Impact of Risk Perception on Public Willingness to Protect Health in Public Health Emergencies: Postprint

Authors: QI Yunfei, Li Qidong, Zhao Yuxiang, Zhu Qinghua

Date: 2023-04-01T16:15:58+00:00

Abstract

[Purpose/Significance] Based on protection motivation theory, this study examines the impact of pandemic information on cultivating public risk awareness, reveals the cognitive patterns of individuals when facing pandemic risks, and explores communication measures that can enhance public willingness for health protection. [Method/Process] Through an online survey, 450 questionnaire responses were collected from 28 provinces across the country. PLS was employed for structural equation modeling analysis, and the hypotheses proposed in the study were validated after testing the measurement model and structural model. [Results/Conclusions] The study finds that threat awareness and coping awareness can significantly enhance public threat appraisal and coping appraisal, forming distinctive risk cognitive characteristics. Adhering to these characteristics in public communication can maximally influence their health protection willingness. The study also reveals that the current public perception of susceptibility is generally low, which may lead to a series of issues such as optimistic bias and should receive more attention.

Full Text

The Impact of Risk Awareness on Public Health Protection Intention During Public Health Emergencies

Qi Yunfei[1], Li Qidong[2], Zhao Yuxiang[3], Zhu Qinghua[4]

[1]School of Information Management, Zhengzhou University of Aeronautics, Zhengzhou 450015
[2]School of Information Management, Zhengzhou University, Zhengzhou 450001
[3]School of Economics & Management, Nanjing University of Science & Technology, Nanjing 210094
[4]School of Information Management, Nanjing University, Nanjing 210023

Abstract

[**Purpose/Significance**] Based on protection motivation theory, this study examines the impact of epidemic information on cultivating public risk awareness, reveals how people cognitively process pandemic risks, and explores communication measures that can enhance public health protection intention. [**Method/Process**] Through an online survey, 450 questionnaire responses were collected from 28 provinces across China. Partial Least Squares (PLS) structural equation modeling was employed, with measurement model and structural model testing conducted to verify the proposed hypotheses. [**Results/Conclusion**] The findings indicate that threat awareness and countermeasure awareness can significantly improve public threat appraisal and coping appraisal, forming distinctive risk perception characteristics. If these characteristics are followed in public communication, they can maximize influence on health protection intention. The study also finds that public perception of vulnerability is currently low, which may lead to optimistic bias and related issues that warrant greater attention.

Keywords: risk communication, protection motivation theory, perceived severity, perceived vulnerability, response efficacy, risk awareness

Introduction

On January 30, 2020, the World Health Organization declared the novel coronavirus (COVID-19) pneumonia epidemic a "Public Health Emergency of International Concern" [1]. In response, the Chinese government implemented active measures, including strict control protocols to limit viral transmission and multi-channel dissemination of updated epidemic information to maintain effective government-public communication. According to data from the National Health Commission, by 24:00 on March 29, 2020, China had 3,373 existing confirmed cases with 106 new cases (30 imported), demonstrating that the domestic epidemic was effectively controlled [2].

Protection Motivation Theory (PMT) is a systematic model describing the relationship between fear and persuasion. It not only explains how risk information influences protection motivation but also provides a systematic risk communication strategy [19]. PMT divides risk cognitive processing into two stages: (1) fear arousal triggered by risk information, and (2) fear influencing health protection behaviors through two pathways—threat appraisal and coping appraisal [20-23]. PMT has been applied to research on various public health emergencies including SARS, H1N1, and H7N9 [24-35]. For instance, M. Ling et al. used multiple regression to analyze the impact of six PMT constructs on seasonal influenza intervention intention [25], while E. Teasdale et al. employed structural equation modeling to examine how threat appraisal and coping appraisal influence public health protection behaviors during pandemics [31].

Insufficient emergency preparedness for public health emergencies can have severe consequences. Given COVID-19's high transmissibility, failure to control

viral spread promptly would pose serious health threats to the public [3-5]. While maintaining good hygiene, wearing masks, and social distancing have proven effective against pandemics [6-11], implementation depends on various factors. Beyond necessary epidemic knowledge [7-8], social and cognitive factors also affect health protection behaviors [9,11-15]. Understanding public risk perception and guiding correct protective measures through targeted information communication is therefore crucial [10,16-18].

Research shows that lack of risk awareness causes people to ignore risk signals, preventing timely emergency response and missing optimal intervention windows [36-39]. While studies have verified risk awareness's impact on health protection behaviors during public health emergencies [40-43], systematic research on the specific influence processes, pathways, and methods remains limited. As an important theory in health protection, PMT provides a framework explaining relationships among risk information, risk appraisal, and protection intention [44-45], offering valuable insights for this study. This paper builds upon PMT to reveal how risk awareness influences public health protection intention during public health emergencies, focusing on: (1) constructing and validating a theoretical model explaining relationships among risk awareness, health protection intention, and related factors; and (2) proposing communication measures to improve public health protection intention based on model validation results.

Literature Review

2.1 Health Protection Behaviors in Public Health Emergencies

Public health emergencies refer to sudden events that may cause serious public health harm, including major infectious disease outbreaks, unexplained group illnesses, major food and occupational poisoning, and other events severely affecting public health [46]. Such emergencies are characterized by suddenness, destructiveness, urgency, unpredictability, and public attention, representing major events concerning public health and social security [47]. Before the current pandemic, the world experienced SARS, H1N1, H7N9, and other public health emergencies, with researchers examining both protective measures and their influencing factors [6-17].

Regarding protective measures, studies have focused on pharmaceutical and non-pharmaceutical interventions. While pharmaceutical treatment is most effective for reducing infections, non-pharmaceutical measures like handwashing, mask-wearing, and social distancing are also considered critical and effective [6-11,14]. J.Y. Heo et al. noted that before epidemic peaks, when drug supplies are limited, non-pharmaceutical measures are more effective for reducing viral harm [17]. S. Hashmi et al. found that combining both approaches is not only effective but more economical [10].

Guiding health protection behaviors is challenging, as information, emotion, and cognition all influence intention [14]. Information research has analyzed how information sources, quantity, and communication channels affect protec-

tive behaviors. B. Etingen et al. found that individuals receiving adequate information were more likely to adopt protective measures, with information sources affecting their evaluation of information quantity [8]. Y.Y. Tsai et al. discovered that knowledge has the most significant impact on protective behaviors, while time spent watching epidemic information had no significant effect [7]. Knowledge reflects individuals' mastery of risk information, with many studies attributing non-adoption or incorrect adoption of protective behaviors to knowledge gaps [7,10-11,14]. Regarding communication channels, W.Y. Yoo et al. found that receiving social media information could increase protection intention, while posting on social media could indirectly increase intention through self-efficacy [48]. A. McNeill et al. analyzed Twitter content to identify barriers and facilitators to H1N1 pharmaceutical treatment [49].

Individual factors research has examined how anxiety, worry, perceived severity, perceived vulnerability, controllability, efficacy, and self-efficacy affect health protection intention based on Health Belief Model and PMT [6,9,11-15,25-29,32-35,50]. Q.Y. Liao et al. found that negative emotions and vulnerability/severity cognition increased protection intention, with emotional factors outweighing cognitive factors throughout outbreak stages [6]. H.C. Chao et al. found that optimistic bias reduced risk communication's impact on intervention behaviors, warranting attention [50]. Environmental factors also matter, as P.K.H. Mo et al. noted that protective behavior determinants differ by epidemic stage—threat appraisal dominates early while coping appraisal dominates post-epidemic [9]. Additionally, studies have found differences in health protection behaviors across age, gender, occupation, race, and health status groups [7-9,14,17,51].

2.2 Risk Awareness and Health Protection Behavior

Risk awareness deficits during health-related events often cause severe consequences. M.J. Fuster-RuizdeApodaca et al. noted many HIV infections occurred unconsciously, with diagnosis awareness deficits causing missed optimal treatment windows and higher morbidity/mortality [36]. E.B. Selcuk et al. reported travelers failing to take necessary precautions due to unawareness of health risks [38]. These studies demonstrate close links between risk awareness and protective behavior—lack of awareness causes people to ignore warning signals and miss optimal timing for health protection [36,39], while enhanced awareness increases protective measure adoption and reduces health risks [37,41-42,52]. M.D. Liu et al. found that strengthening policy awareness increased self-protection intention against avian influenza [41]. E. Maidl et al. found higher risk awareness motivated information seeking and active emergency preparedness [53]. R. Goodwin et al. found high mortality awareness during H7N9 outbreak increased adoption of recommended protective measures [42].

Risk events increase risk awareness [41,54-55]. M.D. Liu et al. found significant improvements in risk awareness and protective behaviors after H5N2 outbreak [41]. E. Mondino et al. compared hydrological-geological risk awareness between 2005 and 2018, finding significantly lower awareness in 2018 due to absence of

risk events [54]. Knowledge and experience are key influencing factors, with high knowledge typically meaning high awareness [56]. M. Moghim et al. studied surgeons' awareness of blood-borne pathogen infection risk during surgery, finding doctors with threat knowledge had higher risk concern [37]. S. Yang et al. found nurses who experienced musculoskeletal disorders had higher injury risk awareness and paid more attention to symptoms [57]. Across health risk domains, researchers advocate developing targeted risk communication strategies and strengthening education to improve risk threat awareness [55,57-61].

In summary, previous research has focused on cognitive appraisal methods and influencing factors of risk information, proposing classic models like Health Belief Model and PMT to explain how risk cognition influences protection intention and behavior, validated in SARS, H1N1, and H7N9 contexts. While these studies effectively reveal risk information processing, insufficient research exists on awareness's 先导作用. Although PMT identifies fear appeals (threat awareness) as key triggers for risk appraisal, lack of systematic theoretical models has limited verification of these relationships. Many studies now recognize risk awareness's importance and its deficit's severe consequences. This paper builds on existing research to construct a theoretical model systematically explaining relationships among risk awareness, risk appraisal, and health protection behavior. Based on PMT, we treat risk awareness as external variables and risk appraisal as mediating variables, using structural equation modeling to analyze multi-path effects on health protection intention and propose targeted interventions.

Model and Hypotheses

3.1 Research Model

Protection Motivation Theory, proposed by R.W. Rogers, explains relationships between fear appeals and public health protection intention [19-20]. PMT posits that risk information processing involves two pathways: threat appraisal (evaluating negative health threat outcomes, comprising perceived severity and perceived vulnerability) and coping appraisal (evaluating recommended protective measures' effectiveness, comprising response efficacy, response cost, and self-efficacy) [20-23]. Both appraisals directly influence protection intention—higher threat and coping appraisals increase health protection intention. Additionally, the two appraisals interact, with high threat appraisal strengthening coping appraisal's effect on protection intention [21-22]. To emphasize social influence's role in risk cognition, researchers introduced subjective norm [19,27,62]. PMT has been widely applied in infectious diseases, cancer, and environmental protection [19,24-35,44-45,63-74].

Based on PMT, this study constructed a risk awareness-health protection intention model (see Figure 1). The model inherits PMT's six cognitive appraisal constructs while adding two risk awareness constructs affecting subsequent cognitive appraisal. We divide risk awareness into threat awareness and countermeasure awareness for two reasons: (1) This dual approach better re-

flects reality. While PMT suggests risk information creates fear appeals (threat awareness), government information actually contains both threat and countermeasure information—warning of dangers while providing solutions, simultaneously triggering both awareness types [75-76]. (2) Equating risk awareness with threat awareness limits persuasive communication options and has "side effects" [37,39,42,53,77]. E. Maidl et al. found that emphasizing threat alone, while raising risk awareness, didn't significantly affect protective behavior [53]. H. Feenstra et al. noted that fear arousal may trigger defensive reactions like risk denial, biased information processing, and reduced information attention [77], with low response efficacy and self-efficacy being key causes [20-23]. When people feel incapable of addressing risks or believe responses are ineffective, fear leads to avoidance. Therefore, simultaneously improving both threat awareness and countermeasure awareness is crucial.

3.2 Research Hypotheses

Threat awareness reflects individuals' ability to identify potential threats through risk information. Identifying threats indicates threat awareness [39,41-42,53-54,62]. PMT suggests threat awareness triggers fear and increases evaluation of health threat severity [20-23]. During this epidemic, China's multi-channel information release, coupled with rising death tolls, helped the public recognize viral threats and assign higher severity evaluations. Therefore:

H1A: Threat awareness positively influences perceived severity.

As a threat appraisal component, higher threat awareness should also strengthen epidemic information's impact on infection probability judgments [20-23,63]. For this epidemic, higher threat awareness increases attention to government-released infection data, enhancing perceived infection probability. Therefore:

H1B: Threat awareness positively influences perceived vulnerability.

Countermeasure awareness reflects individuals' ability to identify effective responses through risk information. When fear appeals from risk information arise, only awareness of effective countermeasures motivates people to seek countermeasure information and conduct coping appraisal [36-37,39,41-42]. In information security, B. Hanus et al. verified countermeasure awareness's positive effect on coping appraisal [75]. R. Torten et al. found countermeasure awareness better helps translate knowledge into action [76]. For this epidemic, higher countermeasure awareness increases attention to health protection measures, motivating active knowledge seeking and learning, which improves perceived measure effectiveness. Therefore:

H2A: Countermeasure awareness positively influences response efficacy.

Countermeasure awareness shifts focus from threats to countermeasures. More knowledge learning also improves public confidence in coping abilities [63,66,72,78]. Therefore:

H2B: Countermeasure awareness positively influences self-efficacy.

Higher countermeasure awareness and information attention enable more comprehensive cost-benefit analysis, reducing sensitivity to time and money costs and alleviating fear-induced psychological costs [19,45,63,69]. Therefore:

H2C: Countermeasure awareness negatively influences response cost.

Higher countermeasure awareness and information attention facilitate epidemic information communication with family and friends, and improve understanding of government and organizational anti-epidemic policies [19,27,73]. Therefore:

H2D: Countermeasure awareness positively influences social influence.

Perceived severity reflects cognition of how seriously the virus harms physical health, generating strong fear [31,68] and motivating protective behaviors [63-64,70-71,73]. E. Teasdale et al. found pandemic severity is an important predictor of threat and coping appraisal [31]. J.C. Ruthig found perceived severity significantly predicted fear of coronary heart disease [68]. In public health emergencies, perceived severity positively influences protection intention for H1N1, H7N9, and seasonal influenza [25,27-28,33]. For COVID-19, severe health impacts increase public perceived severity and motivate adoption of government-recommended measures. Therefore:

H3: Perceived severity positively influences public health protection intention.

Perceived vulnerability reflects judgments of infection probability, another key threat appraisal factor [20-23]. It triggers fear and influences protective behaviors. In health research, higher perceived vulnerability increases protective measure adoption to avoid heavy metal, skin cancer, and breast cancer hazards [66-67,70-71,73]. During public health emergencies, high vulnerability increases intervention intention for H1N1, H7N9, and seasonal influenza [25-27]. For this epidemic, higher infection probability increases threat appraisal and motivates protective measures. Therefore:

H4: Perceived vulnerability positively influences public health protection intention.

Response efficacy reflects beliefs that health protection measures can effectively address viral threats [68]. As a core coping appraisal component, higher response efficacy increases health protection intention. Many studies show significant positive relationships between response efficacy and health protection behaviors [18,63,66-71,73]. During public health emergencies, response efficacy is a key predictor of intervention behaviors for H1N1, H7N9, and seasonal influenza [25-28,31,48]. If the public recognizes government-recommended measures as effective, they will implement them sincerely. Therefore:

H5: Response efficacy positively influences public health protection intention.

Self-efficacy reflects individuals' confidence in coping with health threats [27,68], another efficacy evaluation component in coping appraisal [31]. Many stud-

ies show significant positive relationships between self-efficacy and health protection intention/behavior [25-28,66-68,71-72]. For this epidemic, higher self-efficacy enables confident threat confrontation and correct countermeasure seeking. Therefore:

H6: Self-efficacy positively influences public health protection intention.

Adopting health protection measures requires time and money, potentially causing emotional discomfort and psychological costs. Many studies find response cost reduces health protection intention [31,67,69], though some find insignificant effects [18,19,25,68]. For COVID-19, the long anti-epidemic period increases living and psychological costs, with some respondents experiencing anxiety, worry, and depression [79-81]. Therefore:

H7: Response cost negatively influences public health protection intention.

PMT reflects social-cognitive decision-making processes for protective behaviors, where social influence plays a key role beyond individual factors [62]. A.L. Gamerini et al. found social influence indirectly affected child vaccination intention through response efficacy [19]. H.C. Cho and J.S. Lee found subjective norms significantly positively influenced H1N1 intervention adoption intention [27]. T.A. Luu et al. found social influence was the most critical factor driving environmental adaptation [82]. During this epidemic, all social sectors participated in virus prevention, with governments and organizations strengthening supervision and management of residents' and employees' epidemic responses. Family and friends also transmitted risk information for safety needs, significantly influencing health protection intention. Therefore:

H8: Subjective norms positively influence public health protection intention.

Methods and Results

4.1 Questionnaire Design and Data Collection

This study collected data through questionnaires measuring: (1) basic respondent information (gender, age, education, occupation, region, health status, information channels); and (2) research constructs including threat awareness, countermeasure awareness, perceived severity, perceived vulnerability, response efficacy, self-efficacy, response cost, subjective norms, and protection intention. All items used seven-point Likert scales. For threat awareness, countermeasure awareness, and subjective norm items, 1 represented "very uncharacteristic" and 7 "very characteristic"; for other items, 1 represented "strongly disagree" and 7 "strongly agree" (see Table 1).

Data collection involved pilot and formal surveys. To test measurement effectiveness, on February 25, 2020, we distributed pilot questionnaires online to university students, collecting 185 responses. Based on identified issues with unclear wording and poor measurement effects, we consulted multiple domain experts for guidance. After revision, the formal survey was launched on March

7, 2020. Since previous research found gender and urban-rural differences affect health protection behaviors [7-9], and this epidemic had clear regional characteristics, we used stratified sampling with a 1:1 gender and urban-rural ratio. We commissioned "Tencent Questionnaire" to randomly distribute questionnaires to provinces with epidemic cases. Tencent Questionnaire was selected for its large user base and ability to target distribution. We obtained 493 questionnaires, removing 43 invalid responses for a final sample of 450 from 28 provinces, autonomous regions, and municipalities. The sample had balanced gender (46.2% male, 53.8% female), was predominantly aged 15-29 (61.1%), had balanced urban-rural distribution (49.8% urban), and was mostly enterprise employees (35.1%).

4.2 Data Analysis and Results

4.2.1 Data Analysis We used SmartPLS for Partial Least Squares (PLS) structural equation modeling. PLS was chosen because it is oriented toward exploratory research and better explains dependent variable variation in small samples [75], making it suitable for our exploratory analysis of risk awareness's influence on protection intention.

Before analysis, we tested for common method bias using Harman's single-factor test, which generated 31 factors with the largest explaining 38.8% of variance—insufficient to indicate common method bias. We also examined construct correlations, finding no correlations exceeding 0.9. Following Podsakoff et al. [83] and Liang et al. [84], we built a second-order model with common method factor and single-indicator constructs, comparing method factor loadings with substantive factor loadings. Substantive factors explained a mean of 0.899 variance while method factors explained 0.065, a large difference (14:1 ratio), confirming no common method bias.

4.2.2 Results (1) Measurement Model Testing. For item reliability, all factor loadings should exceed 0.5. As Table 2 shows, all loadings exceeded 0.5, indicating good reliability.

For convergent validity, besides factor loadings >0.5, construct composite reliability should exceed 0.7 and average variance extracted (AVE) should exceed 0.5. Table 2 shows all six constructs had composite reliability >0.9 and AVE between 0.7-0.8, indicating good convergent validity. For discriminant validity, AVE's square root should exceed correlations with other constructs. Table 3 shows each construct's AVE square root (on the diagonal) exceeded its correlations with other constructs, indicating good discriminant validity.

(2) Structural Model Testing. Based on the measurement model, we used SmartPLS bootstrapping (1,000 resamples) to obtain path coefficient significance levels. Construct R^2 values, path coefficients, and significance levels are shown in Figure 2 [Figure 2: see original paper].

Results show threat awareness significantly influenced perceived severity, while

countermeasure awareness significantly influenced response cost, response efficacy, self-efficacy, and subjective norms, supporting H1A, H2A, H2B, H2C, and H2D. H1B was rejected as threat awareness had significant negative influence on perceived vulnerability. Besides perceived vulnerability's non-significant effect, perceived severity, response efficacy, self-efficacy, response cost, and subjective norms all significantly influenced protection intention, with response cost having significant negative influence, supporting H3, H5, H6, H7, and H8 but not H4.

In terms of explained variance, perceived vulnerability and response cost had low R^2, while perceived severity had 13.4% explained variance, response efficacy 32.3%, self-efficacy 36.1%, subjective norms 25.2%, and protection intention 54.9%, indicating good model explanatory power.

Discussion and Implications

5.1 Results Discussion

Regarding risk awareness, respondents showed high threat awareness (mean $5.91\$\pm1.042, median 6.00) and countermeasure awareness (mean 6.14\pm\$0.993$, median 6.50), indicating effective government risk communication. Model results show threat awareness significantly increased perceived severity, while countermeasure awareness significantly increased response efficacy, self-efficacy, and subjective norms, and decreased response cost. These results demonstrate risk awareness's effective influence on most risk cognition factors. Increasing threat awareness helps the public recognize epidemic severity [36-37,39,41]; increasing countermeasure awareness enhances confidence in government-recommended measures, reduces sensitivity to time/money/psychological costs, and improves understanding of and compliance with society's unified anti-epidemic consensus [26,65,72,78]. Notably, countermeasure awareness's significant effect suggests it can serve as a new coping appraisal motivator, improving response efficacy and self-efficacy to avoid avoidance problems that pure fear-based threat appraisal might trigger [12].

Meanwhile, threat awareness showed significant negative influence on perceived vulnerability, contrary to our hypothesis. Research on this relationship shows mixed results: R. Torten et al. verified positive influence [76], while B. Hanus et al. found non-significant influence, attributing it to excessive exaggerated information reducing threat judgment [75]. Our interpretation is that perceived vulnerability is a multidimensional construct affected by perceived controllability besides threat awareness [9,11], which likely moderates the relationship. When the public believes the epidemic is completely controllable, high threat awareness may still produce low vulnerability, making them feel the virus is distant and reducing threat judgment [85].

Regarding cognitive appraisal, besides perceived vulnerability, all other health protection intention determinants were significant. Coping appraisal (response efficacy, self-efficacy, response cost) showed stronger influence than threat ap-

praisal (perceived severity), indicating coping appraisal's dominant role, consistent with R.W. Rogers et al. [20,25-26,28,31]. According to P.K.H. Mo et al., public risk appraisal shows clear stage characteristics—threat appraisal dominates early in public health emergencies, but coping appraisal dominates as events subside [6,9,14,17]. These results suggest that facing COVID-19, the public had moved beyond initial panic toward rational understanding. For threat appraisal, since perceived vulnerability's effect was non-significant, perceived severity fully explained threat appraisal's influence on protection intention, consistent with P.K.H. Mo et al. [9,63]. For coping appraisal, response efficacy explained the most variance, followed by self-efficacy, aligning with B. Cui et al. [26,28,68,71].

5.2 Research Implications

5.2.1 Strengthening Public Risk Awareness Cultivation During public health emergencies, governments should prioritize public risk awareness cultivation because it helps people identify potential threats, seek correct responses, improve risk appraisal quality, and motivate correct protective measures, avoiding inappropriate responses from awareness deficits [36-39]. Risk communication effectively cultivates risk awareness by increasing sensitivity to health threats and countermeasures and strengthening risk appraisal's impact on protective behaviors [56,58-59,61]. PMT emphasizes using fear to guide attention to countermeasures and protective actions [20-23], but high fear and threat appraisal with low response/self-efficacy trigger avoidance [12]. Therefore, facing COVID-19, governments should cultivate risk awareness through both threat and countermeasure awareness, using targeted epidemic information to guide comprehensive, objective, rational threat evaluation and improve self-protection capability. Specifically, when releasing risk information, governments should emphasize both virus severity/vulnerability (increasing threat awareness) and countermeasure effectiveness/feasibility (increasing countermeasure awareness) to guide correct health protection.

5.2.2 Developing Communication Strategies Based on Public Cognitive Patterns Public health emergencies have clear stage characteristics—early and late epidemic stages show different risk identification and evaluation patterns [6,9]. Therefore, guiding protective behaviors requires targeted education based on current cognitive patterns [65,78]. When this survey was conducted, China's epidemic was stage-controlled, with reduced threat appraisal influence and dominant coping appraisal influence on protection intention. Thus, government-public communication should emphasize countermeasure awareness cultivation [25-26,28,31]. Results also show response efficacy and self-efficacy as core coping appraisal components, so countermeasure awareness cultivation should focus on enhancing perceived measure effectiveness and implementation confidence [26,28,68].

Meanwhile, PMT indicates interaction between threat and coping appraisal,

with low vulnerability limiting response efficacy and self-efficacy's impact on protective behavior [21,23]. Therefore, we should address the current low vulnerability issue through more epidemic transmission case/knowledge publicity to improve threat recognition. Given vulnerability's multidimensional nature, communication should emphasize both high transmissibility and the epidemic's dynamic changes, uncertainties, and uncontrollable factors requiring constant vigilance [9,11]. Additionally, we should address optimistic bias from low vulnerability through continuous education and timely reminders to maintain rational threat recognition and appropriate responses, preventing complacency-induced prevention lapses [50,85].

References

[1] Chai Guangjun, Suo Jijiang, Liu Yunxi, et al. Preliminary investigation on epidemiological investigation experience of COVID-19 outbreak [J]. Chinese Journal of Nosocomiology, 2020, 30(8): 1147-1151.
[2] National Health Commission of the People's Republic of China. Real-time national epidemic dynamics [R/OL]. [2020-03-29]. http://www.nhc.gov.cn/xcs/yqtb/202003/c46e73d692d047619b
[3] Li Shixue, Shan Ying. Review of research progress on COVID-19 [J]. Journal of Shandong University (Medical Science), 2020, 58(3): 19-25.
[4] Li Tianzhi, Xu Guogang. Research progress on COVID-19 diagnosis and treatment [J]. Medical Journal of Chinese People's Liberation Army, 2020, 45(3): 260-264.
[5] Wu Tong, Hu Erya, Zeng Wenhui, et al. China's unprecedented measures to control the 2019 coronavirus disease epidemic (English) [J]. Journal of Central South University (Medical Science), 2020, 45(3): 334-337.
[6] Liao QY, Cowling BJ, Lam WW, et al. Anxiety, worry and cognitive risk estimate in relation to protective behaviors during the 2009 influenza A/H1N1 pandemic in Hong Kong: ten cross-sectional surveys [J]. Biomedcentral, 2014, 14: 169-180.
[7] Tsai YY, Lee JJS, Hsieh WW. Determinants of the public intent to receive the seasonal influenza vaccine and protective behaviors: a population-based study in Taiwan [J]. Vaccine, 2014, 32(49): 6667-6676.
[8] Etingen B, Lavela SL, Miskevics SS, et al. Health information sources, information sufficiency, and protective behaviors in veterans at risk of H1N1 [J]. Journal of health communication, 2013, 38(3): 443-450.
[9] Mo PKH, Lau JTF. Illness representation on H1N1 influenza and preventive behaviors, and vaccination coverage in the Korean population during the 2009-2010 pandemic influenza a (H1N1): comparison between high-risk group and non-high-risk group [J]. Plos one, 2013, 8(5): 1-8.
[10] Hashmi S, D'Ambrosio L, Diamond DV, et al. Preventive behaviors and perceived infection prevention influence among university student population [J]. Journal of public health, 2016, 28(4): 1-7.
[11] Gu J, Zhong Y, Hao YT, et al. Preventive behaviors and mental distress in response to H1N1 among university students in Guangzhou, China [J]. Asia-pacific journal of public health, 2015, 27(2): 1867-1879.

[12] Jeong HS, Lee DW, Youn CH, et al. Perception and performance of preventive behaviors for the pandemic influenza in hospital employees and outpatients [J]. Yonsei medical journal, 2011, 52(1): 181-187.
[13] Lau JTF, Griffiths S, Choi KC, et al. Prevalence of preventive behaviors and associated factors during early phase of the H1N1 influenza epidemic [J]. Journal of public health, 2010, 38(5): 374-381.
[14] Kanadiyam K, Sallaram M. Preventive behaviors, beliefs, and anxieties in relation to the swine flu outbreak among college students aged 18-24 years [J]. J public health, 2011, 19(2): 139-145.
[15] Keller JJ, Kim JH, Lau JCH, et al. Intention to engage in preventive behaviors in response to the A/H1N1 pandemic among university entrants in four Chinese cities [J]. Asia-Pacific journal of public health, 2014, 26(1): 42-47.
[16] Kim YS, Zhong W, Jehn M. Public risk perceptions and preventive behaviors during the 2009 H1N1 influenza pandemic [J]. Disaster medicine and public health, 2015, 9(2): 145-154.
[17] Heo JY, Chang SH, Gom J, et al. Risk perception, preventive behaviors, and vaccination coverage in the Korean population during the 2009-2010 pandemic influenza a (H1N1) [J]. Plos one, 2013, 8(5): 1-8.
[18] Xie B, He DQ, Mercert. Global health crises are also information crises: a call to action [J/OL]. Journal of the Association for Information Science and Technology, 2020: 1-5. [2020-07-03]. https://asistdl.onlinelibrary.wiley.com/doi/epdf/10.1002/asi.24357.
[19] Gamerini AL, Diviani N, Fadda M, et al. Using protection motivation theory to predict intention to adhere to official MMR vaccination recommendations in Switzerland [J]. SSM-population health, 2019, 7: 1-11.
[20] Rogers RW. A protection motivation theory of fear appeals and attitude change [J]. The journal of psychology, 1975, 91(1): 93-114.
[21] Rogers RW, Mewborn CR. Fear appeals and attitude change: effects of a threat's noxiousness, probability of occurrence, and the efficacy of coping responses [J]. Journal of personality and social psychology, 1976, 34(1): 54-61.
[22] Maddux JE, Sherer M, Rogers RW. Self-efficacy expectancy and outcome expectancy: their relationship and their effects on behavioral intention [J]. Cognitive therapy and research, 1982, 6(2): 207-211.
[23] Maddux JE, Rogers RW. Protection motivation and self-efficacy: a revised theory of fear appeals and attitude change [J]. Journal of experimental social psychology, 1983, 19(5): 469-479.
[24] Cui B, Wang LD, Ke J, et al. Chinese poultry farmers' decision-making for avian influenza prevention: a qualitative analysis [J]. Zoonoses public health, 2019, 66(6): 647-654.
[25] Ling M, Kothee J, Mullan BA. Predicting intention to receive seasonal influenza vaccination using protection motivation theory [J]. Social science & medicine, 2019, 233: 87-92.
[26] Cui B, Liao QY, Lam WW, et al. Avian influenza A/H7N9 risk perception, information trust and adoption of protective behaviors among poultry farmers in Jiangsu Province, China [J]. BMC public health, 2017, 17(1): 463-476.
[27] Cho HC, Lee JS. The influence of self-efficacy, subjective norms, and risk perception on behavioral intentions related to the H1N1 flu pandemic: a

comparison between Korea and the US [J]. Asian journal of social psychology, 2015, 18(4): 311-324.
[28] Bell MA, Dake JA, Price JH, et al. A national survey of emergency nurses and avian influenza threat [J]. Journal of emergency nursing, 2014, 40(3): 212-217.
[29] Liao QY, Wong WS, Fielding R. Comparison of different risk perception measures in predicting seasonal influenza vaccination among healthy Chinese adults in Hong Kong: a prospective longitudinal study [J]. Plos one, 2013, 8(7): 1-8.
[30] Evensen DT, Clarke CE. Efficacy information in media coverage of infectious disease risks: an ill predicament? [J]. Science communication, 2012, 34(3): 392-418.
[31] Teasdale E, Yardley L, Schlotz W, et al. The importance of coping appraisal in behavioural responses to pandemic flu [J]. British journal of health psychology, 2012, 17(1): 44-59.
[32] Goodall C, Sabo J, Cline R. Threat, efficacy, and uncertainty in the first 5 months of national print and electronic news coverage of the H1N1 virus [J]. Journal of health communication, 2012, 17(3): 338-355.
[33] Zwarthoed D, Veldhuijzen IK, Richardus JH, et al. Monitoring of risk perceptions and correlates of precautionary behaviour related to human avian influenza during 2006-2007 in the Netherlands: results of seven consecutive surveys [J]. BMC infectious diseases, 2010, 10(1): 114-129.
[34] Jiang XY, Elam G, Yuen C, et al. The perceived threat of SARS and its impact on precautionary actions and adverse consequences: a qualitative study among Chinese communities in the United Kingdom and the Netherlands [J]. International Society of Behavioral Medicine, 2009, 11(3): 241-256.
[35] Jiang XY. The virtual SARS epidemic in Europe 2002-2003 and its effects on European Chinese [J]. Health, risk & society, 2009, 11(3): 241-256.
[36] Fuster-RuizdeApodaca MJ, Laguia A, Molero F, et al. Psychosocial determinants of HIV testing across stages of change in Spanish population: a cross-sectional national survey [J]. BMC public health, 2017, 17(1): 234-246.
[37] Moghimim M, Marashi SA, Kabir A, et al. Knowledge, attitude, and practice of Iranian surgeons about blood-borne diseases [J]. Journal of surgical research, 2009, 151(1): 80-84.
[38] Selcuk EB, Kayabas U, Binbasoglu H, et al. Travel health attitudes among Turkish business travellers to African countries [J]. Travel medicine and infectious disease, 2016, 14(6): 1-7.
[39] Xu WL, Hao YH, Wu QH, et al. Community preparedness for emergency: a cross-sectional survey of residents in Heilongjiang of China [J]. BMJ open, 2015, 5(11): 1-9.
[40] Scolobig A, Marchi BD, Borga M. The missing link between flood risk awareness and preparedness: findings from case studies in an Alpine Region [J]. Natural hazards, 2012, 63(2): 499-520.
[41] Liu MD, Chan TC, Wan CH, et al. Changing risk awareness and personal protection measures for low to highly pathogenic avian influenza in live-poultry markets in Taiwan, 2007 to 2012 [J]. BMC infectious diseases, 2015, 15(1):

241-256.
[42] Goodwin R, Sun SJ. Early responses to H7N9 in southern Mainland China [J]. BMC infectious diseases, 2014, 14: 8-15.
[43] Alcantara-Ayala I, Garnica-Penar J, Murillo-Garcia F, et al. Landslide disaster risk awareness in Mexico: community access to mapping at local scale [J]. Landslides, 2018, 15(5): 1-14.
[44] Lee TS, Kilbreath SL, Sullivan G, et al. The development of an arm activity survey for breast cancer survivors using protection motivation theory [J]. BMC cancer, 2007, 7(1): 75-84.
[45] Wang J, Liu-Lastres BJ, Ritchie BW, et al. Travellers' self-protections against health risks: an application of the full protection motivation theory [J]. Annals of tourism research, 2019, 78: 1-12.
[46] State Council. Regulations on Public Health Emergency Response [EB/OL]. [2020-03-29]. http://www.china.com.cn/chinese/zhuanti/tufa/328963.htm.
[47] Wang Xiaofei, Hao Yanhua, Wu Qunhong, et al. Analysis of risk communication status in health institutions during public health emergencies [J]. Chinese Health Service Management, 2018, 35(11): 827-829, 851.
[48] Yoo WW, Choi DH, Park K. The effects of SNS communication: how expressing and receiving information predict MERS-preventive behavioral intentions in South Korea [J]. Computers in human behavior, 2016, 62: 34-43.
[49] McNeill A, Harris PR, Briggs P. Twitter influence on UK vaccination and antiviral uptake during the 2009 H1N1 Pandemic [J]. Frontiers in public health, 2016, 4: 1-13.
[50] Cho HC, Lee JS, Lee SJ. Optimistic bias about H1N1 flu: testing the links between risk communication, optimistic bias, and self-protection behavior [J]. Health communication, 2013, 28(2): 146-158.
[51] SteelFisher GK, Blendon RJ, Kang M. Adoption of preventive behaviors in response to the 2009 H1N1 influenza pandemic: a multiethnic perspective [J]. Influenza and other respiratory viruses, 2015, 9(3): 131-142.
[52] Zhou XY, Zhang Y, Shen CJ, et al. Knowledge, attitudes, and practices associated with avian influenza along the live chicken market chains in Eastern China: a cross-sectional survey in Shanghai, Anhui, and Jiangsu [J]. Transboundary and emerging diseases, 2019, 66(11): 1529-1538.
[53] Maidl E, Buchecker M. Raising risk preparedness by flood risk communication [J]. Natural hazards and earth system sciences, 2015, 15(7): 1577-1595.
[54] Mondino E, Scolobig A, Borga M, et al. Exploring changes in hydrogeological risk awareness and preparedness over time: a case study in northeastern Italy [J]. Hydrological sciences journal, 2020, 65(7): 1-12.
[55] Amugsi DA, Haregu TN, Mberu B. Levels and determinants of perceived health risk from solid wastes among communities living near dump sites in Kenya [J]. International journal of environmental health research, 2019, 29(6): 1-13.
[56] Arcer SC, Onuki M, Esteban M, et al. Risk awareness and intended tsunami evacuation behaviour of international tourists in Kamakura City, Japan [J]. International journal of disaster risk reduction, 2017, 23: 178-192.
[57] Yang S, Li M, Zeng JQ, et al. Prevalence and risk factors of work-related

musculoskeletal disorders among intensive care unit nurses in China [J]. Workplace health & safety, 2018, 67(6): 1-10.
[58] Flannery C, Burke LA, Grainger L, et al. Risky suntanning behaviours amongst Irish University students: a quantitative analysis [J]. Irish journal of medical science, 2015, 185(4): 1-12.
[59] Garcia-Retamero R, Cokely ET. Effective communication of risks to young adults: using message framing and visual aids to increase condom use and STDs screening [J]. Journal of experimental psychology: applied, 2011, 17(3): 270-287.
[60] Sherman SM, Lane EL. Awareness of risk factors for breast, lung and cervical cancer in a UK student population [J]. Journal of cancer education, 2015, 30(4): 660-663.
[61] Felo L, Otero-Lobato M, Geldhof A, et al. Effectiveness of the golimumab educational program in ensuring health care professionals' awareness of risks described in the European risk management plan [J]. Therapeutic advances in drug safety, 2019, 10: 1-12.
[62] Johnston AC, Warkentin M. Fear appeals and information security behaviors: an empirical study [J]. MIS quarterly, 2010, 34(3): 549-566.
[63] Li QM, Liu Q, Chen XG, et al. Protection motivation theory in predicting consumers' information security behaviors: an empirical study [J]. MIS quarterly, 2010, 34(3): 549-566.
[64] Moeini B, Ezati E, Barati M, et al. Skin cancer preventive behaviors in Iranian farmers: applying protection motivation theory [J]. Workplace health & safety, 2018, 67(5): 1-10.
[65] Taheri AM, Mohhebi S, Gharlipour Z. Effect of educational intervention based on protection motivation theory on predicting cervical cancer screening participation: a longitudinal study [J]. International journal of cancer management, 2019, 12(3): 1-9.
[66] Nabizadeh SM, Taymoori P, Hazhir MS, et al. Predicting vitamin E and C consumption intentions and behaviors among factory workers based on protection motivation theory [J]. Environmental health and preventive medicine, 2018, 23(51): 1-8.
[67] Babazadeh T, Nadrian H, Banayejeddi M, et al. Determinants of skin cancer preventive behaviors among rural farmers in Iran: an application of protection motivation theory [J]. Journal of cancer education, 2016, 32(3): 1-9.
[68] Ruthig JC. Health risk perceptions and exercise in older adulthood: an application of protection motivation theory [J]. Journal of applied gerontology, 2014, 35(9): 1-21.
[69] Williams L, Rasmussen S, Kleczkowski A, et al. Protection motivation theory and social distancing behaviour in response to a simulated infectious disease epidemic [J]. Psychology, health & medicine, 2015, 20(7): 1-8.
[70] Ralph AF, Ager B, Bell ML, et al. Women's preferences for selective estrogen reuptake modulators: an investigation using protection motivation theory [J]. Patient education and counseling, 2014, 96(1): 1-7.
[71] Henson S, Cranfield J, Herath D. Understanding consumer receptivity toward foods and non-prescription pills containing phytosterols as a means to

offset the risk of cardiovascular disease: an application of protection motivation theory [J]. International journal of consumer studies, 2010, 34(1): 28-37.
[72] Helmes AW. Application of the protection motivation theory to genetic testing for breast cancer risk [J]. Preventive medicine, 2002, 35(1): 453-462.
[73] Puspitasari I, Firdausy A. Characterizing consumer behavior in leveraging social media for e-patient and health-related activities [J]. International journal of environment research and public health, 2019, 16(18): 3348-3365.
[74] Marceron JE, Rohrbeck CA. Disability and disasters: the role of self-efficacy in emergency preparedness [J]. Psychology, health & medicine, 2018, 24(5): 1-12.
[75] Hanus B, Wu YA. Impact of users' security awareness on desktop security behavior: a protection motivation theory perspective [J]. Information systems management, 2016, 33(1): 2-16.
[76] Torten R, Reaiche C, Boyle S. The impact of security awareness on information technology professionals' behavior [J]. Computers & security, 2018, 79: 68-79.
[77] Feenstra H, Ruiter RAC, Kok G. Evaluating traffic informers: testing the behavioral and social-cognitive effects of an adolescent bicycle safety education program [J]. Accident analysis and prevention, 2014, 73: 288-295.
[78] Nabizadeh SM, Taymoori P, Hazhir MS, et al. Educational intervention based on protection motivation theory to improve vitamin E and C consumption among Iranian factory workers [J]. Journal of clinical and diagnostic research, 2018, 12(10): 1-6.
[79] Li Wenhao, Liu Bo, Liu Min, et al. Survey analysis of public knowledge, attitude and practice regarding COVID-19 inside and outside Hubei Province [J]. Journal of Jinan University (Natural Science & Medicine Edition), 2020, 41(2): 186-193.
[80] Zheng Jiansheng, Zhang Yanfeng, Xu Ying, et al. Survey on health literacy and health education needs for COVID-19 prevention and control among community residents [J/OL]. Chinese Journal of Public Health, 2020, 36(2): 160-164.
[81] Cai Huanle, Zhu Yanxin, Lei Lubi, et al. Knowledge, behavior and psychological response to COVID-19: a web-based cross-sectional survey [J]. Chinese Journal of Public Health, 2020, 36(2): 152-155.
[82] Luu TA, Nguyen AT, Trinh QA, et al. Farmers' intention to climate change adaptation in agriculture in the red river delta biosphere reserve (Vietnam): a combination of structural equation modeling (SEM) and protection motivation theory (PMT) [J]. Sustainability, 2019, 11(10): 2-17.
[83] Podsakoff PM, MacKenzie SB, Lee JY, et al. Common method biases in behavioral research: a critical review of the literature and recommended remedies [J]. Journal of applied psychology, 2003, 88(5): 879-903.
[84] Liang H, Saraf N, Xue HY. Assimilation of enterprise systems: the effect of institutional pressures and the mediating role of top management [J]. MIS quarterly, 2007, 31(1): 59-87.
[85] Harris PR, Griffin DW, Murray S. Testing the limits of optimistic bias: event and person moderators in a multilevel framework [J]. Journal of

personality and social psychology, 2008, 95(5): 1225-1237.

Author Contributions

Qi Yunfei: Collected research data, analyzed results, wrote the paper
Li Qidong: Assisted with literature collection, reviewed and validated the paper
Zhao Yuxiang: Proposed research ideas, revised research framework, guided data analysis
Zhu Qinghua: Determined research topic, guided research design, reviewed and validated the paper

---

The Impact of Risk Awareness on Public's Health Protection Intention in Public Health Emergencies

Qi Yunfei[1], Li Qidong[2], Zhao Yuxiang[3], Zhu Qinghua[4]

[1]School of Information Management, Zhengzhou University of Aeronautics, Zhengzhou 450015
[2]School of Information Management, Zhengzhou University, Zhengzhou 450001
[3]School of Economics & Management, Nanjing University of Science & Technology, Nanjing 210094
[4]School of Information Management, Nanjing University, Nanjing 210023

Abstract: [Purpose/significance] Based on protection motivation theory, this paper examines the impact of epidemic information on public risk awareness cultivation, reveals people's cognitive patterns when facing epidemic risks, and explores communication measures that can improve public health protection intention. [Method/process] Through an online survey, 450 questionnaire responses were collected from 28 provinces across China. Partial Least Squares (PLS) structural equation modeling was employed, with measurement model and structural model testing conducted to verify the proposed hypotheses. [Result/conclusion] The findings indicate that threat awareness and countermeasure awareness can significantly improve public threat appraisal and coping appraisal, forming distinctive risk perception characteristics. If these characteristics are followed in public communication, they can maximize influence on health protection intention. The study also finds that public perception of vulnerability is currently low, which may lead to optimistic bias and related issues that warrant greater attention.

Keywords: risk communication, protection motivation theory, perceived severity, perceived vulnerability, response efficacy, risk awareness

Note: Figure translations are in progress. See original paper for figures.