, there were short instructions to explain the purpose of the study, the content, and guidance on how to answer. After completing the questionnaire, participants were entered into a prize drawing for approximately 8¥ (US $1.25).

Finally, 603 questionnaires were collected during the study period. After excluding 97 invalid questionnaires and 8 participants who reported that they had never heard of COVID-19, a total of 498 valid questionnaires (82.6%) were collected from 31 provinces, municipalities and autonomous regions in mainland China.

First, descriptive statistics summarized participants’ socio-demographic characteristics, COVID-19-related knowledge levels, information sources, risk perceptions, negative emotions, attitudes and behavioral response. Second, the bivariate correlations of COVID-19-related knowledge, information sources, risk perceptions, negative emotions, attitudes and behavioral responses are shown by correlation analysis. Then, the relationships between socio-demographic characteristics and behavioral responses were analyzed by one-way analysis of variance (ANOVA) and independent sample t tests. Finally, two mediated effects models were used to explore the internal mechanisms by which older adults’ levels of knowledge about the pandemic and their information communication sources influenced their behavioral responses by setting statistically significant socio-demographic characteristics as control variables. Unstandardized regression coefficients (β) and 95% CIs were reported in the results, while the bootstrap method was used for significance testing of mediating effects, and the effect values of the paths were reported. All statistical analyses for this study were conducted in SPSS 22.0 and its Process macro program.

3.2 Measures

3.2.1 Independent Variables

- **COVID-19-related knowledge**: Based on the references (Ahmed et al., 2020; Olaimat et al., 2020; Reuben et al., 2021), the participants’ COVID-19-related factual knowledge levels were measured by seven items in five dimensions, namely causes, treatment, incubation period, symptoms, and prevention and control methods. Each item was scored as 1 point for correct answers and 0 points for errors or uncertainty. The scores were summed (knowledge level scores, range 0-7), and a cutoff point of 70% was set to represent the knowledge level as a dichotomous variable: GKL (good knowledge level, scores from 5 to 7) and AKL (average knowledge level, scores from 0 to 4) (Mallhi et al., 2018; Habib et al., 2021; Naseef et al., 2021).
• **Information Sources:** The six sources of information communication were divided into three categories: government sources, media sources, and family and friend sources. Among them, government sources included government units such as the Health and Welfare Commission and relevant units such as street communities and village committees; media sources included television and radio broadcasts; social networking platforms such as WeChat and Weibo; and family and friend sources included family members, friends and acquaintances. Each selected item was counted as 1 point, with scores ranging from 0-2 points for each source type.

• **Socio-demographic characteristics:** Participants’ socio-demographic characteristics were collected in this study, including sex, age, education, occupation, location, marital status, fertility status and residence status, and participants’ self-perceived physical conditions during the pandemic (since July 2020) were investigated.

3.2.2 **Dependent Variable**

• **Coping behaviors:** According to the literature (Shi et al., 2002), in view of the rush to buy and hoard household goods and the indiscriminate use of antibiotics during the pandemic, we first examined participants’ three types of coping behaviors, namely, herding behaviors, avoidance behaviors, and prevention behaviors. Herding behaviors were measured by three items, avoidance behaviors by two items, superstitious behaviors by three items, and positive preventive behaviors by 14 items. Participants scored each question item on a scale of 0-6, ranging from “hardly ever” to “always”, and the scores of the corresponding question items under each behavior dimension were summed for the final score of the coping behavior.

3.2.3 **Mediators**

• **Risk perception:** Referring to the literature (Xie et al., 2005; Wen et al., 2020; Zhou et al., 2021), the perception of risk measured in this study contained four dimensions: (1) the likelihood of being infected: “I am at high risk of being infected”; (2) the severity of the pneumonia pandemic: “This pneumonia is likely to cause death”, “If infected, it will cause very serious health effects”, and “I think this pneumonia pandemic is very widespread”; (3) the uncertainty about the pandemic: “I think this pneumonia is more serious than the previous pneumonia” and “I think this pneumonia is a new disease”; and (4) the uncontrollability of the pandemic: “I think this pneumonia is very difficult to treat” and “I think the prevalence and spread of this pneumonia is very difficult to control”. Participants responded on a 5-point Likert scale about how well the above descriptions matched their feelings at the moment (1 = not at all, 2 = not very much, 3 = mostly, 4 = more or less, 5 = completely). The total score for all items was used as the score for variable risk perception. In addition, the sum of the subjects’ scores on all items within the same dimension was the final score for that dimension.

• **Negative emotions:** Negative emotions were measured in terms of both anxiety and depression. Anxiety levels were assessed by 8 items using the Self-Rating Anxiety Scale (SAS) (Zung, 1971). Depression levels were measured by 18 items using the Depression Status Inventory (DSI) (Zung, 1972). Participants rated the description of each item based on their feelings on a scale of 1-4, indicating how well the description matched their situation from “not at all” to “very significantly” or how often the scenario occurred in their actual situation from “none or occasionally” to “consistently”. After the questions involving positive descriptions were reversed, the scores for all questions were summed to obtain the final score for negative emotions.

• **Attitudes:** The participants’ attitudes were assessed by 8 items. Each item was scored as 1 point for “YES” and 0 points for “NO”. After the questions involving negative descriptions were reversed, the ‘Uncertain’ response was scored as 0 points as well. Finally, the scores for all questions were summed to obtain the final score for attitude, and higher scores represented a more positive attitude.
4. EMPIRICAL ANALYSIS

4.1 Descriptive Statistics

The mean age of the 498 participants was 57.99 years (SD=7.07); of these, more than half were female (260/498, 52.21%); 327 (65.66%) were urban residents; 252 (50.60%) were from the central region; more than three quarters were married (407/498, 81.37%) and had one or more children (442/498, 88.76%); 57 (11.45%) lived alone and 345 (69.28%) lived with their spouse, their children or their spouse and children; and 331 (66.98%) reported that they had been in good health since the start of the outbreak (July 2020). The participants’ demographics are summarized in Table 1.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Participants</th>
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<tbody>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>50-59</td>
<td>318 (63.86%)</td>
</tr>
<tr>
<td>60-69</td>
<td>145 (29.12%)</td>
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<tr>
<td>≥70</td>
<td>35 (7.03%)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>238 (47.79%)</td>
</tr>
<tr>
<td>Female</td>
<td>260 (52.21%)</td>
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<tr>
<td>Region</td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>327 (65.66%)</td>
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<tr>
<td>Rural</td>
<td>171 (34.34%)</td>
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<tr>
<td>Area</td>
<td></td>
</tr>
<tr>
<td>Eastern</td>
<td>201 (40.36%)</td>
</tr>
<tr>
<td>Central</td>
<td>252 (50.60%)</td>
</tr>
<tr>
<td>Western</td>
<td>45 (9.04%)</td>
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<tr>
<td>Marital status</td>
<td></td>
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<tr>
<td>Married</td>
<td>407 (81.73%)</td>
</tr>
<tr>
<td>Unmarried/divorce/widowed</td>
<td>91 (18.27%)</td>
</tr>
<tr>
<td>Fertility status</td>
<td></td>
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<tr>
<td>No kid</td>
<td>56 (11.24%)</td>
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<tr>
<td>≥One kid</td>
<td>442 (88.76%)</td>
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<tr>
<td>Residence status</td>
<td></td>
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<tr>
<td>Solitary</td>
<td>57 (11.45%)</td>
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<tr>
<td>Cohabitation</td>
<td>441 (88.55%)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>70 (14.06%)</td>
</tr>
<tr>
<td>Middle school</td>
<td>113 (22.69%)</td>
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<tr>
<td>High school or more</td>
<td>315 (63.25%)</td>
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<tr>
<td>Physical condition</td>
<td></td>
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<tr>
<td>Good</td>
<td>331 (66.47%)</td>
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<tr>
<td>Average</td>
<td>159 (31.93%)</td>
</tr>
<tr>
<td>Poor or not good</td>
<td>8 (1.61%)</td>
</tr>
</tbody>
</table>
4.1.1 COVID-19-Related Knowledge

The mean score of 3.68 (SD=0.06, score range 1-7) indicated that the overall correctness of the participants’ COVID-19-related factual knowledge tests was only 52.57% (3.68/7*100%), and by setting a cutoff point of 70%, 28.31% (n=141) of the participants had a GKL (good knowledge level), and 71.69% (n=357) of the participants had an AKL (average knowledge level).

Of these, participants had good knowledge in terms of causes and treatment, with 82.13% (n=409) of the 498 participants being able to identify the etiology of the current disease as a variant of COVID-19 and 75.50% (n=376) believing that the Delta strain had a longer duration of treatment and a higher rate of severe disease compared to the previous COVID-19 strains. However, in terms of the incubation period, only 57.63% (n=287) of the participants knew that the incubation period of the Delta strain was shorter. In terms of symptoms, prevention and control methods, participants’ overall knowledge was even worse: only 50.80% (n=253) of the participants believed that the COVID-19 vaccines were useful against the Delta strain, 10.64% (n=53) knew that the clinical symptoms of the Delta strain were atypical, and only 8.63% (n=43) knew that the definition of close contact with the Delta strain had expanded and was not the same as the concept of close contact in the past. However, 82.33% of the participants identified preventive measures such as wearing masks, frequent hand washing and no gatherings, which were measures that were typical of the initial response to COVID-19, as effective.

4.1.2 Information Sources

The mean scores of government sources, media sources and family and friend sources were 1.04 (SD=0.83), 1.45 (SD=0.64) and 0.98 (SD=0.89), respectively, which suggests that media sources were the most popular information communication channels for the 498 participants during the COVID-19 pandemic. Meanwhile, two sources’ mean scores exceeded 1 point, indicating that people usually depended on more than one way to participate in social communication about the pandemic.

4.1.3 Risk Perceptions

The overall assessment of risk was high among the 498 participants in this study, with a mean total risk perception score of 26.85 (SD=0.37, range 9-45). Overall, the participants perceived that the description “highly likely to be infected” did not fit their situation well, with a mean of 1.97 (SD=0.05). In terms of perceived severity, uncertainty, and uncontrollability, the participants assessed the Delta strain as having a high severity (mean=9.64, SD=0.15, range of scores 3-15), great uncertainty (mean=6.75, SD=0.11, score range 2-10), and great uncontrollability (mean=8.49, SD=0.14, score range 3-15) and considered the descriptions to be “generally” or “relatively” consistent with their perceptions.

4.1.4 Negative Emotions

The 498 participants in this study did not show serious negative emotional problems during the week closest to the time of the questionnaire, and the mean value of the total negative emotion score was 54.33 (SD=0.57, score range 16-104). Of these, the mean anxiety score was 16.09 (SD=0.22, score range 8-32) and the mean depression score was 38.23 (SD=0.40, score range 18-72), and the participants gave overall responses of “sometimes” or “often” for the descriptions of feeling nervous, scared, having trouble sitting still or sleeping.

4.1.5 Attitudes

Overall, the 498 participants in this study had a positive attitude toward the pandemic (mean=5.33, SD=1.84, score range 0-8). Regarding attitudes toward their family, 173 (34.74%) showed more confidence and did not worry about their family being infected; regarding attitudes toward being infected, although most participants did not consider it shameful to be infected (394/498, 79.12%),
only approximately 40% (n=194) were willing to interact with cured patients. Regarding attitudes toward prevention, more than three-quarters (380/498, 76.31%) of the participants would adhere to active prevention measures unremittingly in the new stage of pandemic prevention.

4.1.6 Coping Behaviors

The 498 participants in this study exhibited more adaptive herding behaviors (mean 9.69, SD=0.23, score range 0-18) and active preventive behaviors (mean 61.71, SD=0.90, score range 0-84) and less avoidance (mean 5.60, SD=0.13, score range 0-12) and superstitious behaviors (mean 5.46, SD=0.23, score range 0-18) since the Delta strain outbreak. Overall, the participants gave responses to the description of herding behaviors as “sometimes or often doing so”, to preventive behaviors as “often or almost always doing so”, to avoidance behaviors as “occasionally or sometimes doing so”, and to superstitious behaviors as “hardly or occasionally doing so”.

4.2 Correlation Analysis

The bivariate correlation coefficients of the relations between variables are summarized in Table 2. The results showed that participants’ knowledge levels about COVID-19 were positively related to their risk perceptions, attitudes and prevention behaviors and were significantly related to decreases in negative emotions, avoidance behaviors and superstitious behaviors. Government sources and media sources were significantly related to increases in positive attitudes and prevention behaviors and negatively related to negative emotions and superstitious behaviors. Family and friend sources were positively related to attitudes and herding behaviors. The participants’ risk perceptions were related to increases in prevention behaviors and herding behaviors, while the participants’ negative emotions were related to decreases in prevention behaviors, which were positively related to avoidance behaviors and superstitious behaviors. The participants’ attitudes were positively related to prevention behaviors and negatively related to avoidance behaviors and superstitious behaviors.

Table 2. Bivariate correlations of the variables

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<tbody>
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<td>1. COVID-19-related Knowledge</td>
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<td>2. Government-info</td>
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<td>.112*</td>
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<td>3. Media-info</td>
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<td>4. Family-info</td>
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<td>5. Risk perception</td>
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<td>.092*</td>
<td>.078</td>
<td>.068</td>
<td>.103*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Attitude</td>
<td></td>
<td>.223**</td>
<td>.095*</td>
<td>.125**</td>
<td>.149**</td>
<td>.122**</td>
<td>-.424**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Prevention behavior</td>
<td></td>
<td>.142**</td>
<td>.215**</td>
<td>.268**</td>
<td>.207**</td>
<td>.373**</td>
<td>-.386**</td>
<td>.213**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Avoidance behavior</td>
<td></td>
<td>-.119**</td>
<td>.057</td>
<td>.006</td>
<td>-.036</td>
<td>.111*</td>
<td>.140**</td>
<td>-.185**</td>
<td>.362**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10. Superstitious behavior</td>
<td></td>
<td>-.209**</td>
<td>-.137**</td>
<td>-.150**</td>
<td>-.061</td>
<td>.052</td>
<td>.387**</td>
<td>-.327**</td>
<td>.050</td>
<td>.626**</td>
<td>1</td>
</tr>
<tr>
<td>11. Herding behavior</td>
<td></td>
<td>.004</td>
<td>.043</td>
<td>.042</td>
<td>.127**</td>
<td>.267**</td>
<td>.001</td>
<td>-.021</td>
<td>.528**</td>
<td>.388**</td>
<td>.417**</td>
</tr>
</tbody>
</table>

*p<.05; **p<.01
4.3 ANOVA Analysis and Independent Sample T Tests

The test results showed that sex, location (urban/rural), marital status, and educational level were significantly associated with behavioral responses (P<0.05). Among the respondents, female participants showed more motivation for preventive behaviors than male participants (P=0.004), and male participants showed a greater tendency toward superstitious behaviors than female participants (P=0.016); divorced participants exhibited a greater tendency for herding behaviors compared to unmarried and widowed participants (P=0.04); however, they demonstrated more avoidance behaviors compared to unmarried, married, and widowed participants (P<0.001). Urban participants also showed more avoidance behaviors than rural participants (P=0.032). Participants with a high school education showed less of a tendency to be superstitious compared to those with an elementary school education, but participants with a graduate school education showed a greater tendency for superstitious behaviors than those with high school and undergraduate educations (P=0.021).

4.4 Regression Model

4.4.1 Regression Model of Information Sources and Behaviors


   Government sources were significantly related to prevention behaviors, with a total effect size of 0.064; the mediation effect was tested by the bootstrap method with a sample size of 5000 and a significant mediation effect of attitude at a 95% confidence interval, with an indirect effect value of 0.005, accounting for 7.81% of the total effect. Media sources were significantly related to prevention behaviors, with a total effect size of 0.096, and a significant mediation effect of attitude was shown on the test, with an indirect effect value of 0.007, accounting for 7.29% of the total effect. Family and friend sources were significantly related to prevention behaviors, with a total effect size of 0.050, and a significant mediation effect of attitude passed the test, with an indirect effect value of 0.006, accounting for 12.00% of the total effect (Table 3).


   Government sources were significantly related to superstitious behaviors, with a total effect size of -0.047; the mediation effect was tested by the bootstrap method with a sample size of 5000 and a significant mediation effect of attitude at a 95% confidence interval, with an indirect effect value of -0.010, accounting for 21.28% of the total effect. Media sources were significantly related to superstitious behaviors, with a total effect size of -0.064, and a significant mediation effect of attitude passed the test, with an indirect effect value of -0.016, accounting for 25.00% of the total effect. The relationship between family and friend sources and superstitious behaviors was not significant (Table 4).

Table 3. Mediating effect test of attitude on information sources-prevention behaviors (***p<.001)

<table>
<thead>
<tr>
<th>X</th>
<th>M</th>
<th>Y</th>
<th>Total effect value</th>
<th>Indirect effect value</th>
<th>BootSE</th>
<th>BootL.LCI</th>
<th>BootU.LCI</th>
<th>Percentage of relative effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government-info</td>
<td>Attitude</td>
<td>Prevention behavior</td>
<td>0.064***</td>
<td>0.005</td>
<td>0.003</td>
<td>0.0002</td>
<td>0.0109</td>
<td>7.81%</td>
</tr>
<tr>
<td>Media-info</td>
<td>Attitude</td>
<td>Prevention behavior</td>
<td>0.096***</td>
<td>0.007</td>
<td>0.004</td>
<td>0.0014</td>
<td>0.0160</td>
<td>7.29%</td>
</tr>
<tr>
<td>Family-info</td>
<td>Attitude</td>
<td>Prevention behavior</td>
<td>0.050***</td>
<td>0.006</td>
<td>0.003</td>
<td>0.0017</td>
<td>0.0129</td>
<td>12.00%</td>
</tr>
</tbody>
</table>
3. Mechanisms of information sources influence herding behaviors

Neither government sources nor media sources were significantly related to herding behaviors. Family information was significantly related to herding behaviors, with a total effect size of 0.044, but the mediation effect of attitude was not significant (Table 5).

4.4.2 Regression Model of Knowledge and Behaviors

As knowledge levels were not significantly related to herding behaviors, the regression analyses on the knowledge levels-herding behaviors pathway will not be given further discussion.

1. Mechanisms of knowledge influence on prevention behavior.

The COVID-19-related knowledge level was significantly related to prevention behaviors, with a total effect size of 0.07 (P=0.003); the mediation effect was tested by the bootstrap method with a sample size of 5000 and a significant mediation effect of risk perception and negative emotions at a 95% confidence interval. The path of COVID-19-related knowledge level-risk perception-prevention behaviors produced an indirect effect value of 0.016, accounting for 22.86% of the total effect, and the path of COVID-19-related knowledge level-negative emotions-prevention behaviors produced an indirect effect value of 0.041, accounting for 58.57% of the total effect (Table 6).


The level of COVID-19-related knowledge was significantly associated with avoidance behaviors, with a total effect size of -0.069 (P=0.004) and a significant direct effect size of -0.061 (P<0.001). The mediating effect was tested by the bootstrap method, with a sample size of 5000, and only the mediating effect of negative emotions passed the test at the 95% confidence interval (COVID-19-

### Table 4. Mediating effect test of attitude on information sources-superstitious behaviors

<table>
<thead>
<tr>
<th>X</th>
<th>M</th>
<th>Y</th>
<th>Total effect value</th>
<th>Indirect effect value</th>
<th>BootSE</th>
<th>BootLLCI</th>
<th>BootULCI</th>
<th>Percentage of relative effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government-info</td>
<td>Attitude</td>
<td>superstitious behavior</td>
<td>-0.047***</td>
<td>-0.010</td>
<td>0.005</td>
<td>-0.0205</td>
<td>-0.0001</td>
<td>21.28%</td>
</tr>
<tr>
<td>Media-info</td>
<td>Attitude</td>
<td>superstitious behavior</td>
<td>-0.064***</td>
<td>-0.016</td>
<td>0.007</td>
<td>-0.0304</td>
<td>-0.0029</td>
<td>25.00%</td>
</tr>
<tr>
<td>Family-info</td>
<td>Attitude</td>
<td>superstitious behavior</td>
<td>-0.016</td>
<td>-0.014</td>
<td>0.005</td>
<td>-0.0241</td>
<td>-0.0049</td>
<td>—</td>
</tr>
</tbody>
</table>

### Table 5. Mediating effect test of attitude on information sources-herding behaviors

<table>
<thead>
<tr>
<th>X</th>
<th>M</th>
<th>Y</th>
<th>Total effect value</th>
<th>Indirect effect value</th>
<th>BootSE</th>
<th>BootLLCI</th>
<th>BootULCI</th>
<th>Percentage of relative effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government-info</td>
<td>Attitude</td>
<td>herding behavior</td>
<td>0.015</td>
<td>-0.001</td>
<td>0.002</td>
<td>-0.0049</td>
<td>0.0029</td>
<td>—</td>
</tr>
<tr>
<td>Media-info</td>
<td>Attitude</td>
<td>herding behavior</td>
<td>0.022</td>
<td>-0.001</td>
<td>0.003</td>
<td>-0.0079</td>
<td>0.0047</td>
<td>—</td>
</tr>
<tr>
<td>Family-info</td>
<td>Attitude</td>
<td>herding behavior</td>
<td>-0.044***</td>
<td>-0.002</td>
<td>0.002</td>
<td>-0.0067</td>
<td>0.0033</td>
<td>—</td>
</tr>
</tbody>
</table>

12
related knowledge level-negative emotions-avoidance behaviors), producing an indirect effect value of -0.015, accounting for 21.74% of the total effect. The mediating effect of risk perception was not significant, with an indirect effect value of 0.007 (Table 7).


The level of COVID-19-related knowledge was significantly associated with superstitious behaviors, with a total effect size of -0.134 (P<0.001) and a significant direct effect of -0.088 (P=0.001). The mediating effect was tested by the bootstrap method, with a sample size of 5000, and only the mediating effect of negative emotions passed the test at the 95% confidence interval (COVID-19-related knowledge level-negative emotions-superstitious behaviors), producing an indirect effect value of -0.050, accounting for 37.31% of the total effect. The mediating effect of risk perception was not significant, with an indirect effect value of 0.005 (Table 8).

Table 6. Mediating effect test of risk perception and negative emotions on knowledge-prevention behaviors

<table>
<thead>
<tr>
<th></th>
<th>Indirect effect value</th>
<th>BootSE</th>
<th>BootLLCI</th>
<th>BootULCI</th>
<th>Percentage of relative effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total indirect effect</td>
<td>0.057</td>
<td>0.013</td>
<td>0.034</td>
<td>0.084</td>
<td>81.43%</td>
</tr>
<tr>
<td>Knowledge level- Risk perception - Prevention behavior</td>
<td>0.016</td>
<td>0.008</td>
<td>0.001</td>
<td>0.033</td>
<td>22.86%</td>
</tr>
<tr>
<td>Knowledge level- Negative emotion - Prevention behavior</td>
<td>0.041</td>
<td>0.009</td>
<td>0.024</td>
<td>0.061</td>
<td>58.57%</td>
</tr>
</tbody>
</table>

Table 7. Mediating effect test of risk perception and negative emotions on knowledge-avoidance behaviors

<table>
<thead>
<tr>
<th></th>
<th>Indirect effect value</th>
<th>BootSE</th>
<th>BootLLCI</th>
<th>BootULCI</th>
<th>Percentage of relative effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total indirect effect</td>
<td>-0.008</td>
<td>0.008</td>
<td>-0.024</td>
<td>0.007</td>
<td>11.59%</td>
</tr>
<tr>
<td>Knowledge level- Risk perception - Avoidance behavior</td>
<td>0.007</td>
<td>0.004</td>
<td>0</td>
<td>0.016</td>
<td>—</td>
</tr>
<tr>
<td>Knowledge level- Negative emotion - Avoidance behavior</td>
<td>-0.015</td>
<td>0.006</td>
<td>-0.029</td>
<td>-0.004</td>
<td>21.74%</td>
</tr>
</tbody>
</table>

Table 8. Mediating effects test of risk perception and negative emotions on knowledge-superstitious behaviors

<table>
<thead>
<tr>
<th></th>
<th>Indirect effect value</th>
<th>BootSE</th>
<th>BootLLCI</th>
<th>BootULCI</th>
<th>Percentage of relative effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total indirect effect</td>
<td>-0.046</td>
<td>0.012</td>
<td>-0.071</td>
<td>-0.024</td>
<td>34.33%</td>
</tr>
<tr>
<td>Knowledge level- risk perception - superstitious behavior</td>
<td>0.005</td>
<td>0.003</td>
<td>0</td>
<td>0.013</td>
<td>—</td>
</tr>
<tr>
<td>Knowledge level-negative emotion - superstitious behavior</td>
<td>-0.05</td>
<td>0.011</td>
<td>-0.075</td>
<td>-0.03</td>
<td>37.31%</td>
</tr>
</tbody>
</table>
5. DISCUSSION

First, based on the results of the descriptive statistics, we found that the COVID-19-related knowledge levels of the participants were not high, with a mean score of only 3.68 (score range 1-7) on the knowledge test and an overall correct rate of only 52.57%. This suggests that as the pandemic has changed, especially since the outbreak of the Delta strain, older adults have not supplemented and updated their knowledge regarding new pandemic features and new prevention and control approaches. In terms of risk perception, the participants had a strong risk assessment of the severity (mean=9.64, SD=0.15, score range 3-15), uncertainty (mean=6.75, SD=0.11, score range 2-10) and uncontrollability (mean=8.49, SD=0.14, score range 3-15) of the Delta strain but did not consider themselves to be at great risk of contracting the virus (mean=1.97, SD=0.05, score range 1-5). In terms of emotional feelings, the participants had not shown serious negative emotional problems since the Delta strain outbreak (mean=54.33, SD=0.57, score range 16-104), with a mean anxiety score of 16.09 (SD=0.22, score range 8-32) and had a mean depression score of 38.23 (SD=0.40, score range 18-72), which suggests that older adults continued to maintain a more positive and optimistic mental state during the pandemic overall. In terms of behavioral responses, older adults who participated in the survey exhibited more herding behaviors (mean 9.69, SD=0.23, score range 0-18) and active preventive behaviors (mean 61.71, SD=0.90, score range 0-84) and few avoidance behaviors (mean 5.60, SD=0.13, score range 0-12) and superstitious behaviors (mean 5.46, SD=0.23, score range 0-18).

Second, in the study of the social amplification mechanisms of risk by which information sources affect older adults’ behavioral responses, we found that social communication was an important factor influencing elderly individuals’ coping behaviors during the COVID-19 pandemic, and different social communication methods, including government, media and family and friend sources, had different effects.

Among them, media sources had the greatest facilitative effect on prevention behaviors and the strongest inhibitory effect on superstitious behaviors, and the mediating effect of attitude was greatest on the paths of media sources-prevention behaviors and media sources-superstitious behaviors. This suggests that, on the one hand, due to the improvement of the internet infrastructure and the rapid development of digital technology, traditional media sources such as television and radio broadcasts, as well as new media platforms such as WeChat, short videos and Today’s headlines, have the uniquely advantageous conditions of convenience, real-time updates and interactivity, which have become important factors influencing older people’s behavioral responses during the COVID-19 pandemic; However, on the other hand, with their short, intuitive, interesting, easy-to-understand and multisensory features, media sources have high inspiration and receptivity. Therefore, the positive messages conveyed by media sources can amplify and reinforce people’s positive and optimistic attitudes, resulting in more prevention behaviors and fewer superstitious behaviors.

In comparison, government sources have a stronger facilitative effect on prevention behaviors and an inhibitory effect on superstitious behaviors, while the mediating effect of attitude was the smallest. This indicates that official information from government-related units, by virtue of being the most credible and truthful, also plays a significant predictive role for the behavioral responses of the older population during the COVID-19 pandemic. However, both because it is not as interesting and interactive as media sources and because it lacks the trust that comes from the closeness of family and friends, government sources have the least effect on people’s subjective attitudes.

In addition, family and friend sources had the least facilitative effect on prevention behaviors and a nonsignificant inhibitory effect on superstitious behaviors but significantly increased the occurrence of herding behaviors. This may be because in the process of an emergency response, communication between individuals such as family and friends are often the least reliable and authentic source of information, yet the added value of close relationships makes people tend to have a stronger sense of trust in the information they receive and have a higher degree of acceptance and willingness to follow the advice of family and friends, which ultimately induces more blind herding behaviors.
Third, in the study of the mechanisms by which older adults’ knowledge affects their behavioral responses, we find that factual knowledge related to COVID-19 had a significant effect on older adults’ behavioral responses and that the mechanisms of effect on different behavioral responses were different.

For preventive behaviors, both risk perception and negative emotions are significantly important mediating variables that serve as complete mediators. That is, different levels of acquisition of objective knowledge do not directly affect older adults’ prevention behavior practices but indirectly influence them by creating differences in subjective risk perceptions and emotional reactions. On the one hand, by having a higher knowledge level about the pandemic, older adults can enhance their perception of risk regarding the pandemic, and this high-risk perception will promote more prevention behaviors; However, on the other hand, increased knowledge can effectively mitigate the impact of the pandemic on mental health, thereby resulting in less anxiety and depression among older adults, these negative emotions would otherwise inhibit their motivation to adopt preventive behaviors. Thus, better knowledge indirectly increases the propensity of older people to engage in positive preventive behaviors by reducing negative emotions.

For the avoidance and superstitious behaviors of older people, both the direct effect of knowledge and the mediating effect of negative emotions are significant, i.e., negative emotions play a partial mediating role and the results of combinations of objective and subjective effects. At the objective level, knowledge about COVID-19 provides a basis for action and scientific guidance for elderly people dealing with the pandemic. Armed with scientific knowledge, elderly individuals know how to deal with the pandemic in a more reasonable and effective way; therefore, they will choose avoidance less and rely less on the power of ghosts and gods to solve the problem, thus directly reducing the tendency of avoidance and superstitious behaviors. At the subjective level, anxiety and depression both aggravate people’s tendencies toward negative avoidance, while the excessive psychological pressure they bring causes people to desperately seek comfort, such as choosing to believe in fate or heaven. This choice, in turn, triggers serious avoidance and superstitious behaviors. A higher level of pandemic-related knowledge can significantly alleviate the negative emotions of the elderly population, thus indirectly contributing to a decrease in avoidance and superstitious behaviors.

6. CONCLUSION

Based on the personal cognition aspect, we assessed the influence of COVID-19-related knowledge levels on different coping behaviors in a Chinese elderly population and explored the mediating effects of risk perception and negative emotions in the knowledge-behavior pathway. Based on SARF, this study also investigated whether the different information access sources by which the Chinese elderly population participated in social communication during the COVID-19 pandemic impacted their coping behaviors.

It was found that (1) with the development of the pandemic, older adults’ factual knowledge levels about the pandemic, especially about new situations such as variant strains, were not high. (2) Factual knowledge related to the pandemic had a significant effect on older people’s pandemic coping behaviors, but the mechanisms of influence on various coping behaviors were different. For prevention behaviors, risk perception and negative emotions were both complete mediators, while for avoidance behaviors and superstitious behaviors, both the direct effect of knowledge and the mediating effect of negative emotions were significant, in which negative emotions served as a partial mediator. (3) Anxiety and depression exacerbated the tendency of older people to practice avoidance, causing excessive psychological stress and easily triggering superstitious behaviors. (4) Information sources had a vital influence on elderly individuals’ coping behaviors, both directly and indirectly. Media sources had the greatest facilitative effect on prevention behaviors and the strongest inhibitory effect on superstitious behaviors, in which the mediating effect of attitude was the greatest; the effect of
government sources was slightly weaker than that of media sources; family and friend sources had the least effect but significantly increased herding behaviors.

These empirical results provide a basis for an in-depth investigation of the relationship among pandemic knowledge, health communication, risk perceptions, emotions, attitudes and coping behaviors. Through the combination of personal cognition and social communication, this study has theoretical implications for improving and optimizing the basic behavior prediction framework of “risk information-risk perception-coping behaviors” for public health emergencies. The findings of this study also have important implications in facilitating the government in designing and delivering intervention programs aimed at the elderly population to improve their knowledge, relieve their negative emotions and enable them to develop optimistic attitudes through more effective and evocative channels, thereby leading to more positive behavioral responses. It also suggests that barriers to technology use should be further eliminated since media sources are pivotal information communication channels during pandemics.

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CONFLICT OF INTEREST

The authors of this publication declare there is no conflict of interest.
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Luyao Li got the B.A. in information management and information system from Southwestern University of Finance and Economics in 2021. As a MIS graduate student of Central University of Finance and Economics, she took part in the COVID-19 questionnaire survey project of older Chinese adults, in which she was responsible for the empirical part of the pathway analyses. Her research areas are emotion analysis and management information system.

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Hongwei Xia is the Deputy Chief Physician of CDC. She received her Bachelor’s degree in preventive medicine from Harbin Medical University in 2002 and her Master’s degree from Dalian Medical University in 2005, specializing in epidemiology and health statistics (mental health direction). She is mainly involved in the selection and determination of research directions and research content, providing analysis of public opinion, communication, policy, and psychology in the light of the progress of the epidemic.