Families coping with the COVID-19 pandemic: Risk perceptions associated with preventive intention across three generations of Chinese families

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Abstract

While generational differences in coping with the threat of the global COVID-19 crisis were widely discussed in Western societies, a more careful look from the family level is needed in collectivistic societies like China. This study conducted an online survey among three generations of Chinese families between late January and late March in 2020. The study examined 1380 individuals (college students [G1]: $N=762$, $M_{age}=20.47 \pm 2.45$, 78.1% female; parents [G2]: $N=386$, $M_{age}=47.64 \pm 4.08$, 51.3% female; grandparents [G3]: $N=232$, $M_{age}=73.50 \pm 8.57$, 54.3% female) and their cognitions, affect, and preventive intentions toward COVID-19. The investigation ultimately yielded 226 pairs of family data. The results showed generational differences in the above variables. Perceived severity showed a significant total effect on preventive intention for all three generations, and perceived societal risk showed a significant (total) effect on preventive intention only for G3. Perceived severity was linked to preventive intentions through negative affect for those with lower self-efficacy in G1 and G2. Perceived societal risk was also linked to preventive intention through negative affect for those with low self-efficacy for G2. Moreover, cluster analyses identified three types of families with different epidemic coping patterns: stand-by families (48.23%), precautious families (35.40%), and insensitive families (16.37%). This research provides theoretical and practical implications for understanding the disparities in epidemic prevention between different generations and families. Findings show insights for improving the government's communication strategies.

The world has been making great efforts to control the spread of the COVID-19 pandemic since its outbreak in late 2019. The general public's abidance by the preventive measures is the key to pandemic control. In the process, individuals' perception of the risk, including their perception of severity, susceptibility, and societal risk, plays an important role (Duong et al., 2021). However, certain aspects of the responses of cohorts may differ. Older people have been found more likely to engage in preventive behaviors as time goes by at the beginning of the pandemic in the US (Luo et al., 2021). People holding different cognitions and perceptions about the pandemic manifest different emotional and behavioral reactions (Li et al., 2020). However, cohorts' difference in the framework of the family has not been well discussed. Meanwhile, as the family is an important channel in collectivistic cultures such as those in East Asian countries, family patterns in coping with the risk are the key to pandemic control. With these two issues under consideration, this study aims to uncover how risk perceptions are linked to preventive intention through negative affect for different generations, and uncover family patterns of coping with the risk. The intergenerational differences and various family patterns in facing the COVID-19 pandemic provide guidance for effective communications with different populations for pandemic control.

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Literature Review

Risk Perception and Preventive Intention

Risk perception is taken as an important factor for behavior, and it is greatly emphasized for health-related behavior. Risk perception reflects the subjective judgment of the likelihood that a negative consequence may occur from a risk (cf. Duong et al., 2021). Risk perception has been included in several widely used theories and provides interpretation under various circumstances, such as the health belief model (Rosenstock, 1974) and protection motivation theory (Rogers, 1975).

Among numerous health and risk behavior change theories, risk perception is usually conceptualized as the two dimensions of perceived susceptibility and perceived severity (So, 2013). Perceived susceptibility refers to individuals' perception of how susceptible they are to a health risk, while perceived severity refers to people's perception about the seriousness of a health risk (Duong et al., 2021). In some studies, the two risk perceptions are taken as personal risk perception, as they are both concerned with individuals being personally infected or at risk.

Besides the two personal-level risk perceptions (i.e., individuals' beliefs about how risk affects themselves), the impersonal impact hypothesis (Tyler & Cook, 1984) proposes the importance of societal-level risk perception, which reflects the concerns that others around the individuals may become infected. Within the context of diseases with high infection, such as SARS and avian influenza, individuals' risk perception is not only about the self but also about close others being affected (i.e., perceived societal risk) (Leppin & Aro, 2009). Moreover, such "societal risk perceptions" are even stronger in the collectivistic societies of Asia than in individualistic countries (Leppin & Aro, 2009).

The risk perceptions, including perceived severity, perceived susceptibility, and perceived societal risk, are consistently observed to be associated with individuals' preventive intention among various groups (e.g., Duong et al., 2021). Individuals experiencing higher personal risk perception or societal risk perception perform a higher level of protective behavioral intention, such as wearing a mask. The associations are explained by perceived social norms, self-efficacy, or other cognitive processes, including information-seeking intention (Duong et al., 2021; Leppin & Aro, 2009). Therefore, this study proposes the following:

> H1: Perceived severity (H1a), susceptibility (H1b), and societal risk (H1c) are positively associated with preventive intention in the early stage of the COVID-19 pandemic across different generations.

In addition, demographic factors, especially age, play a role in risk perception (Cameron et al., 2009) and preventive intention (Chu & Liu, 2021). Considering that the older generation is more easily attacked by the virus and have a weaker immune system, we propose the following:

> H2: In the early stage of the COVID-19 pandemic, older individuals, especially grandparents (G3), report higher levels of severity perception, susceptibility perception, societal risk perception, and preventive intention than the younger two groups.

The Mediating Role of Negative Affect

The negative affective responses involved in this study are typical negative emotions to COVID-19, including panic, sadness, and worry. According to the risk information seeking and processing model (RISP; Griffin et al., 1999), individuals' assessment of risk may induce negative emotions, and the notion has been well supported in the field of general personal health-related risk (e.g., Kahlor, 2010).

Affective response is a significant antecedent for people's behavioral intention. In a meta-analysis study conducted by Sandberg and Conner (2008), affective response (such as anticipated regret) presented a stronger effect on behavioral intentions than attitudes. Similarly, Keer et al. (2010) found that affective evaluations significantly predicted behavioral intentions for 20 health behaviors. Typical negative emotions, such as worry and fear, increase individuals' health behavioral intentions like accepting vaccines (e.g., Chon & Park, 2021; Edmonds et al., 2011). Furthermore, individuals' fear in the context of a public health crisis facilitates their willingness to follow the CDC's instructions to cope with infectious diseases, thus speaking to the importance of affect in supporting government actions in a public crisis (Chon & Park, 2021). Affect drives people to make decisions in uncertain situations more instinctively and quickly, through which way the individuals are protected (Slovic et al., 2005).

The COVID-19 pandemic ignited widespread worries and anxieties in China at its early stage. The high uncertainty people sensed brought high perceived risks and negative affect for individuals of different ages (Chinese Academy of Social Sciences, 2020). On the basis of the role of affective responses discussed above, we propose the following:

> H3: Negative affect mediates the relationship between perceived risks (i.e., perceived severity, susceptibility, and societal risk) and preventive intention across three generations.

The Moderating Role of Self-Efficacy

Individuals experiencing the same level of negative affect may not perform similar behavioral intentions because of varied self-efficacy, which refers to confidence in one's ability to follow the epidemic prevention and control recommendations. According to the extended parallel process model (EPPM; Witte, 1994), individuals may select the danger

control process or the fear control process according to their perceived efficacy and perceived threat. High threat and low self-efficacy can lead to defensive motivation, in which individuals attempt to control fear instead of danger. Meanwhile, those with high self-efficacy will show protective intention and cope with danger actively.

Past research has indicated that self-efficacy is an important determinant of behavioral intention and a moderating variable for the behavior change process (Kim et al., 2018). Barnett et al. (2014) showed that self-efficacy enhanced individuals' response willingness under both scenarios of a weather-related emergency and a radiological "dirty" bomb event. The strengthening effect of self-efficacy on behavioral intention has been widely supported in health-related behaviors like accepting health messages (Lewis et al., 2013). However, mixed findings have been notably reported in the domain of smoking cessation. Although a study from Zarghami et al. (2021) supported the role of self-efficacy proposed by EPPM, Kim et al. (2018) found an opposite effect on the intention to quit smoking. The strengthened and significant link between negative emotion (mainly shame) and smoking cessation intention only appeared among individuals with low self-efficacy but not among those with high self-efficacy. One explanation by Kim et al. (2018) was that smoking has been long regarded as highly addictive and habit-forming behavior, hence, those with lower self-efficacy may be more reactive to related stigma messages that cause negative affect.

As the pandemic is a new circumstance and is closer to the scenarios that have consistently supported EPPM in former studies (e.g., Barnett et al., 2014), we therefore hypothesize the following:

H4: Self-efficacy moderates the link between individuals' negative affect and preventive intention in a way that those experiencing higher self-efficacy show a stronger affect-intention association.

Family Patterns in Coping with the Risk across Three Generations

Prior researchers have proposed that health and illness are a family affairs (Ones, 2020). This issue is even more salient in the age of COVID-19 when every family member is highly involved in coping with the risk. According to Bowen's theory of family systems (Bowen, 1978), family members are all connected and interact with one another; thus, they are highly influenced by familial relationships (Ron & Rovner, 2014). Such connection and interaction, together with genetic components, bring similarities between family members not only to their personalities but also to their values and behavioral tendencies (Bouchard & Loehlin, 2001). Family norms and values, such as pro-environment

values and pro-social values, are transmitted from the older generations to their offspring (Grønhøj & Thøgersen, 2012; Kasser et al., 1995). Intergenerational transmission, which is taken as a mechanism for the family resemblance, also appears in crisis coping. Ron and Rovner (2014) demonstrated that problem-focused coping strategies and crisis perception could be transferred from grandparents to parents and from parents to grandchildren. In light of this notion, the current study attempts to examine whether family resemblance appears in the emergent and threatening situation of the COVID-19 pandemic.

Research about family pattern shows its legitimacy in the collectivistic cultural context of China where this study is conducted. Cultural values can affect individuals' coping mechanisms in adapting to life in a new country (Bardi & Guerra, 2011). Collectivistic cultural values are associated with more collective coping patterns (Kuo, 2013), in a process in which people exhibit more congruency and consideration about others' wellbeing. The characteristics of the consistency of risk coping strategy helped individuals at the early stage of the COVID-19 pandemic in China (e.g., Liu, Yue, & Tchounwou, 2020). However, we still do not know whether families would manifest different patterns and the distributions, which can be crucial for public health management at the early stage of risk. Therefore, the current study aims to address the following research question:

RQ1: What are the family patterns and distributions in coping with the COVID-19 pandemic at its early stage?

In sum, we present all hypotheses and research question in Table 1.

Methods

Participants and Procedures

Students from universities in Nanjing and Shenzhen, China, their parents (one for each student), and grandparents (one for each student) finished an online survey from Jan 28th, 2020 to Mar 27th, 2020, a relatively early stage of the Covid-19 pandemic. Each student earned a one-month membership for the video website Bilibili, one of the most popular platforms in China. They were encouraged to invite one of their parents and grandparents to complete the survey. In total, 762 college students (**G1**: $M_{age} = 20.47 \pm 2.45$, 78.1% female, 90.6% undergraduates), 386 parents (**G2**: $M_{age} = 47.64 \pm 4.08$, 51.3% female), and 232 grandparents (**G3**: $M_{age} = 73.50 \pm 8.57$, 54.3% female) finished the survey. The more detailed demographic information of the three generations is in Table 2.

Table 1 Summary of hypotheses and research question

	Hypotheses/research question
H1a	Perceived severity is positively related to preventive intention in the early stage of the COVID-19 pandemic across different generations.
H1b	Perceived susceptibility is positively related to preventive intention in the early stage of the COVID-19 pandemic across different generations.
H1c	Perceived societal risk is positively related to preventive intention in the early stage of the COVID-19 pandemic across different generations.
H2	Older generations report higher levels of severity perception, susceptibility perception, societal risk perception, and preventive intention than the younger groups.
H3	Negative affect mediates the relationship between perceived risks (i.e., perceived severity, susceptibility, and societal risk) and preventive intention across three generations.
H4	Self-efficacy moderates the link between individuals' negative affect and preventive intention in a way that those experiencing higher self-efficacy show a stronger affect-intention association.
RQ1	What are the family patterns and distributions in coping with the COVID-19 pandemic at its early stage?

We further merged the data of the three generations on the basis of the students' ID (parents and grandparents also provided their child's or grandchild's student ID) and obtained 226 pairs of family data (G1: $M_{age} = 20.30 \pm 2.19$, 84.5% female; G2: $M_{age} = 46.96 \pm 3.91$, 54% female; G3: $M_{age} = 73.58 \pm 7.61$, 54.4% female).

Measures

Health Risk Perception

We measured the perceived susceptibility, perceived severity, and perceived societal risk. Participants answered the items on a five-point scale (1 = *strongly disagree*,

5 = *strongly agree*), with a higher score indicating a higher risk perception.

The perceived susceptibility was measured with a three-item modified scale that had been used in prior studies (e.g., Shi & Smith, 2016). Participants answered items like "*I'm at risk for COVID-19.*" The Cronbach's alphas were .89 for G1, .92 for G2, and .94 for G3.

Four items modified from Shi and Smith (2016) measured the perceived severity. Participants answered items like "*COVID-19 can pose a serious threat to my daily life.*" The Cronbach's alphas were .88 for G1, .91 for G2, and .92 for G3.

The perceived societal risk was measured with three questions from Duong et al. (2021), such as "*People around me*

Table 2 Demographic information about the three generation participants

Demographic variables	G1 (N1 = 762) ($M_{age} = 20.47 \pm 2.45$)	G2 (N2 = 386) ($M_{age} = 47.64 \pm 4.08$)	G3 (N3 = 232) ($M_{age} = 73.50 \pm 8.57$)
Gender (Female)	595 (78.1%)	198 (51.3%)	126 (54.3%)
Education			
Elementary or below		24 (6.2%)	114 (49.1%)
Junior level		113 (29.3%)	55 (23.7%)
High school		103 (26.7%)	28 (12.1%)
Junior college		72 (18.7%)	12 (5.2%)
Senior college/ Undergraduates	690 (90.6%)	71 (18.4%)	22 (9.5%)
Master's and above	72 (9.4%)	3 (0.8%)	1 (0.4%)
Monthly revenue			
Below 1000 yuan	169 (22.2%)		
1001–1500 yuan	252 (33.1%)		
1501–2000 yuan	202 (26.5%)		
2001–2500 yuan	75 (9.8%)		
Over 2501 yuan	64 (8.4%)		
Below 1000 yuan		14 (3.6%)	36 (15.5%)
1001–3000 yuan		47 (12.2%)	122 (52.6%)
3001–5000 yuan		111 (28.8%)	51 (22.0%)
Over 5000 yuan		214 (55.4%)	23 (9.9%)

The numbers in the table indicate frequencies and ratio

are at risk for COVID-19." The Cronbach's alphas were .93 for G1, .96 for G2, and .98 for G3.

Preventive Intention

Preventive intention was measured by six items (Cronbach's α = .86/ .91/ .91 for G1, G2, and G3, respectively). Participants reported their intentions about their various preventive behaviors (e.g., "*wear a mask when going to the hospital or public places*") on a five-point scale (1 = *Very unlikely*, 5 = *Very likely*). A higher score indicated a stronger intention to adopt preventive behaviors for the COVID-19 pandemic.

Negative Affect

Three items modified from Kim and Lai (2020) were used to measure individuals' levels of *negative affect* (NA). Participants reported their emotional responses (e.g. "*I am panicked and scared of this epidemic*") to COVID-19 on a five-point scale (1 = *Absolutely not*, 5 = *Very much*). The Cronbach's alphas were .81 for G1, .83 for G2, and .92 for G3.

Self-Efficacy

This study used and modified a three-item self-efficacy scale from Shi and Smith (2016). Participants answered items like "*It is easy for me to follow the precautionary measures for COVID-19*" on a five-point scale (1 = *strongly disagree* and 5 = *strongly agree*). The Cronbach's alphas were .91 for G1, .88 for G2, and .94 for G3.

Demographic Information

Participants reported demographic information, including gender (1 = male; 2 = female), age, and revenues.

Data Analysis

We used Mplus 7.4 (Muthén & Muthén, 1998) and SPSS 22.0 in data analysis. The main data analysis included three parts. Firstly, we conducted an initial group means comparison on each of the key variables. Secondly, we examined our hypothesized model for G1, G2, and G3, respectively, by testing the links among risk perception, affect responses, and preventive intention. To achieve such examination, demographic information, including gender and revenues, was controlled (as the three generations indicated age stages, we did not control age in the model test). Acceptable fit for models was set at CFI > 0.90, and RMSEA and SRMR <0.08 (Kline, 2010). Finally, we merged the data of the three generations and further explored potential family response patterns with cluster analysis.

Results

Means, Standard Deviations, Generational Differences, and Correlations

Table 3 shows the means, standard deviations, generational differences of the key variables, and correlations among them. Risk perceptions, including perceived severity, perceived susceptibility, and perceived socetial risk, were all positively correlated with negative affect for each of the three generations. Perceived severity was also positively correlated with preventive intention for all three generations. However, perceived susceptibility and perceived societal risk were not associated with preventive intention for any of the three generations. Moreover, negative affect and self-efficacy were positively related to preventive intentions for all three generations.

We also examined the differences in the key variables between the three generations. The three generations showed no difference in perceived severity and perceived societal risk, *p*s > .05, which was not consistent with H2. In terms of perceived susceptibility, G3 scored significantly higher than G1 and G2 ($F = 6.17$, $p < .01$). G1 experienced stronger negative affect than both G2 and G3 ($F = 34.10$, $p < .001$). For both self-efficacy and preventive intentions, differences existed between either two of the three generations, with G1 scoring the highest and G3 scoring lowest, *p*s < .05, which indicated that the young generation performed the strongest self-efficacy ($F = 20.64$, $p < .001$) and preventive intention ($F = 11.73$, $p < .001$).

Theoretical Model Test for G1, G2, and G3

We examined the theoretical model on the three generations. For each of the three models, we first controlled gender (1 = male; 2 = female) and revenues. Then, we trimmed the links from the control variables that showed no effect on the key variables in the model. Age was not controlled, as it might contribute to the generational differences.

Model Test for G1 Considering that the data on perceived severity (skewness = − 1.73, $SE = 0.09$; after transformation: skewness = 0.29, $SE = 0.09$) and self-efficacy (skewness = − 0.85, $SE = 0.09$; after transformation: skewness = 0.37; $SE = 0.09$) were skewed distributed, we transformed the data through the formula of $X' = 1/(1 + \max - X)$ and decreased their skewness before entering the model. The model fit was acceptable for G1 after trimming the non-significant control variables and including additional variable correlations between perceived severity with self-efficacy as the program suggested to improve the model fit (**Model$_{G1}$**: $\chi^2(16) = 36.34$, $p = .003$; CFI = .93, RMSEA = .04, 90%CI = .02 - .06,

Table 3 Means, standard deviations, generational differences, and correlations between key variables

	PSE	PSU	PSR	NA	SE	PI
Mean	4.47/4.49/4.40	2.78/2.87/3.08	2.81/2.87/2.95	3.62/3.28/3.18	4.22/4.11/3.99	4.77/4.69/4.53
SD	.66/.68/.72	1.12/1.18/1.29	1.15/1.21/1.33	.79/.88/1.01	.71/.71/.82	.43/.54/.67
PSE	1					
PSU	.17***/.07/.19**	1				
PSR	.12**/.07/.19**	.89***/.90***/.93***	1			
NA	.24***/.26***/.29***	.16***/.23***/.41***	.16***/.25***/.39***	1		
SE	.25***/.34***/.48***	−.00/.004/−.03	−.01/.04/−.05	.08*/.08/.12	1	
PI	.19***/.36***/.49***	−.02/−.01/.11	−.05/.001/.13	.11**/.16**/.21**	.32***/.46***/.59***	1
Generational difference test	–	G1-G3[a] G2-G3[a]	–	G1-G2[a] G1-G3[a]	G1-G2[a] G1-G3[a] G2-G3[a]	G1-G2[a] G1-G3[a] G2-G3[a]

PSE = Perceived severity, PSU = Perceived susceptibility, PSR = Perceived societal risk, NA = Negative affect, SE = Self-efficacy, PI = Preventive intention;

The results are for G1, G2 and G3 respectively

*p ≤ .05; **p ≤ .01; ***p ≤ .001; [a] difference is significant between generations

SRMR = .03). In the model (Fig. 1), perceived severity (but not perceived susceptibility and perceived societal risk, ps > .05) was positively linked to preventive intention, $\beta = .13$, $p < .001$, 90%CI = .07 - .19. Both perceived severity ($\beta = .25$, $p < .001$, 90%CI = .19 - .31) and societal risk ($\beta = .16$, $p = .041$, 90%CI = .03 - .28) were linked to negative affect. Despite the non-significant effect from negative affect to preventive intention ($\beta = .05$, $p = .198$), its interaction with self-efficacy was negatively linked to preventive intention, $\beta = −.10$, $p = .014$, 90%CI = (−.17) - (−.03), thus indicating a moderation of self-efficacy.

We further calculated the indirect effect from both perceived severity and societal risk on preventive intention through negative affect for people with low (−1SD) and high (+1SD) levels of self-efficacy. Perceived severity showed a significant indirect effect of .02, $p = .047$, 90%CI = .003 - .03 on preventive intention for those with low self-efficacy but not for those with high self-efficacy ($p = .258$). In addition, perceived societal risk showed no significant indirect effect on preventive intention for those with either a low (−1SD) or high (+1SD) level of self-efficacy, ps > .05.
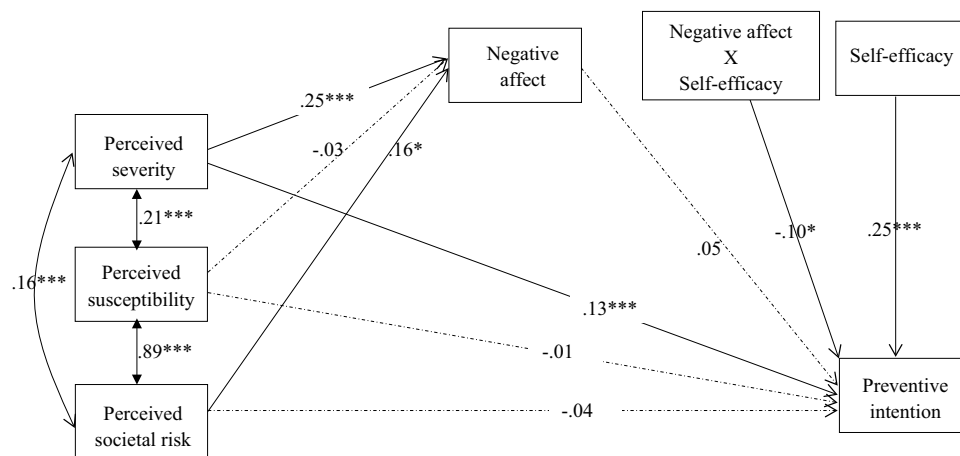

Fig. 1 Model$_{G1}$. Theoretical model test on risk perception and preventive intentions of **G1.** *Note.* *p ≤ .05, **p ≤ .01, ***p ≤ .001; Dash lines indicate the non-significant coefficients; coefficient of each path is a standardized one in the figure; **Model fit:** $\chi^2(16) = 36.34$, $p = .003$; CFI = .93, RMSEA = .04, 90%CI = .02 - .06, SRMR = .03; **Control variables:** Revenues ➔ Perceived severity: .07*; Revenues ➔ Self-efficacy: .12**; Gender ➔ Negative affection: .17***; Gender ➔ Preventive intention: .20***; **Additional correlations for model modification:** Perceived severity with self-efficacy: $r = .20$***. **Standardized indirect effects for -1SD/+1SD self-efficacy**: Perceived severity ➔ negative affection ➔ preventive intention: .02*/−.005; Perceived societal risk ➔ negative affection ➔ preventive intention: .01*/−.003; **Total effect:** Perceived severity ➔ preventive intention: .07***/ .06***.

Model Test for G2 As in model 1, we also transformed the left-skewed-distributed data of perceived severity (skewness $= -1.99$, $SE = 0.13$; after transformation: skewness $= -0.41$, $SE = 0.13$) via the formula of X' $= 1/(1 + \max - X)$ and decreased the skewness before entering the model. The non-significant paths from control variables were removed. The model fit of **Model$_{G2}$** was acceptable: $\chi^2(15) = 26.31$, $p = .035$; CFI $= .95$, RMSEA $= .05$, 90%CI $= .01 - .07$, SRMR $= .03$. In the model for G2 (Fig. 2), perceived severity (but not perceived susceptibility and perceived societal risk, ps $> .05$) was positively linked to preventive intention, $\beta = .19$, $p < .001$, 90%CI $= .10 - .27$. Similar to the model for G1, both perceived severity ($\beta = .26$, $p < .001$, 90%CI $= .18 - .34$) and perceived societal risk ($\beta = .31$, $p < .001$, 90%CI $= .13 - .49$) were linked to negative affect. Moreover, self-efficacy had a moderating effect between negative affect and preventive intention. Specifically, negative affect ($\beta = .11$, $p = .026$, 90%CI $= .03 - .18$), self-efficacy ($\beta = .37$, $p < .001$, 90%CI $= .30 - .45$), and their product ($\beta = -.16$, $p < .001$, 90%CI $= (-.23) - (-.09)$) were all significantly linked to preventive intention.

We further calculated the indirect effect from both perceived severity and societal risk on preventive intention through negative affect for people with low ($-1SD$) and high ($+1SD$) levels of self-efficacy. Perceived severity showed a significant indirect effect of .04, $p = .004$, 90%CI $= .02 - .05$ on preventive intention for those with low self-efficacy but not for those with high self-efficacy ($p = .334$). In addition, perceived societal risk showed a significant indirect effect on preventive intention for those with low ($-1SD$)

(indirect effect $= .04$, $p = .036$, 90%CI $= .01 - .08$) but not high ($+1SD$) ($p = .331$) levels of self-efficacy. Perceived susceptibility showed no significant indirect effect on preventive intention for those with either low ($-1SD$) and high ($+1SD$) levels of self-efficacy, ps $> .05$.

Model Test for G3 In the model test for G3, perceived severity was left-skewed-distributed (skewness $= -1.01$, $SE = 0.16$) and was transformed (skewness $= -0.20$, $SE = 0.16$), as in the models for G1 and G2. Gender and revenue were included in the model as control variables, and the non-significant paths from them were removed in the final model (**Model$_{G3}$**). The model fit was acceptable: $\chi^2(10) = 12.13$, $p = .276$; CFI $= .99$, RMSEA $= .03$, 90%CI $= .00 - .08$, SRMR $= .04$. In the model (Fig. 3), perceived severity ($\beta = .14$, $p = .018$, 90%CI $= .03 - .25$) and societal risk ($\beta = .25$, $p = .036$, 90%CI $= .06 - .45$), but not perceived susceptibility ($p = .118$), were directly linked to preventive intention. Perceived severity ($\beta = .15$, $p = .018$, 90%CI $= .05 - .25$) and perceived susceptibility ($\beta = .40$, $p = .011$, 90%CI $= .14 - .65$), but not perceived societal risk ($p = .902$), were linked to negative affect. In addition, self-efficacy had a moderating effect between negative affect and preventive intention. Although negative affect ($\beta = .11$, $p = .115$, 90%CI $= (-.01) - .22$) showed no prediction to preventive intention, self-efficacy ($\beta = .46$, $p < .001$, 90%CI $= .37 - .55$) and their product ($\beta = -.16$, $p = .008$, 90%CI $= (-.26) - (-.06)$) were both significantly linked to preventive intention.

Indirect effect calculation indicated that perceived susceptibility showed a trend to have an indirect effect on preventive intention through negative affect only for those with
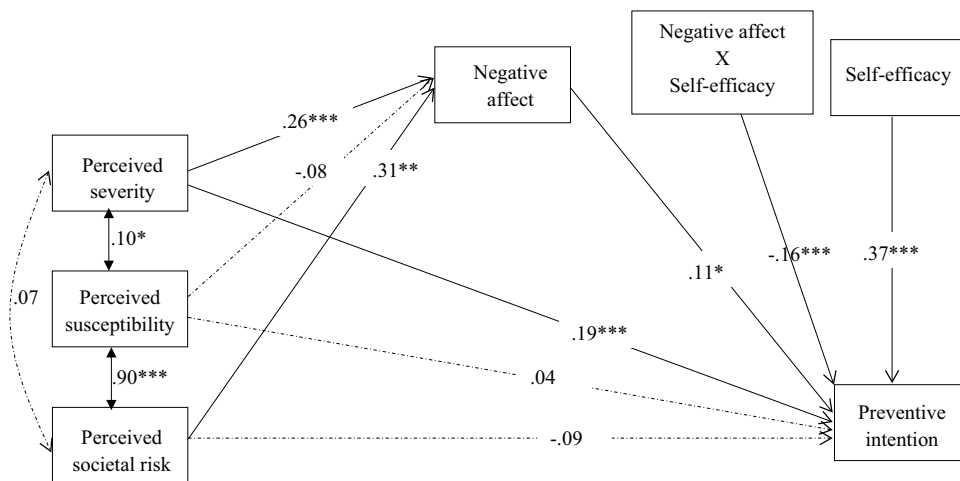

Fig. 2 Model$_{G2}$. Theoretical model test on risk perception and preventive intentions of **G2.** *Note.* *$p \leq .05$, **$p \leq .01$, ***$p \leq .001$; Dash lines indicate the non-significant coefficients; **Model fit:** $\chi^2(15) = 26.31$, $p = .035$; CFI $= .95$, RMSEA $= .05$, 90%CI $= .01 - .07$, SRMR $= .03$; **Control variables:** Revenues ➜ Perceived severity: $-.11$**; Gender ➜ Negative affect: $.26$**; Gender ➜ Preventive intention: $.09$ ($p = .052$); **Additional correlations for model modi-** **fication:** Perceived severity with self-efficacy: $r = .32$***; Product (NA*SE) with negative affect: $r = .20$*; **Standardized indirect effects for -1SD/+1SD self-efficacy**: Perceived severity ➜ negative affect ➜ preventive intention: $.04$**/$-.005$; Perceived societal risk ➜ negative affect ➜ preventive intention: $.04$*/$-.006$. **Total effects:** Perceived severity ➜ preventive intention: $.14$***/$.12$***
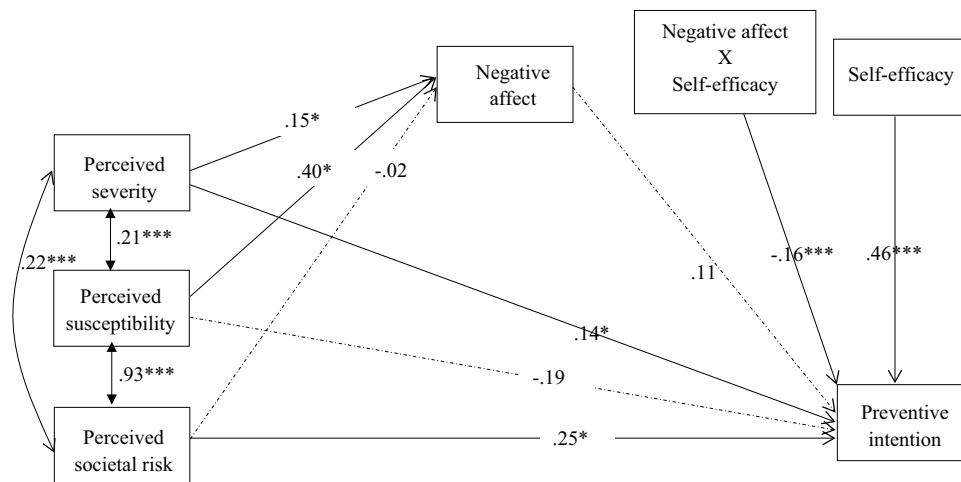
Fig. 3 Model$_{G3}$. Theoretical model test on risk perception and preventive intentions of **G3**. *Note.* *$p \leq .05$, **$p \leq .01$, ***$p \leq .001$; Dash lines indicate the non-significant coefficients; **Model fit:** $\chi^2(10) = 12.13$, $p = .276$; CFI = .99, RMSEA = .03, 90%CI = .00 - .08, SRMR = .04; **Additional correlations for model modification:** Per-

ceived severity with self-efficacy: $r = .43***$; Product (NA*SE) with negative affect: $r = .24*$; Product (NA*SE) with perceived severity: $r = -.19**$; **Total effects for -1SD/+1SD self-efficacy:** Perceived severity ➔ preventive intention: .11**/.10*; Perceived societal risk ➔ preventive intention: .16*/ .16*

low self-efficacy (effect = .06, $p = .081$, 90%CI = .004 - .12). The indirect effect of either perceived severity or perceived societal risk on preventive intention was not significant for either low or high self-efficacy groups ($ps > .10$).

Family Patterns in Coping with COVID-19 Pandemic

We used a K-means cluster analysis to explore family patterns in coping with the COVID-19 pandemic on the key variables in this study, including risk perception (*perceived severity, perceived susceptibility, and perceived societal risk*), negative affect, self-efficacy, and preventive intention. We paired the data of G1, G2, and G3, and obtained 226 families. Results indicated that three types of families exhibited different patterns in coping with the pandemic at its early stage. Age and revenue showed no difference between the three clusters for the three generations except that age differed between the three clusters for G3, $F(2, 223) = 4.13$, $p = .017$. Cluster 1 ($M = 75.06$, $SD = 6.32$) of G3 were older than Clusters 2 ($M = 72.41$, $SD = 9.22$) and 3 ($M = 71.78$, $SD = 6.58$); however, Cluster 2 and 3 showed no difference. The original means and standard deviations of the key variables for the three clusters are presented in Table 4. Figure 4 also presents each cluster's level of the key variables. To make a clearer comparison, we used the standardized scores of the measures in the figures.

Cluster 1, named *stand-by families*, took 48.23% (N1 = 109) of the total sample, thus ranking the highest in amount. In this cluster, the three generations of these families reported relatively high risk perception, negative affect, self-efficacy, and preventive intention. Such families had a more comprehensive recognition of the COVID-19, could realize its

seriousness, and believed that they and other people around them had a chance of being infected. They accordingly experienced stronger negative emotions and reported relatively high preventive intentions. At the same time, family members also maintained high confidence in themselves to follow the epidemic prevention advice. Hence, they could rationally adjust their moods and actively respond to the epidemic.

Cluster 2, named *precautious families,* took 35.40% (N2 = 80) of the total sample, thus ranking second. The three generations of this cluster synchronously reported relatively lower risk perception (especially perceived susceptibility and perceived societal risk) and negative affect. However, they had high efficacy and preventive intention, thus showing a high level of precaution in coping with COVID-19 at its early stage. The pattern reflected that for these families, individuals' instant susceptibility to being infected might not be necessary for their intense preventive intentions and even actions. Such relatively lower risk perception concurred with the weaker negative affect they had reported. Few confirmed local cases might have contributed to such risk perception at the early stage of the pandemic. However, the cluster still maintained a high intention to take epidemic preventive measures for protection.

Cluster 3, named *insensitive families*, took 16.37% (N3 = 37) of the total sample. Different from the other two clusters, these families reported a relatively lower risk perception about the pandemic, experienced a lower level of negative affect, and most importantly, showed low preventive intention. Although the individuals under G1 in this cluster were aware of the threat to a better extent, they still manifested a relatively lower preventive intention. In addition, this cluster showed lower self-efficacy in successfully coping with the pandemic across three generations. In summary, this type of family was

Table 4 Responses of three clusters of families at the early stage of COVID-19 pandemic

	Cluster 1 (C1) (N1 = 109)	Cluster 2 (C2) (N2 = 80)	Cluster 3 (C3) (N3 = 37)	F	Post-Hoc Test
PSE_G1	4.59 ± 0.53	4.55 ± 0.56	4.39 ± 0.65	1.81	–
PSU_G1	3.44 ± 0.97	2.10 ± 0.99	2.96 ± 0.96	43.29***	C1-C3[a], C1-C2[a], C3-C2[a]
PSR_G1	3.53 ± 0.91	1.96 ± 0.95	2.94 ± 0.94	66.27***	C1-C3[a], C1-C2[a], C3-C2[a]
NA_ G1	3.83 ± 0.78	3.53 ± 0.85	3.46 ± 0.87	4.34*	C1-C2[a],C1-C3[a]
SE_ G1	4.40 ± 0.60	4.40 ± 0.71	3.77 ± 0.75	13.89***	C1-C3[a], C3-C2[a]
PI_ G1	4.83 ± 0.29	4.92 ± 0.23	4.44 ± 0.59	26.39***	C1-C3[a], C3-C2[a]
PSE_G2	4.61 ± 0.52	4.57 ± 0.58	3.93 ± 0.84	18.58***	C1-C3[a], C3-C2[a]
PSU_G2	3.71 ± 0.93	1.71 ± 0.78	2.76 ± 0.85	122.43***	C1-C3[a], C1-C2[a], C3-C2[a]
PSR_G2	3.69 ± 0.96	1.68 ± 0.78	2.75 ± 0.81	122.35***	C1-C3[a], C1-C2[a], C3-C2[a]
NA_G2	3.43 ± 0.93	3.05 ± 0.93	2.86 ± 0.69	7.54**	C1-C2[a], C1-C3[a]
SE_G2	4.32 ± 0.58	4.29 ± 0.69	3.51 ± 0.76	23.07***	C1-C3[a], C3-C2[a]
PI_G2	4.81 ± 0.40	4.89 ± 0.32	3.91 ± 0.72	68.80***	C1-C3[a], C3-C2[a]
PSE_G3	4.62 ± 0.49	4.45 ± 0.67	3.72 ± 0.74	30.84***	C1-C3[a], C3-C2[a]
PSU_G3	4.01 ± 0.91	1.97 ± 0.96	2.88 ± 0.66	121.14***	C1-C3[a], C1-C2[a], C3-C2[a]
PSR_G3	3.95 ± 0.95	1.75 ± 0.86	2.78 ± 0.67	145.15***	C1-C3[a], C1-C2[a], C3-C2[a]
NA_ G3	3.58 ± 0.93	2.88 ± 1.02	2.74 ± 0.71	18.31***	C1-C2[a], C1-C3[a]
SE_ G3	4.09 ± 0.68	4.33 ± 0.63	3.06 ± 0.74	45.91***	C1-C3[a], C1-C2[a], C3-C2[a]
PI_ G3	4.73 ± 0.46	4.70 ± 0.44	3.67 ± 0.70	67.97***	C1-C3[a], C3-C2[a]

NA = Negative affect, PI = Preventive intention, PSE = Perceived severity, PSU = Perceived susceptibility, PSR = Perceived societal risk; SE = Self-efficacy;

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$; [a] the difference between the two clusters is significant

classified as an *insensitive family*, which was at a low level from cognition to affect to behavioral intentions. These families were those who needed extra attention on public guidance to follow preventive measures in coping with the pandemic at its early stage.

Discussion

Covering three generations of families, this study examined the link of risk perception to preventive intention through negative affect and the moderating role of self-efficacy at the early stage of the COVID-19 pandemic. We found the following results. 1) Although G3 perceived higher susceptibility, negative affect and preventive intention decreased from G1 to G3. 2) For G1, perceived severity predicted preventive intention directly and indirectly when self-efficacy was low. 3) For G2, perceived severity predicted preventive intention directly, and indirectly, similar to perceived societal risk, when self-efficacy was low. 4) For G3, both perceived severity and perceived societal risk predicted preventive intention directly but not indirectly. 5) Three types of families were coping with the COVID-19 epidemic at its early stage, with *stand-by families* maintaining a high level of perceived risk, affect, and preventive intention, *precautious families* having relatively low risk perception and affect but high preventive intention, and *insensitive families* having low levels in every aspect.

Responses of Generations at the Early Stage of the COVID-19 Pandemic

The higher level of perceived susceptibility of G3 than G1 and G2 is in line with the development of the epidemic at its early stage. Older adults are more susceptible and are the main victims of the COVID-19 outbreak, with higher hospitalization and mortality (Amore et al., 2021). However, the weaker negative affect and lower preventive intention they have reported bring more concerns to this group, especially when related strategies (e.g., Long Term Care Facilities; Amore et al., 2021) are not helpful in reducing the mortality rate as expected. From practical consideration, public education and encouragement to follow precautionary measures that specifically target older adults (G3) may be necessary. In addition, the similar severity and societal risk perception between generations imply that the information about the epidemic reached people across different cohorts well.

Negative affect, self-efficacy, and preventive intention decrease in older generations. Thus, we reasonably observe that older individuals are more sophisticated and panic less intensely when facing an unprecedented threat. Furthermore, social media exposure, which increases negative affect (Gao et al., 2020), may also contribute to this difference, as younger individuals are more exposed (Gao et al., 2020). Such finding is in line with a large-scale survey conducted in mainland China at the first stage of the epidemic, thus indicating a negative association between

Fig. 4 Standardized scores of varibles for three types of families. *Note*. PSE = Perceived severity; PSU = Perceived susceptibility; PSR = Perceived societal risk; NA = Negative affect; SE = Self-efficacy; PI = Preventive intention; standardized scores were used in cluster analysis

age and perceived anxiety (Liu, Zhang, & Huang, 2020). Lower self-efficacy and preventive intentions call for more attention to build the elder's confidence in coping with the threat and following precautionary measures. Nevertheless, the overall behavioral intentions are high, thus reflecting an active "fighting" mental set rather than "flight" or "freeze" ones.

The Moderated Mediation Model Test for Generations

The moderated mediation models further demonstrated the link of risk perceptions to preventive intention through negative affect and the moderating role of self-efficacy. For all

three generations, perceived severity showed a positive total effect on preventive intention, speaking to the importance of severity perception to people's reactions. At the first stage of the epidemic, when the current study was conducted, confirmed cases increased sharply every day all over the world, and the consequences of COVID-19 were recognized further. From that time, people have become increasingly aware of its severity. Despite high severity perception, perceived susceptibility and societal risk were relatively lower for all three generations and showed no total effect on preventive intention except the effect of societal risk perception for G3.

At least three factors might have contributed to such predicting differences between the three types of risk perceptions. In reality, the lockdown in Wuhan (from Jan 23rd to Apr 8th, 2020) in Mainland China limited the spread of the virus to the nation. The situations in areas where most of the participants stayed were not as severe as those in other cities like Wuhan. Moreover, individuals might have tended to underestimate their own susceptibility to the virus, thus showing optimism biases (Weinstein, 1989). The belief of being less likely to experience misfortune than others is prevalent among people of all ages, and it further reduces people's motivation to adopt preventive behaviors with the illusion of self-invulnerability (Weinstein, 1989). Additionally, construal level theory (Liberman & Trope, 1998) posits that psychological distance plays a role in how people perceive risks, as well as in their behavioral intention. In this study, the epidemic was at its first stage, and many people were still experiencing psychological distance from the virus, as reflected by the relatively low susceptibility and societal risk that participants reported. As demonstrated in former research, decreasing sense of distance from risk might be considered to improve an individual's behavioral intention and actual health behaviors (Ahn, 2015). Supporting such proposition, the main targeted population, G3, in this study, reported a significantly higher level of susceptibility, and it further facilitated their preventive intention.

The moderating role of self-efficacy produced a significant indirect effect from severity perception to preventive intention for the low self-efficacy group of G1, and that from both severity and societal risk perception to preventive intention for the low self-efficacy group of G2. Our findings indicated that, for those high in self-efficacy, individuals reported high preventive intention regardless of their negative affect level. However, for those with low self-efficacy, preventive intention increased along with negative affect. The findings did not support our hypothesis (H4), which expected a positive association between negative affect and preventive intention for high self-efficacy individuals. Cognitive dissonance might provide affordance for the results. When people are not self-confident, they feel more fearful, anxious, and worried, and they are more likely to have the intention to follow the preventive policies to lower the

dissonance and tension they experience. However, whether such change only happens in belief and intention instead of behavior as in former research (Fotuhi et al., 2013) needs further study. Nevertheless, such findings suggest the importance of building people's confidence in achieving preventive measures. Public education and practical nudge strategies, such as posting more public service advertisements and providing more sanitizers at public places, can help to facilitate people's preventive behaviors and improve their efficacy.

Family Patterns in Coping with the Pandemic

The study revealed three types of families in coping with the pandemic at its early stage. The family is the key unit for epidemic control in collectivistic cultures like China where families usually live together. Thus, studying the family as a "whole" facilitates our understanding of family interaction (family system theory; Bowen, 1978) and further provides implications to the understanding and governance of social systems. Parent-child and marital dynamics, as well as family norms, can be key factors for individuals' underlying behavioral processes. The interactions within each subsystem exhibit adaptive meanings (Rothbaum et al., 2002). Indeed, former research posits that families may vary in vulnerability to the sequelae of the COVID-19 pandemic (Prime et al., 2020) due to both the objective situation, such as socioeconomic status, and subjective factors, such as communication and belief systems. In this study, a difference also exists in responses to the risk at the beginning. Approximately half of the families (i.e., stand-by families) are rational, being cautious to the adversity and showing high preventive intention. Precautious families are also alert in prevention while experiencing low negative affect. Meanwhile, insensitive families can be an issue for the pandemic control within society, as all the generations in this type of family perceive lower risk and report lower negative affect and preventive intention. Facing a high infectiousness virus like COVID-19, these families can be the weak part of the chain of pandemic control and threaten social management. Thus, recognizing and motivating these families to follow preventive measures actively will hugely benefit pandemic control.

Different generations in each of the three family types showed relatively consistent response patterns, probably because of the collectivistic culture in which the participants were embedded. However, strict control policies employed by many cities and districts have increased the chances that family members staying together, with intensive physical contact and emotional contact (Lebow, 2020). For example, there has been the intensive transformation of workplaces from the institutional form toward the home-office form. It is therefore possible that families have become closer than before, including those in individualistic societies. However, whether this change truly happened and whether the change

could survive the end of the pandemic among Western families calls for more exploration.

Contributions, Limitations, and Future Directions

The study contributes to the field of pandemic coping by revealing the intergenerational disparities in responses, uncovering the mechanism of risk perception linking to behavioral intention, and categorizing family types in reactions. Theoretically, the model supports the importance of severity perception across three generations and the role of negative affect in arousing individuals' preventive intention. In addition, helping the public to build self-efficacy has the potential to facilitate the intention to follow preventive measures. The three types of families imply the existence of family dynamic in coping with the pandemic. Practically, generational differences in this study indicate that communicating with different populations by considering their differences and enhancing people's confidence in overcoming the epidemic is crucial for pandemic control. Particularly designed health communication that especially targets the elderly to increase their intention to follow preventive measures may be needed. At the same time, insensitive families should also be given special attention. Although they only comprise a small part, they may still bring great risks to society under the pandemic.

Although the study has several contributions, the research still has certain limitations. Hence, we have some suggestions for the direction of future studies. First, the participants covered in this study were mainly from non-outbreak rather than high-risk areas like Wuhan. Therefore, generalizing the findings to people from outbreak centers should be careful. Future research could include the pandemic severity of the locations as a moderator and compare people's responses. Second, the study only explored people's responses at the early stage of the pandemic without tracing the pandemic development. Longitudinal studies could provide valuable implications in policies and strategies for pandemic control along with its evolution. Third, factors that accounted for different family response patterns were not clarified in this study. External indexes, such as social class and demographic factors, together with internal factors, such as interactions and relationship qualities between family members, should be further inquired to provide more direct standards to recognize insensitive families. In addition, the sample size was relatively small, and large-scale research is needed to verify the findings in this study. Despite these limitations, the study contributes to the understanding of different generations' responses to the unprecedented COVID-19 pandemic at its first stage, in which risk perception, especially perceived severity, was linked to preventive intentions through negative affect. Moreover, families might have reacted in three different ways. Therefore, pandemic control should take the characteristics of different generations and family patterns into consideration.

Declarations

Ethics Approval The research was approved by the Institutional Review Board of Shenzhen University.

Consent to Participate Informed consent was obtained from all individual participants included in the study.

Consent to Publication Participants all consented to submitting findings for publishing purposes.

Competing Interests The authors have no conflicts of interest to declare that are relevant to the content of this article.

References

Ahn, S. J. (2015). Incorporating immersive virtual environments in health promotion campaigns: A construal level theory approach. *Health Communication, 30*(6), 545–556. https://doi.org/10.1080/10410236.2013.869650

Amore, S., Puppo, E., Melara, J., Terracciano, E., Gentili, S., & Liotta, G. (2021). Impact of COVID-19 on older adults and role of long-term care facilities during early stages of epidemic in Italy. *Scientific Reports, 11*(1), 1–13. https://doi.org/10.1038/s41598-021-91992-9

Bardi, A., & Guerra, V. M. (2011). Cultural values predict coping using culture as an individual difference variable in multicultural samples. *Journal of Cross-Cultural Psychology, 42*(6), 908–927. https://doi.org/10.1177/0022022110381119

Barnett, D. J., Thompson, C. B., Semon, N. L., Errett, N. A., Harrison, K. L., Anderson, M. K., Ferrell, J. L., Freiheit, J. M., Hudson, R., McKee, M., Mejia-Echeverry, A., Spitzer, J., Balicer, R. D., Links, J. M., & Storey, J. D. (2014). EPPM and willingness to respond: The role of risk and efficacy communication in strengthening public health emergency response systems. *Health Communication, 29*(6), 598–609. https://doi.org/10.1080/10410236.2013.785474

Bouchard, T. J., & Loehlin, J. C. (2001). Genes, evolution, and personality. *Behavior Genetics, 31*(3), 243–273. https://doi.org/10.1023/A:1012294324713

Bowen, M. (1978). *Family therapy in clinical practice*. Jason Aaronson.

Cameron, L. D., Sherman, K. A., Marteau, T. M., & Brown, P. M. (2009). Impact of genetic risk information and type of disease on perceived risk, anticipated affect, and expected consequences of genetic tests. *Health Psychology, 28*(3), 307. https://psycnet.apa.org/doi/10.1037/a0013947

Chinese Academy of Social Sciences (2020). *The 18-day evolution of social mentality under the epidemic*. Available at: http://sociology.cssn.cn/shxsw/swx_kycg/swx_yjbg/202002/t20200218_5090128.html. Accessed 1 July 2022.

Chon, M. G., & Park, H. (2021). Predicting public support for government actions in a public health crisis: Testing fear, organization-public relationship, and behavioral intention in the framework of the situational theory of problem solving. *Health Communication, 36*(4), 476–486. https://doi.org/10.1080/10410236.2019.1700439

Chu, H., & Liu, S. (2021). Integrating health behavior theories to predict American's intention to receive a COVID-19 vaccine. *Patient Education and Counseling, 104*(8), 1878–1886. https://doi.org/10.1016/j.pec.2021.02.031

Duong, H. T., Vu, H. T., & Nguyen, L. T. V. (2021). Influenced by anonymous others: Effects of online comments on risk perception and intention to communicate. *Health Communication, 36*(7), 909–919. https://doi.org/10.1080/10410236.2020.1723050

Edmonds, B. M. T., Coleman, J., Armstrong, K., & Shea, J. A. (2011). Risk perceptions, worry, or distrust: What drives pregnant women's decisions to accept the H1N1 vaccine? *Maternal and Child Health Journal, 15*(8), 1203–1209. https://doi.org/10.1007/s10995-010-0693-5

Fotuhi, O., Fong, G. T., Zanna, M. P., Borland, R., Yong, H. H., & Cummings, K. M. (2013). Patterns of cognitive dissonance-reducing beliefs among smokers: A longitudinal analysis from the international tobacco control (ITC) four country survey. *Tobacco Control, 22*(1), 52–58. https://doi.org/10.1136/tobaccocontrol-2011-050139

Gao, J., Zheng, P., Jia, Y., Chen, H., Mao, Y., Chen, S., Wang, Y., Fu, H., & Dai, J. (2020). Mental health problems and social media exposure during COVID-19 outbreak. *PLoS One, 15*(4), e0231924. https://doi.org/10.1371/journal.pone.0231924

Griffin, R. J., Dunwoody, S., & Neuwirth, K. (1999). Proposed model of the relationship of risk information seeking and processing to the development of preventive behaviors. *Environmental Research, 80*(2), S230–S245. https://doi.org/10.1006/enrs.1998.3940

Grønhøj, A., & Thøgersen, J. (2012). Action speaks louder than words: The effect of personal attitudes and family norms on adolescents' pro-environmental behaviour. *Journal of Economic Psychology, 33*(1), 292–302. https://doi.org/10.1016/j.joep.2011.10.001

Kahlor, L. (2010). PRISM: A planned risk information seeking model. *Health Communication, 25*(4), 345–356. https://doi.org/10.1080/10410231003775172

Kasser, T., Ryan, R. M., Zax, M., & Sameroff, A. J. (1995). The relations of maternal and social environments to late adolescents' materialistic and prosocial values. *Developmental Psychology, 31*(6), 907. https://psycnet.apa.org/doi/10.1037/0012-1649.31.6.907

Keer, M., van den Putte, B., & Neijens, P. (2010). The role of affect and cognition in health decision making. *British Journal of Social Psychology, 49*(1), 143–153. https://doi.org/10.1348/014466609X425337

Kim, H. K., & Lai, C. H. (2020). Seeking and sharing information about transboundary air pollution in Singapore: Effects of own and others' information insufficiency. *Environmental Communication, 14*(1), 68–81. https://doi.org/10.1080/17524032.2019.1597751

Kim, J., Cao, X., & Meczkowski, E. (2018). Does stigmatization motivate people to quit smoking? Examining the effect of stigmatizing anti-smoking campaigns on cessation intention. *Health Communication, 33*(6), 681–689. https://doi.org/10.1080/10410236.2017.1299275

Kline, R. B. (2010). *Principles and practices of structural equation modeling*. Guilford.

Kuo, B. C. (2013). Collectivism and coping: Current theories, evidence, and measurements of collective coping. *International Journal of Psychology, 48*(3), 374–388. https://doi.org/10.1080/00207594.2011.640681

Lebow, J. L. (2020). Family in the age of COVID-19. *Family Process, 59*(2), 309–312. https://doi.org/10.1111/famp.12543

Leppin, A., & Aro, A. R. (2009). Risk perceptions related to SARS and avian influenza: Theoretical foundations of current empirical research. *International Journal of Behavioral Medicine, 16*(1), 7–29. https://doi.org/10.1007/s12529-008-9002-8

Lewis, I., Watson, B., & White, K. M. (2013). Extending the explanatory utility of the EPPM beyond fear-based persuasion. *Health Communication, 28*(1), 84–98. https://doi.org/10.1080/10410236.2013.743430

Li, Y., Zeng, Y., Liu, G., Lu, D., Yang, H., Ying, Z., ... Song, H. (2020). Public awareness, emotional reactions and human mobility in response to the COVID-19 outbreak in China – A population-based ecological study. *Psychological Medicine*, 1-8. https://doi.org/10.1017/S003329172000375X.

Liberman, N., & Trope, Y. (1998). The role of feasibility and desirability considerations in near and distant future decisions: A test of temporal construal theory. *Journal of Personality and Social Psychology, 75*(1), 5–18. https://doi.org/10.1037/0022-3514.75.1.5

Liu, M., Zhang, H., & Huang, H. (2020). Media exposure to COVID-19 information, risk perception, social and geographical proximity, and self-rated anxiety in China. *BMC Public Health, 20*(1), 1–8. https://doi.org/10.1186/s12889-020-09761-8.

Liu, W., Yue, X.-G., & Tchounwou, P. B. (2020). Response to the COVID-19 Epidemic: The Chinese Experience and Implications for Other Countries. *International Journal of Environmental Research and Public Health, 17*(7), 2304. MDPI AG. https://doi.org/10.3390/ijerph17072304.

Luo, Y., Cheng, Y., & Sui, M. (2021). The moderating effects of perceived severity on the generational gap in preventive behaviors during the COVID-19 pandemic in the US. *International Journal of Environmental Research and Public Health, 18*(4), 2011. https://doi.org/10.3390/ijerph18042011

Muthén, L. K., & Muthén, B. O. (1998). *Mplus: The comprehensive modeling program for applied researchers: User's guide*. Muthén & Muthén.

Ones, L. (2020). The COVID-19 pandemic: A family affair. *Journal of Family Nursing, 26*(2), 87–89. https://doi.org/10.1177/1074840720920883

Prime, H., Wade, M., & Browne, D. T. (2020). Risk and resilience in family well-being during the COVID-19 pandemic. *American Psychologist, 75*(5), 631–643. https://doi.org/10.1037/amp0000660

Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change1. *The Journal of Psychology, 91*(1), 93–114. https://doi.org/10.1080/00223980.1975.9915803

Ron, P., & Rovner, M. (2014). The relationship between self-esteem, sense of mastery and humor as personal resources and crisis-coping strategies in three generations. *Advances in Aging Research, 3*, 160–171. https://doi.org/10.4236/aar.2014.32024

Rosenstock, I. M. (1974). The health belief model and preventive health behavior. *Health Education Monographs, 2*(4), 354–386. https://doi.org/10.1177/109019817400200405

Rothbaum, F., Rosen, K., Ujiie, T., & Uchida, N. (2002). Family systems theory, attachment theory, and culture. *Family Process,*

41(3), 328–350. https://doi.org/10.1111/j.1545-5300.2002.41305.x

Sandberg, T., & Conner, M. (2008). Anticipated regret as an additional predictor in the theory of planned behaviour: A meta-analysis. *British Journal of Social Psychology, 47*(4), 589–606. https://doi.org/10.1348/014466607X258704

Shi, J., & Smith, S. W. (2016). The effects of fear appeal message repetition on perceived threat, perceived efficacy, and behavioral intention in the extended parallel process model. *Health Communication, 31*(3), 275–286. https://doi.org/10.1080/10410236.2014.948145

Slovic, P., Peters, E., Finucane, M. L., & MacGregor, D. G. (2005). Affect, risk, and decision making. *Health Psychology, 24*(4, Suppl), S35–S40. https://doi.org/10.1037/0278-6133.24.4.S35

So, J. (2013). A further extension of the extended parallel process model (E-EPPM): Implications of cognitive appraisal theory of emotion and dispositional coping style. *Health Communication, 28*(1), 72–83. https://doi.org/10.1080/10410236.2012.708633

Tyler, T. R., & Cook, F. L. (1984). The mass media and judgments of risk: Distinguishing impact on personal and societal level judgments. *Journal of Personality and Social Psychology*, *47*(4), 693. https://psycnet.apa.org/doi/10.1037/0022-3514.47.4.693

Weinstein, N. D. (1989). Optimistic biases about personal risks. *Science, 246*(4935), 1232+ https://link.gale.com/apps/doc/A8351381/HRCA?u=anon~4ea35eb2&sid=googleScholar&xid=e783525c

Witte, K. (1994). Fear control and danger control: A test of the extended parallel process model (EPPM). *Communications Monographs, 61*(2), 113–134. https://doi.org/10.1080/03637759409376328

Zarghami, F., Allahverdipour, H., & Jafarabadi, M. A. (2021). Extended parallel process model (EPPM) in evaluating lung Cancer risk perception among older smokers. *BMC Public Health, 21*(1), 1–11. https://doi.org/10.1186/s12889-021-11896-1

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