



# Informational support, risk perception, anti-pandemic motivation and behavior: a longitudinal study in China

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## Abstract

Mobilizing the public to take anti-pandemic behavior (APB) by strengthening informational support has been recognized as an effective strategy to combat the COVID-19 pandemic. However, it remains unclear how health-related informational support from different channels affects individual factors and, thus, the adoption of different types of APB as the pandemic situation changes. To resolve this issue, we build a multiple mediation model to investigate the associations among informational support from three different channels, two individual internal factors, and two kinds of APB. A three-stage longitudinal study administered to Chinese citizens from February to October 2020 revealed that informational support from media played the most critical role in facilitating individuals' adoption of compliance APB, while informational support from family was the most significant predictor of the adoption of participation APB. Meanwhile, these effects were mediated by risk perception and anti-pandemic motivation, and weakened to varying degrees as the pandemic situation eased. It is recommended that authorities adjust the focus of publicity strategies in light of the changing situation, and make efforts to heighten the public's risk perception and anti-pandemic motivation. This study contributes to deepening the understanding of the dynamic efficacy of informational support from different channels on individuals' adoption of two heterogeneous APBs, and thus to the formulation of more scientific, and situation-based publicity strategies during a public health crisis.

**Keywords** COVID-19 · Informational support · Risk perception · Safety motivation · Protective behavior

## Introduction

Most countries and regions are still trapped in the COVID-19 pandemic, though it has been more than one year since its outbreak. To control the pandemic, government authorities worldwide have adopted a series of countermeasures. Among them, mobilizing the public to adopt anti-pandemic behavior (APB) has been recognized as an effective strategy to reduce virus transmission by strengthening pandemic-related information dissemination and support to arouse their attention and risk awareness (Chen, Min, Zhang, Wang, Ma, & Evans, 2020; Lee & Ong, 2020).

Essentially, individual APB contains two subdimensions: compliance APB and participation APB. The former refers to “individuals' self-protective behaviors required by governments to maintain public health” (Clark, Davila, Regis, & Kraus, 2020; Griffin & Neal, 2000), such as social distancing and wearing a face mask in public. The latter refers to “individuals' voluntary behaviors that do not directly contribute to their own health, but that do help to develop an environment that supports pandemic prevention and control” (Griffin & Neal, 2000), for example, introducing prevention knowledge to others and encouraging them to take self-protective behavior.

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Previous studies mainly focused on compliance APB, with few discussions on participation APB. As these two kinds of APB might be strengthened by different forms of individual internal factors and external incentives, it is essential to clarify their motivational bases, which helps promote public mobilization practices. Meanwhile, it is also significant to understand the dynamic properties of the associations because they act as important prerequisites for government authorities to proactively adjust publicity strategies in response to the changing pandemic situation (Habersaat et al., 2020). However, there are few clues to these issues currently.

To fill the research gap, this study applies the protective action decision model (PADM) to investigate the dynamic associations among informational support from different channels, individual internal factors, and the adoption of these two heterogeneous APB types in the context of the COVID-19 pandemic. The PADM proposes that when people face a disaster, information from different channels will arouse their concern to generate risk perceptions, protective action perceptions, and stakeholder perceptions, thus facilitating their adoption of protective behavior (Lindell & Perry, 2012). Indeed, the easy access to pandemic-related information through different channels has empowered the public to be more active in evaluating health risks and adopting precautionary measures (Zhong, Huang, & Liu, 2020). In the current study, drawing on China's experience, we set informational support from media, community, and family as the sources of pandemic information, risk perception, and anti-pandemic motivation as extensions of individual perceptions, and compliance APB and participation APB as extensions of individual protective behavior. Based on these postulations, one meaningful issue that needs to be explored is how the effects of informational support from media, community, and family on individual risk perception and anti-pandemic motivation—and thus on the adoption of compliance APB and participation APB—change with the pandemic situation.

## Literature Review and Conceptual Model

To mobilize the public more effectively, a number of studies have focused on the predictors of the adoption of APB, which fall into two main categories: individual factors and government interventions (Duan, Jiang, Deng, Zhang, & Wang, 2020).

### Individual Factors and APB

With regard to individual factors, as early as the 2003 SARS epidemic and 2009 H1N1 flu pandemic, Lau, Yang, Tsui, and Pang (2004), and Rubin, Amlôt, Page, and Wessely (2009) highlighted the vital role of risk perception in promoting individuals' adoption of compliance APB. During the COVID-19

pandemic, this argument was supported again by Dai, Fu, Meng, Liu, Li, and Liu (2020) when they investigated individual factors predicting self-protective behavior. Meanwhile, mastery of epidemic knowledge was regarded as an important individual predictor of compliance APB. Ahmad, Iram, and Jabeen (2020) uncovered that individuals' perceived knowledge quantity regarding epidemic prevention significantly enhanced personal intention to take precautionary measures. Moreover, the significant association between emotional response and individual compliance APB has been supported by several previous studies. For example, anxiety, fear, and depression were found to be inextricably linked with individual self-protective behavior (Akdeniz, Kavakci, Gozugok, Yalcinkaya, Kucukay, & Sahutogullari, 2020). Other important individual predictors of compliance APB include anti-epidemic attitude (Bae & Chang, 2020), perceived efficacy (Jose, Narendran, Bindu, Beevi, Manju, & Benny, 2020), perceived feasibility to take protections (Ahmad et al., 2020), perceived information credibility (Lep, Babnik, & Hacin Beyazoglu, 2020), trust in government (Clark et al., 2020), need for cognition and self-control (Xu & Cheng, 2021). In addition, individual compliance APB is also affected by demographic characteristics, such as age, gender, and education level (Moon, 2020).

It is notable that this study introduced a new individual internal factor, namely, anti-pandemic motivation, which was modified from safety motivation in the field of safety management. Little literature has examined individuals' health-related psychological factors and behaviors in a health crisis from a safety management perspective. Safety motivation, as a kind of safety attitude, is regarded as a pivotal mediator in the associations between safety education and safety behavior (Lim, Li, Fang, & Wu, 2018), and risk perception and safety compliance/participation behavior (Xia, Xie, Hu, Wang, & Meng, 2020). Individuals' anti-pandemic motivation has rarely been mentioned in the existing literature regarding pandemic prevention and control. Mimicking the definition of safety motivation, we define anti-pandemic motivation as "individuals' willingness to exert effort to enact APB and the valence associated with this behavior" (Vinodkumar & Bhasi, 2010). Based on the Theory of Planned Behavior (TPB) (Ajzen, 1985), we argue that anti-pandemic motivation mediates the relationships between informational support/risk perception and individuals' adoption of compliance/participation APB.

### Government Interventions and APB

As for government interventions, one of the most discussed predictors is pandemic-related information dissemination and support. For instance, French (2011), and Zhong et al. (2020) highlighted the significant impact of pandemic information on individual risk awareness, mental resilience, and attitudes

toward the adoption of protections. Dai et al. (2020) explored the role of emergency public information in public mobilization during the COVID-19 pandemic. They revealed that open and transparent official information significantly promoted individuals' self-protective behavior. Similarly, Ahmad et al. (2020) argued that official guidelines were significantly associated with individual anti-epidemic intention with risk perception as a mediator. Another oft-discussed governmental predictor is government prevention and control, such as closing crowded public places and designating hospitals for patients' treatment (Duan et al., 2020). Moreover, active risk communication, swift rumor refutation, and efforts to ensure the provision of supplies are also believed to inspire the public to take precautionary measures by enhancing their trust in government (Chen et al., 2020; Greenhill & Oppenheim, 2017).

### Conceptual Model

A variety of predictors of individuals' adoption of APB have been explored, which contributes greatly to public mobilization. Nevertheless, there are three meaningful issues that remain unclear and need to be discussed. The first is whether health-related informational support from different channels produces different effects. As social support in the form of information, informational support refers to "information provided via different channels in which people can ask about health problems and receive relevant information and advice" (Uchino, Bowen, de Grey, Mikel, & Fisher, 2018; Xing, Goggins, & Introne, 2018). In the face of a health crisis, informational support could help decrease perceived uncertainty and improve coping methods (McConnell, Birkett, & Mustanski, 2015). It is well known that governments simultaneously provide health-related informational support for the public through different channels. For example, from January to April 2020, when the COVID-19 pandemic was at its worst in China, the Chinese government made huge efforts to disseminate pandemic-related information and prevention knowledge through the media and communities. It not only alleviated the public's anxiety, but effectively raised their risk perception, thus encouraging them to participate in the battle against the pandemic (Dai et al., 2020). Furthermore, informational support from family and friends has also been credited with tellingly promoting individual risk awareness, anti-pandemic attitude, and the adoption of APB (Qazi et al., 2020). However, the influence of informational support from these channels on individual internal factors, and thus on the adoption of APB, might be different. Media has the advantage of efficiently providing massive pandemic information (Habersaat et al., 2020), while community and family can offer individuals more direct and trusted information, suggestions, and encouragement (Williams, Valero, & Kim, 2018). Each has its advantages, but it remains unclear how they make

an impact, and which has the greater impact. It is necessary to understand the different efficacy of informational support from these three channels, which is conducive to the rational allocation of limited resources for publicity. However, this issue has not been sufficiently discussed in terms of the available evidence.

The second is whether these two kinds of APB are affected by different predictors. In previous studies, APB mainly refers to compliance APB (i.e., self-protective behavior), and discussions of participation APB are lacking. In fact, individual participation APB is also critical contributor to pandemic mitigation because it benefits the development of a social environment supporting pandemic governance (Clark et al., 2020). Since major predictors of compliance APB and participation APB could be different, it is essential to clarify their incentive bases, which is a prerequisite for the effective promotion of these two types of APB. However, extant research has provided little guidance on this issue.

Third, we must examine how the effects of informational support from different channels change with the pandemic situation, which is a derivative of issues 1 and 2. Previous studies have revealed that the implementation of individual protective behavior changes with the epidemic situation. For example, Machida et al. (2020) argued that Japanese citizens' self-protective measures, such as social distancing and self-isolation, improved significantly with the community spread of the COVID-19. However, it remains unclear how the effects of different forms of informational support on individual internal factors, and thus on the adoption of compliance APB and participation APB, change with the pandemic situation. It is meaningful to understand the dynamic properties of these three channels' effects, which enables government authorities to adjust publicity strategies according to the changing situation. Currently, this issue still lacks sufficient longitudinal empirical research.

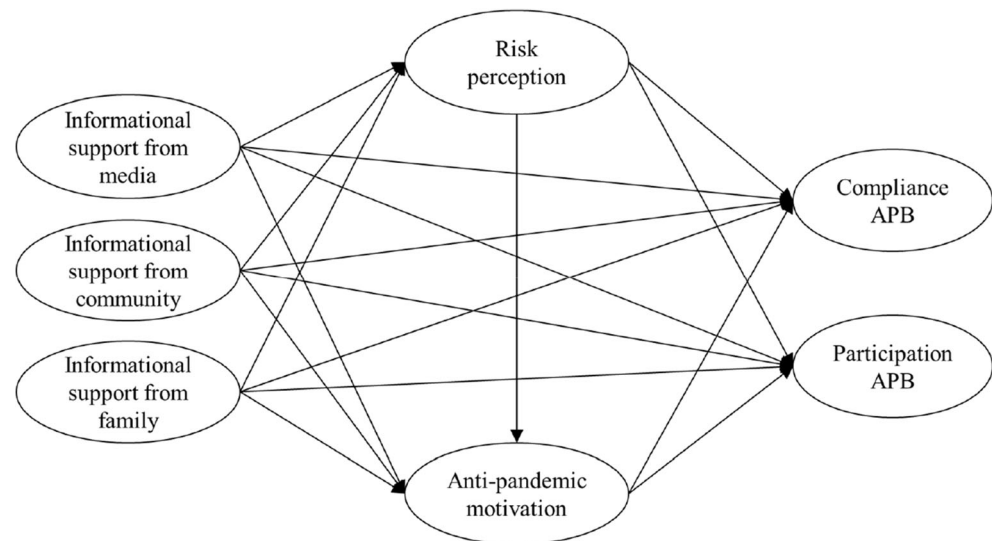
According to the PADM, TPB, and the above discussions and postulations, we further test the following three main hypotheses: informational support from media, community, and family will directly encourage people to engage in compliance and participation APB to varying degrees; informational support from the three channels will push people to practice these two kinds of APB by enhancing their risk perception and anti-pandemic motivation; and these effects will change with the pandemic situation. Figure 1 presents the conceptual model.

## Materials and Methods

### Participants

This study was approved by the Ethical Committee of Tianjin University. On February 19, 2020, we invited 25 graduate students from three universities in China to participate in a

Fig. 1 Conceptual model



pilot test. Among them, seven were from Tianjin University of Traditional Chinese Medicine, nine were from Tianjin Medical University, and nine were from Tianjin University. Based on their feedback, we modified some items' statements to ensure their clarity.

The formal data collection was carried out in China in three representative stages through an online survey application called Wenjuanxing on the platform of WeChat, the most widely and frequently used social media software in China. The first stage was conducted from February 23 to March 5, 2020. At this stage, the first wave of the COVID-19 epidemic in China was not over and the situation remained severe, with hundreds of new local cases appearing every day. The second stage was held from June 24 to July 6, 2020, nearly two months after China had contained the pandemic at the end of April (WHO declared the COVID-19 a pandemic on March 11). At this stage, large-scale work had resumed across China, but a new small wave of the COVID-19 pandemic was hitting the Chinese capital, Beijing, with dozens of new local cases arising daily. This made people deeply aware that pandemic prevention and control would become a regular theme. The third stage was conducted from September 22 to October 2, 2020. Prior to this, there had been no new local cases for 37 consecutive days (National Health Commission of the PRC, 2020).

In Stage 1, we asked our colleagues to send the questionnaire designed on Wenjuanxing to as many of their friends, classmates, and relatives as possible via WeChat. In addition to completing relevant scales, participants were asked to report their demographic information and WeChat ID, which enabled us to contact them in the latter two stages for follow-up survey. In Stages 2 and 3, we only sent the questionnaire to participants who provided a valid questionnaire in the former stage. Informed consent was obtained from all the

participants. The number of participants for each stage is 2416, 1837, and 1352, respectively. After examination, the corresponding number of valid questionnaires is 1891 (78.3%), 1605 (87.4%), and 1233 (91.2%). To ensure the homogeneity of the three groups, we only employed data from the 1233 participants who provided a valid questionnaire across all three stages for further statistical analysis.

Table 1 presents the 1233 participants' demographics. Regarding the participants' gender, males accounted for a larger proportion than females (51.6% vs. 48.4%). Concerning the participants' age, the proportion of participants aged 16–30 years was the highest (43.4%), and the proportion of the three older age groups decreases

**Table 1** Participants' demographics ( $N = 1233$ )

Demographic feature	Frequency (percentage)
<i>Gender</i>	
Male	636 (51.6)
Female	597 (48.4)
<i>Age (years)</i>	
16–30	535 (43.4)
31–45	318 (25.8)
46–60	233 (18.9)
61–74	147 (11.9)
<i>Highest level of education</i>	
High school or below (Level 1)	297 (24.1)
Junior college (Level 2)	67 (5.40)
Bachelor's degree (Level 3)	456 (37.0)
Master's degree or doctorate (Level 4)	413 (33.5)
<i>Area of residence</i>	
Urban area	810 (65.7)
Rural area	423 (34.3)

successively. Participants over 61 years old were the least represented, making up only 11.9% of the sample. As for the participants' education levels, those with a bachelor's, master's, or doctoral degree accounted for a large proportion (70.5%). Furthermore, 65.7% of the participants lived in urban areas. In addition to covering different genders, ages, education levels, and residential areas, the participants also covered 23 of 34 provincial regions in China, including all the developed eastern regions and several less-developed central and western regions. In view of this, the sample was considered to be representative.

## Measures

The scales of informational support from media (ISM), informational support from community (ISC), and informational support from family (ISF) were modified from the informational support scale developed by Zhong et al. (2020). After discussions with professionals from public health authorities and professors in management studies, ISM includes five items: "COVID-19-related information or prevention knowledge is disseminated every day through the media (including but not limited to radio, television, newspaper, official websites, and social media) (ISM1)," "You use the media to obtain the COVID-19-related information or prevention knowledge (ISM2)," "You can usually find the answers from the media if you have a COVID-19-related question (ISM3)," "You spend time following and thinking about the COVID-19-related information or prevention knowledge from the media (ISM4)," and "You have learned about COVID-19-related information or prevention knowledge from the media (ISM5)." The items for ISC contain "COVID-19-related information or prevention knowledge is often disseminated through community advocacy (including but not limited to posters, banners, flyers, broadcasts, WeChat groups, and health workers within your community) (ISC1)," "You obtain the COVID-19-related information or prevention knowledge through community advocacy (ISC2)," "You can usually find the answers from the community advocacy if you have a COVID-19-related question (ISC3)," "You spend time following and thinking about the COVID-19-related information or prevention knowledge from community advocacy (ISC4)," and "You have learned about COVID-19-related information or prevention knowledge from community advocacy (ISC5)." ISF also contains five items: "COVID-19-related information or prevention knowledge is often introduced by your family members or friends (ISF1)," "You obtain the COVID-19-related information or prevention knowledge from your family members or friends (ISF2)," "You can usually find the answers from your family members or friends if you have a COVID-19-related question (ISF3)," "You spend time following and thinking about the COVID-19-related information or prevention knowledge from your family members or friends

(ISF4)," and "You have learned about COVID-19-related information or prevention knowledge from your family members or friends (ISF5)." Among them, Items 2, 3, and 5 of ISM, ISC, and ISF were adopted from Zhong et al.'s (2020) scale with some modifications to their wording to meet the purpose of this study. Moreover, to better measure the informational support individuals obtain from different perspectives, two supplementary items (i.e., Items 1 and 4 of each scale) were added to assess the frequency of pandemic-related information dissemination through different channels and the degree of individuals' attention to such information. Participants were asked to rate the 15 items on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Risk perception (RP) refers to "individuals' subjective judgment of the risk" (Aven & Renn, 2009). The scale of risk perception in this study was modified from the measurement method for the SARS risk developed by de Zwart et al. (2009), which consists of vulnerability and severity. After discussions, RP includes three items: "How serious do you think the coronavirus disease is in the area where you live? 1 (not serious at all) to 5 (very serious) (RP1)," "How likely do you think you will be infected with the new coronavirus? 1 (very low) to 5 (very high) (RP2)," and "How dangerous do you think the new coronavirus is? 1 (not dangerous at all) to 5 (very dangerous) (RP3)." Among them, RP2 and RP3 were adopted from de Zwart et al.'s (2009) scale with some modifications to their wording to meet current research context. Moreover, to better measure individuals' risk perception, RP1 was added to the scale considering that individuals' assessment of the likelihood of their contracting new coronavirus is heavily influenced by their perceived severity of the coronavirus disease in the area where they live.

The scale of anti-pandemic motivation (APM) was revised from Vinodkumar and Bhasi's (2010) safety motivation scale by modifying the wording of four reserved items and removing one item unsuitable for the current research context. The variable contains four items: "You think it is important to protect your health (APM1)," "You think pandemic prevention and control is a very important issue (APM2)," "You think it is necessary to adopt anti-pandemic behavior to mitigate the pandemic (APM3)," and "You think it is important to encourage others to adopt anti-pandemic behavior (APM4)." The scale of compliance APB (CAPB) was self-created based on the coronavirus disease advice for the public published by WHO (2020). The contents of this scale were discussed with professionals from public health authorities and professors in management studies to ensure face validity. The variable contains four items: "You always wear a face mask in public (CAPB1)," "You wash your hands in time when you get home (CAPB2)," "You often ventilate and disinfect the room (CAPB3)," and "You always maintain a social distance from others (CAPB4)." Moreover, the scale of participation APB

(PAPB) was revised from Vinodkumar and Bhasi's (2010) safety participation scale by modifying four items' wording. These items contain "You introduce pandemic-related information or prevention knowledge to others (PAPB1)," "You encourage others to adopt anti-pandemic behavior (PAPB2)," "You always report to the management if you notice any issues related to pandemic prevention in your community or company (PAPB3)," and "You voluntarily participate in tasks or activities that are conducive to pandemic prevention and control (PAPB4)." Participants were asked to rate these 12 items on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

## Methods

In the data analysis process, confirmatory factor analysis was performed to test the reliability and validity of the scale. Pearson correlation analysis was conducted to determine whether or not the associations between the seven variables were significant. *T*-tests were carried out to examine the differences between the mean values of these seven variables in different stages, and to compare the effects of demographic characteristics on such variables. Structural equation modeling (SEM) was used to test the fitting degree of the mediational model and the proposed causalities. Finally, the bootstrapping method was adopted to examine the significance of the direct and indirect effects of informational support from media, community, and family on the two kinds of APB, as well as the mediating roles of risk perception and anti-pandemic motivation.

## Results

### Measurement Model

Confirmatory factor analysis indicates that these seven scales have high validity and reliability. In the three stages, item loading of the seven variables ranges from .654 to .913, higher than the minimum acceptable value of .6; the composite reliability (CR) of the variables ranges from .727 to .887, greater than the threshold value of .7, indicating the internal consistency of their items; the average variance extraction (AVE) of the variables ranges from .597 to .798, above the threshold value of .5, reflecting the items' good explanatory power for the latent variable to which they belong; and the Cronbach's  $\alpha$  of the variables ranges from .709 to .872, over the criterion of .7, which means they have adequate reliability (Hair, 2009). Meanwhile, the results in Table 2 confirm the existence of discriminant validity between variables. Moreover, the associations between the seven explanatory variables are significant

( $p < .05$ ). According to these evaluation results, the constructed conceptual model can be further employed for the in-depth analysis of the data.

*T*-tests were used to examine the differences between the mean values of these seven variables in Stages 1 and 3. Figure 2 illustrates that, except for informational support from media (ISM) and anti-pandemic motivation (APM), the mean values of informational support from community (ISC), informational support from family (ISF), risk perception (RP), compliance APB (CAPB), and participation APB (PAPB) significantly declined to varying degrees from Stage 1 to Stage 3. This indicates that informational support people obtain from community and family, RP, and two kinds of APB decrease as the pandemic situation eases.

### Multi-Group Comparison

We performed a multi-group comparison to explore the impact of demographic features on the seven explanatory variables, and *T*-tests were used to examine the differences between the mean values of subclasses within a group. The results reveal that gender had a significant impact on RP, APM, and CAPB. In Stage 1, when the epidemic was still severe, females showed higher RP, APM, and more CAPB than males ( $p < .05$ ). In contrast, as the situation eased, females showed significantly lower RP, APM, and less CAPB in Stage 2, as well as lower APM and less CAPB in Stage 3 ( $p < .05$ ). Meanwhile, age significantly affected most of the seven explanatory variables. For instance, in Stage 1, participants aged 61–74 years showed more ISF, less ISM, lower RP, APM, and less CAPB and PABP than those aged 16–30 years ( $p < .05$ ). This is also the case in Stages 2 and 3.

Moreover, education level had a significant influence on all seven explanatory variables. In Stages 1 and 2, participants with a bachelor's, master's, or doctoral degree exhibited significantly less ISF, higher RP, APM, and more CAPB and PABP than participants with only a high school education or less ( $p < .01$ ). In addition, area of residence also significantly affected most explanatory variables. Particularly, rural participants showed lower RP, APM, and less ISF, CAPB and PABP than urban participants in Stage 1 ( $p < .05$ ). Similarly, in Stages 2 and 3, rural participants showed lower APM, and less ISC, CAPB and PABP than urban participants ( $p < .05$ ).

It is worth noting that, with the easing of the pandemic situation and the continuous dissemination of relevant information, people's RP gradually converged, and there were basically no significant differences between subclasses within each group ( $p > .05$ ). However, regarding APM, CAPB, and PABP, definite differences between subgroups remained ( $p < .05$ ).

**Table 2** Descriptive statistics and correlation matrix

Variable	Mean (SD)	ISM	ISC	ISF	RP	APM	CAPB	PAPB
Stage 1								
ISM	4.617 (.503)	(.870)						
ISC	4.133 (.691)	.383**	(.860)					
ISF	4.021 (.634)	.209**	.394**	(.872)				
RP	3.902 (.986)	.411**	.301**	.324**	(.859)			
APM	4.083 (.940)	.370**	.260**	.277**	.314**	(.801)		
CAPB	4.072 (.932)	.323**	.283**	.335**	.380**	.321**	(.819)	
PAPB	3.008 (1.143)	.159*	.156*	.295**	.312**	.360**	.372**	(.773)
Stage 2								
ISM	4.502 (.529)	(.871)						
ISC	3.604 (.822)	.327**	(.868)					
ISF	2.710 (.906)	.213**	.363**	(.870)				
RP	3.443 (.963)	.389**	.264**	.207**	(.852)			
APM	4.017 (.702)	.344**	.167*	.115*	.243**	(.798)		
CAPB	3.571 (.894)	.277**	.281**	.207**	.362**	.331**	(.812)	
PAPB	2.863 (.852)	.152*	.140*	.188*	.266**	.373**	.325**	(.775)
Stage 3								
ISM	4.614 (.527)	(.886)						
ISC	3.016 (.725)	.327**	(.883)					
ISF	2.580 (.801)	.242**	.346**	(.893)				
RP	2.763 (.870)	.351**	.270**	.266**	(.852)			
APM	4.005 (.831)	.283**	.152*	.174*	.281**	(.814)		
CAPB	3.227 (.695)	.287**	.293**	.282**	.342**	.306**	(.801)	
PAPB	2.667 (.772)	.146*	.147*	.195*	.289**	.290**	.316**	(.772)

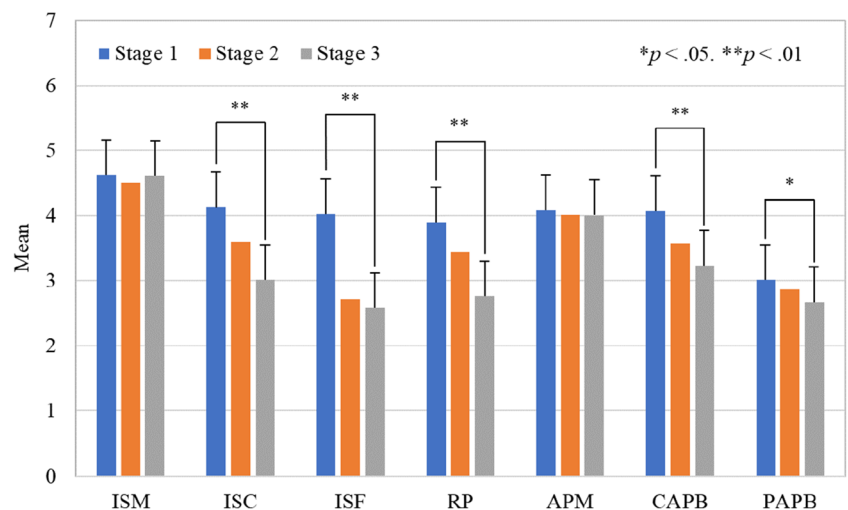
Note: the values on the diagonal refer to the square root of AVE of each variable. \* $p < .05$ . \*\* $p < .01$

**Structural Model**

The SEM was employed to evaluate the fitting degree of the mediational model. Given the potential impact of demographic features on these seven explanatory variables, the hypothesized model was tested adding gender, age, education level, and area of residence as control variables. The evaluation results indicated that the goodness-of-fit indices of the initial hypothesized models in Stage 1 (root mean square error of approximation [RMSEA]=.073, standardized root mean square residual [SRMR]=.067, normed fit index

[NFI]=.866, comparative fit index [CFI]=.892, goodness of fit index [GFI]=.928), Stage 2 (RMSEA=.075, SRMR=.070, NFI=.844, CFI=.874, GFI=.899), and Stage 3 (RMSEA=.078, SRMR=.073, NFI=.840, CFI=.865, GFI=.901) did not meet the requirements (RMSEA < .080, SRMR < .080, NFI ≥ .900, CFI ≥ .900, GFI ≥ .900) stated by Cohen, Cohen, West, and Aiken (2013). In Stage 1, there were two insignificant influence paths, including the relationships between ISM and PAPB ( $\beta_1 = .149, p_1 = .068$ ), and ISC and PAPB ( $\beta_1 = .139, p_1 = .082$ ). The insignificant paths in Stages 2 and 3 were the

**Fig. 2** Change in the mean values of seven variables



same, including the relationships between ISM and PAPB ( $\beta_2 = .133$ ,  $p_2 = .101$ ;  $\beta_3 = .114$ ,  $p_3 = .127$ ), ISC and PAPB ( $\beta_2 = .117$ ,  $p_2 = .126$ ;  $\beta_3 = .139$ ,  $p_3 = .083$ ), ISC and APM ( $\beta_2 = .136$ ,  $p_2 = .090$ ;  $\beta_3 = .124$ ,  $p_3 = .115$ ), and ISF and APM ( $\beta_2 = .106$ ,  $p_2 = .130$ ;  $\beta_3 = .141$ ,  $p_3 = .079$ ). After removing these paths, the modified models in Stage 1 (RMSEA = .060, SRMR = .042, NFI = .947, CFI = .956, GFI = .963), Stage 2 (RMSEA = .057, SRMR = .038, NFI = .961, CFI = .968, GFI = .973), and Stage 3 (RMSEA = .054, SRMR = .036, NFI = .966, CFI = .972, GFI = .978) fit the data well. The final established structural models with pathway coefficients are presented in Fig. 3.

In addition, we combined all data from the three stages and then re-evaluated the fitting degree of the mediational model. The results showed that the goodness-of-fit indices of such an integrated model (RMSEA = .078, SRMR = .075, NFI = .842, CFI = .861, GFI = .895) were worse than that of the initial model at any stage, which in turn strengthens the necessity and significance of this longitudinal study.

### Mediation Test

Based on the modified models, we employed the bootstrapping method (Mackinnon, Lockwood, & Williams, 2004) to estimate the direct and indirect effects of informational support from the three channels on the two kinds of APB, as well as the mediating roles of RP and APM. Table 3 illustrates the standardized estimate results of the effects of ISM, ISC, and ISF on CAPB and PAPB. Among the direct and indirect associations in ISM, ISC, ISF, and CAPB and PAPB, the corresponding bias-correlated 95% confidence interval (BC 95% CI) did not contain zero. This indicates that, during the three stages, all three forms of informational support could significantly influence CAPB and PAPB, including direct and indirect influences.

Figure 4 displays a comparison of the total effects of informational support from the three channels on CAPB and PAPB. It clearly reflects how the effects of ISM, ISC, and ISF on individuals' adoption of CAPB and PAPB changed with the pandemic situation. On one hand, the three forms of informational support had different effects on people's adoption of APB. ISM was the most effective way to promote the adoption of CAPB in all three stages (total effect [TE]<sub>1</sub> = .595, TE<sub>2</sub> = .458, TE<sub>3</sub> = .396;  $p < .001$ ), while ISF was the most effective way to encourage the adoption of PAPB (TE<sub>1</sub> = .350, TE<sub>2</sub> = .208, TE<sub>3</sub> = .200;  $p < .001$ ). Meanwhile, in Stage 1, ISF was more effective in promoting CAPB than ISC, but in Stages 2 and 3, the latter was more effective than the former. As for PAPB, ISM was more effective than ISC in all three stages. The results also prove that the key predictors of CAPB and PAPB were different. Specifically, the key predictor of CAPB was ISM, followed by ISC and ISF; while the key predictor of PAPB was ISF, followed by ISM and ISC.

On the other hand, it can be inferred that, as the pandemic situation eased, the efficacy of these three forms of informational support weakened to varying degrees. Particularly, the decline from Stage 1 to Stage 2 was greater than that from Stage 2 to Stage 3. As a result, individuals' adoption of APB also declined to varying degrees (see Fig. 2).

Table 4 presents the standardized estimate results of the indirect effects of ISM, ISC, and ISF on CAPB and PAPB through RP and APM. The results demonstrate that most of the mediating pathways were significant, except for the pathways of "ISC → APM → CAPB" (Stage 1), "ISF → APM → CAPB" (Stage 1), "ISF → RP → APM → CAPB" (Stages 2 and 3), and "ISF → RP → APM → PAPB" (Stages 2 and 3). Accordingly, the significant mediating roles of RP and APM were approved.

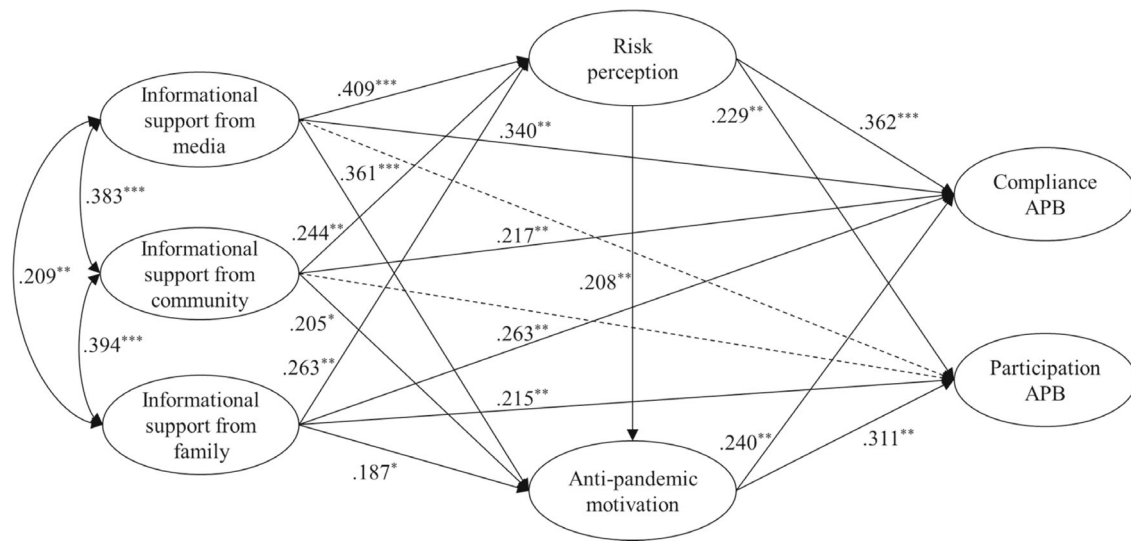
## Discussion

In this research, we conducted a three-stage longitudinal study to explore the dynamic associations among health-related informational support from three channels, risk perception, anti-pandemic motivation, and the adoption of two kinds of APB in the context of the COVID-19 pandemic in China. We found that demographic characteristics had a significant impact on individuals' adoption of APB. The informational support from different channels encouraged people to practice compliance APB and participation APB to varying degrees, while the effects weakened as the pandemic situation eased. Risk perception and anti-pandemic motivation played significant mediating roles in these relationships. Furthermore, the key predictors of compliance APB and participation APB were different. This study helps clarify the motivational bases of two heterogeneous APB types.

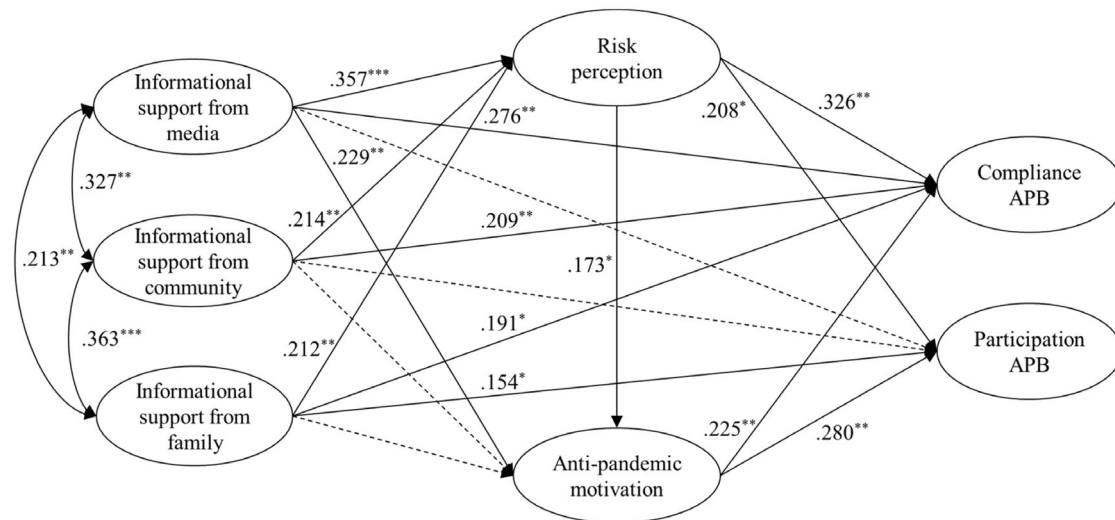
### Analysis

In the early stage of the COVID-19 pandemic, females adopted more compliance APB than males, which is consistent with the previous research findings. For instance, Moran, Del, and Hiroshi (2016) argued that females were 1.5 times more likely to engage in self-protective behavior than males. Park, Cheong, Son, Kim, and Ha (2010) emphasized that females were more involved in social distancing practices than males. However, as the COVID-19 pandemic situation eased in China, females adopted significantly less compliance APB than males. This kind of delayed perception and action in males has not been mentioned in the literature. These two findings suggest that, in the early outbreak stage of an infectious disease, governments should strengthen informational support for males to spur them to take more self-protective actions. As the situation eases, the focus of publicity should shift to females.

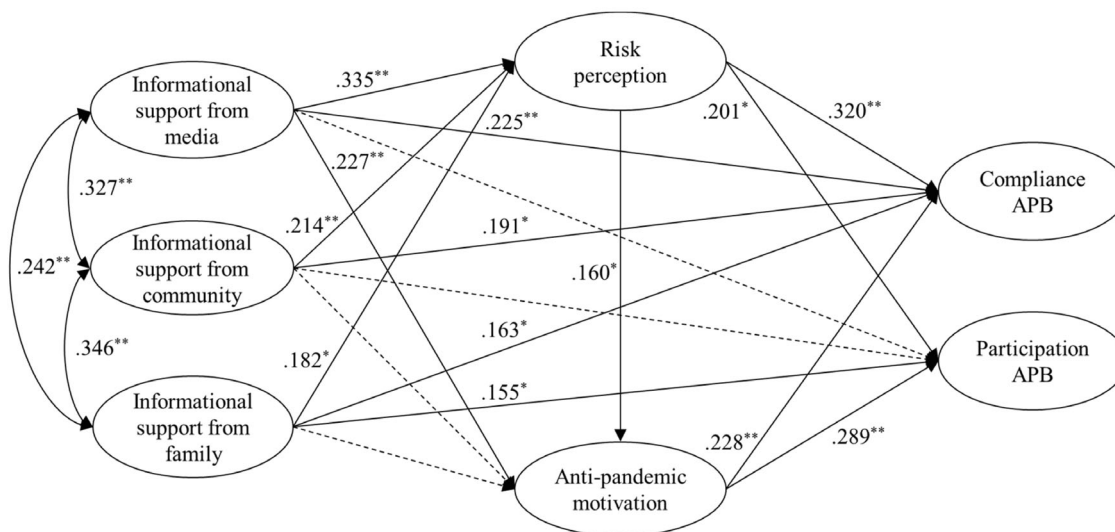




(a) Stage 1



(b) Stage 2



(c) Stage 3

Fig. 3 Standard estimates of the structural models. \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ . (a) Stage 1, (b) Stage 2, (c) Stage 3

**Table 3** Standardized estimates of the effects of ISM, ISC, and ISF on CAPB and PAPB

Effects of variable	Effects on CAPB					
	Stage 1		Stage 2		Stage 3	
	$\beta$	BC 95% CI	$\beta$	BC 95% CI	$\beta$	BC 95% CI
<i>Informational support from media</i>						
Total effect	.595 <sup>***</sup>	[.436, .761]	.458 <sup>***</sup>	[.361, .565]	.396 <sup>***</sup>	[.312, .490]
Direct effect	.340 <sup>***</sup>	[.268, .423]	.276 <sup>***</sup>	[.190, .371]	.225 <sup>***</sup>	[.140, .339]
Indirect effect	.255 <sup>***</sup>	[.176, .344]	.182 <sup>***</sup>	[.118, .247]	.171 <sup>***</sup>	[.116, .235]
<i>Informational support from community</i>						
Total effect	.366 <sup>***</sup>	[.281, .460]	.287 <sup>***</sup>	[.198, .386]	.267 <sup>***</sup>	[.184, .352]
Direct effect	.217 <sup>***</sup>	[.133, .341]	.209 <sup>***</sup>	[.124, .295]	.191 <sup>***</sup>	[.116, .275]
Indirect effect	.149 <sup>***</sup>	[.103, .216]	.078 <sup>**</sup>	[.045, .120]	.076 <sup>**</sup>	[.042, .119]
<i>Informational support from family</i>						
Total effect	.416 <sup>***</sup>	[.308, .536]	.268 <sup>***</sup>	[.188, .359]	.228 <sup>***</sup>	[.146, .314]
Direct effect	.263 <sup>***</sup>	[.181, .388]	.191 <sup>***</sup>	[.122, .287]	.163 <sup>***</sup>	[.117, .211]
Indirect effect	.153 <sup>***</sup>	[.114, .203]	.077 <sup>**</sup>	[.037, .142]	.065 <sup>**</sup>	[.035, .099]
Effects on PAPB						
	Stage 1		Stage 2		Stage 3	
	$\beta$	BC 95% CI	$\beta$	BC 95% CI	$\beta$	BC 95% CI
<i>Informational support from media</i>						
Total effect	.232 <sup>***</sup>	[.149, .324]	.155 <sup>***</sup>	[.114, .201]	.148 <sup>***</sup>	[.110, .195]
Direct effect	–		–		–	
Indirect effect	.232 <sup>***</sup>	[.149, .324]	.155 <sup>***</sup>	[.114, .201]	.148 <sup>***</sup>	[.110, .195]
<i>Informational support from community</i>						
Total effect	.136 <sup>***</sup>	[.098, .182]	.055 <sup>**</sup>	[.030, .084]	.053 <sup>**</sup>	[.028, .082]
Direct effect	–		–		–	
Indirect effect	.136 <sup>***</sup>	[.098, .182]	.055 <sup>**</sup>	[.030, .084]	.053 <sup>**</sup>	[.028, .082]
<i>Informational support from family</i>						
Total effect	.350 <sup>***</sup>	[.277, .432]	.208 <sup>***</sup>	[.124, .301]	.200 <sup>***</sup>	[.126, .287]
Direct effect	.215 <sup>***</sup>	[.133, .307]	.154 <sup>***</sup>	[.117, .197]	.155 <sup>***</sup>	[.117, .194]
Indirect effect	.135 <sup>***</sup>	[.106, .172]	.054 <sup>**</sup>	[.026, .085]	.045 <sup>**</sup>	[.021, .080]

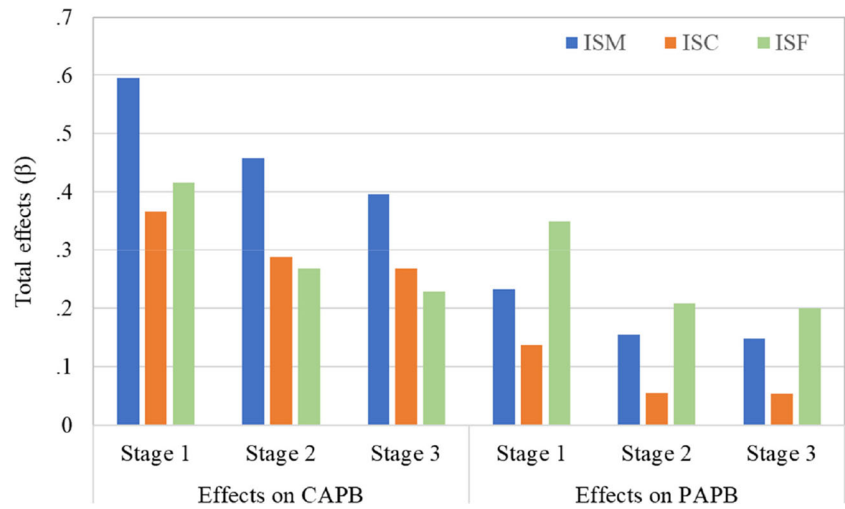
Note: \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$

Meanwhile, the elderly adopted significantly less compliance APB and participation ABP than younger people, which contradicts the findings of Meier et al. (2020). They reported that self-protective behavior was observed more frequently in older people when investigating individuals' beliefs and reactions to the COVID-19 pandemic in Europe. To explore the reasons behind this discrepancy, we interviewed 19 older participants, aged 63–71 years, and 22 younger participants, aged 19–29 years, in July 2020. Most of the older participants reported that they were unaccustomed to taking routine protective measures, and those with a face mask were often seen as artificial and ridiculed by their peers. Furthermore, social distancing and avoiding gatherings also went against their living habits. However, these situations were rarely reported by the younger participants. Combined with the findings that older participants tend to receive less informational support from media, and have lower risk perception and anti-pandemic

motivation, we argue that this difference may be due to the different social environments, media usage, and attitudes toward daily self-protective measures of the elderly in the two regions. In view of this, we suggest that the anti-pandemic publicity for the elderly should be strengthened. Moreover, people living in a rural area or having a lower education level exhibited significantly less compliance APB and participation APB, which is consistent with the findings of Wong and Alias (2020). Therefore, these two factors should also be fully considered when formulating publicity strategies.

Among the three forms of informational support, informational support from media was the most effective way to encourage people to engage in compliance APB. From the perspective of the government, as argued by Habersaat et al. (2020), effective and timely dissemination of pandemic information through the media enables the public to quickly understand the pandemic situation and the

**Fig. 4** Comparison of total effects of ISM, ISC, and ISF on CAPB and PAPB



efforts made by stakeholders for pandemic prevention and control. It can effectively enhance the public’s risk perception and anti-pandemic motivation, thus prompting them to take adequate self-protective actions in accordance with official recommendations. Meanwhile, the dissemination of accurate, transparent, timely, and easily understood pandemic information is essential to raising

public trust in government, which is one of the necessary premises for the public to adopt the recommended measures (Dai et al., 2020). A counterexample is that, in the early weeks after the COVID-19 outbreak in Wuhan, the slow response of China’s public health authorities and the strict information censorship by propaganda authorities resulted in a lack of timely and transparent release of

**Table 4** Standardized estimates of the indirect effects of ISM, ISC, and ISF on CAPB and PAPB

Pathway	Indirect effects on CAPB					
	Stage 1		Stage 2		Stage 3	
	β	BC 95% CI	β	BC 95% CI	β	BC 95% CI
ISM→RP→CAPB	.148***	[.099, .198]	.116***	[.068, .169]	.107***	[.058, .150]
ISM→APM→CAPB	.087**	[.033, .151]	.052**	[.024, .083]	.052**	[.025, .083]
ISM→RP→APM→CAPB	.020*	[.003, .041]	.014*	[.003, .026]	.012*	[.003, .024]
ISC→RP→CAPB	.088**	[.034, .159]	.070**	[.030, .112]	.068**	[.029, .109]
ISC→APM→CAPB	.049	[-.002, .103]	—	—	—	—
ISC→RP→APM→CAPB	.012*	[.003, .026]	.008*	[.002, .016]	.008*	[.002, .013]
ISF→RP→CAPB	.095**	[.043, .154]	.069**	[.029, .115]	.058**	[.024, .094]
ISF→APM→CAPB	.045	[-.003, .096]	—	—	—	—
ISF→RP→APM→CAPB	.013*	[.003, .025]	.008	[-.003, .019]	.007	[-.003, .018]
	Indirect effects on PAPB					
	Stage 1		Stage 2		Stage 3	
	β	BC 95% CI	β	BC 95% CI	β	BC 95% CI
ISM→RP→PAPB	.094**	[.040, .157]	.074**	[.042, .116]	.067**	[.037, .099]
ISM→APM→PAPB	.112***	[.062, .168]	.064**	[.035, .098]	.066**	[.037, .098]
ISM→RP→APM→PAPB	.026**	[.006, .047]	.017*	[.004, .032]	.015*	[.004, .027]
ISC→RP→PAPB	.056**	[.027, .090]	.045**	[.021, .071]	.043**	[.021, .065]
ISC→APM→PAPB	.064**	[.035, .096]	—	—	—	—
ISC→RP→APM→PAPB	.016*	[.004, .032]	.010*	[.002, .018]	.010*	[.002, .019]
ISF→RP→PAPB	.060**	[.030, .093]	.044**	[.023, .067]	.037**	[.019, .065]
ISF→APM→PAPB	.058**	[.030, .089]	—	—	—	—
ISF→RP→APM→PAPB	.017*	[.003, .031]	.010	[-.002, .025]	.008	[-.002, .022]

Note: \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$

epidemic information. It further led to conspiracy theories, a decline in public trust in government, and the public's failure to take recommended protective actions (Fu, Wang, Wang, Griffin, & Li, 2020). From the public's point of view, as emphasized by Zhong et al. (2020), seeking pandemic-related information from broadcast media or social media helps people make decisions about self-protection based on the current pandemic situation. The informational support people get from the media enables them to obtain higher self-esteem and a healthier psychology, which in turn helps them to improve coping methods (Selkie, Adkins, Masters, Bajpai, & Shumer, 2020).

Informational support from family was the most significant predictor of individuals' adoption of participation APB. People tend to trust the information, knowledge, and suggestions received from family or friends more than those from the media (Williams et al., 2018). Informational support from family not only helps to reduce individuals' sense of insecurity, but to increase their perceived care and support and to strengthen cohesion, thus making them realize that they are part of the battle against the pandemic (Du et al., 2020). As some researchers have stressed, peer support contributes to people's health outcomes by increasing self-efficacy and reducing self-uncertainty (Naslund, Aschbrenner, Marsch, & Bartels, 2016). Accordingly, people who obtain more informational support from family may actively encourage others to take anti-pandemic actions and voluntarily participate in tasks or activities that are conducive to pandemic prevention and control (i.e., adopting more participation APB).

Informational support from community played an important role in promoting the adoption of compliance APB. As Fu et al. (2020) and Lee and Ong (2020) highlighted, the community is the front line of joint prevention and control of the pandemic, as well as a critical battlefield to contain the spread of the virus. However, informational support from community was the least effective of the three forms of informational support in encouraging people to adopt participation APB. This is because it can only promote individuals' adoption of participation APB by increasing their risk perception and anti-pandemic motivation, without direct impact.

Based on the above findings, it is evident that the key predictors of compliance APB and participation APB are different. The most critical predictor of compliance APB was informational support from media, followed by informational support from community and family. However, the key predictor of participation APB was informational support from family, followed by informational support from media and community. Clearly, compliance APB is needed and recommended by the governments more than participation APB. Therefore, it is suggested that, in the outbreak stage of an infectious disease, authorities should strengthen media publicity.

It is worth noting that, with the easing of pandemic situation, the efficacy of informational support from these three channels has weakened to varying degrees, and the decline from Stage 1 to Stage 2 was greater than that from Stage 2 to Stage 3. Accordingly, from Stage 1 to Stage 3, the public had practiced less compliance APB and participation APB. In particular, during Stage 1, in addition to informational support from media, informational support from family was the second most effective method of motivating people to adopt compliance APB, but in Stages 2 and 3, informational support from community was the second most effective channel. As for participation APB, in addition to informational support from family, informational support from media was the second most effective channel in all three stages. It is recommended that governments proactively adjust the publicity channels in light of the changing pandemic situation.

Lastly, this study revealed that risk perception and anti-pandemic motivation were the significant mediators of the associations between informational support from the three channels and two kinds of APB. From Stage 1 to Stage 3, informational support from media, community, and family could significantly increase people's risk perception of the pandemic, thus prompting them to adopt APB. Among them, informational support from media was the most effective. As for anti-pandemic motivation, in Stage 1, these three forms of informational support had a significant direct impact on it. However, in Stages 2 and 3, informational support from community and family could only indirectly influence it by increasing individuals' risk perceptions. Overall, authorities should make efforts to increase the public's risk perception and anti-pandemic motivation, so as to inspire the adoption of more APB.

## Theoretical Implications

Inspired by the PADM, this study established a conceptual model to investigate the potential dynamic impact of health-related informational support from media, community, and family on individual risk perception and anti-pandemic motivation, and thus on the adoption of compliance APB and participation APB. The established model contributes to the literature in two ways. First, it has expanded and deepened the application of the classic PADM theoretical framework by employing it to investigate the ongoing COVID-19 pandemic. Besides setting the information sources as three representative channels in line with the context of the COVID-19 pandemic, this study supplemented two significant variables of anti-pandemic motivation and participation APB into the PADM, based on two important variables in the field of safety management: safety motivation and safety participation. Of them, anti-pandemic motivation was regarded as a crucial clue for people to practice APB, which, to the best of our knowledge, has rarely been mentioned in the literature. Moreover,

voluntary participation APB was treated as another important subdimension of APB, different from traditional compliance APB. However, studies discussing this subject remain scarce. In this regard, this study is conducive to preliminarily filling the theoretical gap. Second, the current three-stage study showed that the significance and coefficients of the causal relationships in the constructed model change with the pandemic situation. This highlights the need for longitudinal observation in theoretical research on informational support during a pandemic, and the present study represents part of that effort.

### Practical Implications

This study provides evidence-based insights into the effects of informational support from three different channels on individuals' adoption of APB, the significant mediating roles of risk perception and anti-pandemic motivation, and the influence of demographic characteristics, which offer guidance for governments to develop more effective publicity strategies. It is recommended that, in the early outbreak stage of an infectious disease, informational support from media should be strengthened first to inspire the public to take recommended self-protective behavior (i.e., compliance APB), especially for the elderly, males, and people living in a rural area. Meanwhile, informational support from family should also be encouraged to promote the adoption of participation APB. In addition, it is suggested that authorities adjust publicity strategies in light of the changing pandemic situation. In view of these findings, this study contributes to the scientific and accurate formulation of publicity strategies during a public health crisis.

### Limitations and Future Research

Despite the above implications, this study has several limitations. First, the research was carried out in China, and highly educated young people accounted for more than two-thirds of the sample, while age and education level were found to have significant influences on the seven explanatory variables. Accordingly, it is suggested that future work implement cross-national comparative researches, with attention paid to the balance of sample sizes of different groups. Second, this study introduced two new variables of anti-pandemic motivation and participation APB into the PADM framework, with preliminary discussions. We call on future studies to build new theoretical models to explore the nature of these two variables and their predictors for more effective anti-pandemic publicity. Third, we did not include media trust variable in the mediational model, which is recognized as one of the important preconditions for the efficacy of informational support from media (Habersaat et al., 2020). We recommend a further study of the moderating role of media trust in anti-pandemic publicity.

### Conclusion

Providing adequate health-related informational support for the public is one of the key tasks in pandemic prevention and control. This study has conducted a three-stage longitudinal study to explore the dynamic effects of informational support from media, community, and family on individual risk perception and anti-pandemic motivation, and thus on the adoption of compliance APB and participation APB. The analysis illustrated that informational support from media and community were the more effective ways to encourage people to practice compliance APB, while informational support from family was the most significant predictor of individuals' adoption of participation APB. Risk perception and anti-pandemic motivation played significant mediating roles in these relationships. Moreover, the efficacy of these three forms of informational support weakened to varying degrees as the pandemic situation eased. It is recommended that governments adjust publicity strategies according to the changing pandemic situation and specific context, and strive to enhance the public's risk perception and anti-pandemic motivation to urge them to take more APB. This study contributes to a deeper understanding of the dynamic efficacy of informational support from different channels on individuals' adoption of two heterogeneous APB types, and thereby to the formulation of more effective, and situation-based publicity strategies during a public health crisis.

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**Data Availability** The data supporting this study is available from the corresponding author upon reasonable request.

**Code Availability** Not applicable.

### Declarations

**Ethics Approval** The study was reviewed and approved by the Ethical Committee of Tianjin University.

**Consent to Participate** Informed consent was obtained from all the participants.

**Conflict of Interest** There are no conflicts of interest to declare.

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