Psychology Research and Behavior Management

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ORIGINAL RESEARCH

Disease Prevention Behavior During the COVID-19 Pandemic and the Role of Self-Esteem: An Extended Parallel Process Model

This article was published in the following Dove Press journal:
Psychology Research and Behavior Management

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Objective: The COVID-19 outbreak has become a serious public health problem worldwide. The purpose of this study was to use an extended parallel process model (EPPM) to understand factors in COVID-19 prevention behaviors.

Methods: This cross-sectional and analytical study was conducted on 1012 participants in Taiwan. A structured questionnaire and an online survey were used to collect data.

Results: The EPPM revealed that the severity of the COVID-19 threat perceived by respondents directly affected the arousal of fear in the respondents (β=0.268, t=9.007, p<0.001), but perceived efficacy did not (β=−0.019, t=−0.619, p>0.05); additionally, fear arousal was significantly associated with COVID-19 prevention behaviors (β=0.119, t=4.603, p<0.001). Regarding personal characteristics, self-esteem moderated the relationship between perceived threat and fear arousal. However, the moderating effect of self-esteem was stronger in people with low self-esteem compared to those with high self-esteem (β=0.606, −0.472; t=26.303, −17.694; p<0.001, p<0.001; respectively). The results of this study also indicated that two demographic characteristics (age and gender) affect COVID-19 prevention behaviors.

Conclusion: When developing healthcare policies and community interventions for improving COVID-19 prevention behaviors during an outbreak, healthcare administrators should carefully consider the main constructs of the EPPM, particularly personal characteristics (ie, self-esteem) and demographic characteristics (ie, age and gender).

Keywords: COVID-19, extended parallel process model, perceived threat, perceived efficacy, prevention behavior

Introduction

In 2020, the WHO reported[1] that the number of COVID-19 cases had exceeded 65 million and that the number of COVID-19 deaths had exceeded 1.5 million. The COVID-19 outbreak has become a global pandemic and is the largest public health crisis in recent human history. In January 2020, Taiwan enhanced the efficacy of its disease surveillance and reporting system by including laboratory tests of respiratory syndrome coronavirus 2. The outbreak was temporarily controlled by sentinel surveillance of respiratory infection and severe or novel influenza infection.[2] However, since no treatment or vaccine for COVID-19 is currently available, how to encourage the practice of effective prevention behaviors is a crucial issue.[3]

The extended parallel process model (EPPM)[4] is a useful theoretical framework not only for understanding how and why a perceived threat and the perceived

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http://doi.org/10.2147/PRBM.S291300

efficacy of a response to the threat potentially affect fear arousal, but also for understanding the mechanisms of change in the prevention and protection behaviors of an individual in response to the experience of fear.[5] A perceived threat is cognition of a threat or a thought about a threat; perceived efficacy refers to the perceived feasibility and effectiveness of a recommended response to a threat.[4] The high explanatory power of EPPM has been verified in many health and illness-related studies that have used this model to evaluate how individual perceptions of a threat and the efficacy of a response to the threat affect various human motivations, cognitions, and behaviors.[6–8] Another important construct in EPPM is fear appeal because it can induce the internal physiological and emotional arousal needed to motivate behavioral change.[4] Since the fear appeal is known to mediate the effects of the perceived threat and perceived efficacy on COVID-19 prevention behavior, this study investigated the mediating role of fear appeal rather than performing a more general investigation of fear arousal.

According to the EPPM, whether fear contributes to the success or failure of a response to a threat depends on two factors: perceived threat and perceived efficacy.[4] The first factor, perceived threat, has two underlying dimensions: perceived severity of the threat and perceived susceptibility to the threat. Witte[4] defined perceived severity as the beliefs of the subject regarding the significance or magnitude of the threat and defined perceived susceptibility as the beliefs and expectations of the subject regarding the risk of experiencing the threat or the risk that the threat will occur.[4] The second factor, perceived efficacy, also has two underlying dimensions: perceived self-efficacy and perceived response efficacy.[7] Perceived self-efficacy refers to the self-perceived ability of an individual to implement a recommended response,[4] and perceived response efficacy refers to the extent to which the individual perceives that a recommended response is effective for averting a threat.[4] Moreover, the EPPM proposes that the perception of a threat determines how an individual reacts in the physical environment, ie, the physical response to the threat whereas perceived efficacy determines how the individual reacts internally, ie, the emotional response to the threat.[4] Based on the above discussion, we propose that EPPM is a useful theoretical perspective for understanding how the psychological mechanisms and the decision-making processes of individuals affect their disease prevention behavior in the context of the COVID-19 outbreak. In this study, fear arousal is defined as the physiological or psychological response aroused and/or experienced by an individual in response to fear;[8] prevention behavior is defined as individual behaviors that are mainly motivated by the goal of decreasing or alleviating the risk of COVID-19 infection.[9]

Self-esteem is defined as the correspondence between the ideal and actual self-concept of an individual.[10] Self-esteem is related to various psychological outcomes, including psychological adjustment and prosocial behavior[11] and is classified as high self-esteem and low self-esteem.[12] High self-esteem is characterized by strong confidence and belief in oneself and high satisfaction with oneself.[13] Low self-esteem is characterized by lack of confidence and the tendency to feel badly about oneself.[11] Studies have verified that low self-esteem is associated with unhealthy behaviors and practices. For example, Ramiro et al[14] and Bermudez et al[15] reported that people with low self-esteem tend to engage in high-risk sexual behavior. Kima et al[16] also found that people with low self-esteem are more likely to experience mental health problems compared to people with high self-esteem.

Interestingly, some scholars have reported that self-esteem has little or no effect on disease prevention and treatment behaviors. For example, Yuan et al[17] excluded self-esteem from their regression equation used for empirical analysis of self-perceived quality of life in Chinese patients with stoma. Arsandaux et al[18] further noted the high heterogeneity of variables used to measure self-esteem in the literature and the high heterogeneity of approaches used to validate and implement measures of self-esteem. Although studies of the role of self-esteem in health status and health prevention behaviors are inconclusive, they do suggest a positive link. Thus, this study investigated the relationships among the perceived threat of COVID-19, the perceived efficacy of the response to the threat, and the fear aroused by the disease. The moderating effects of self-esteem characteristics (ie, high versus low self-esteem) on these relationships were also investigated.

Previous studies have investigated and compared health behaviors in populations with specific demographic characteristics, eg, age and gender. This study defined age as the period of time a person has been alive.[19] Studies have reported salient differences between the health behaviors of adolescents and young adults. For example, Ames et al[20] that different age groups exhibit different effects of age stereotypes on the sense-making process, which then results in differences in self-perceived health behaviors.[21] In terms of gender, which refers to the physical condition of being male or female,[22] sociodemographic data

collected in Olson et al[23] revealed gender differences in unhealthy behavior. In young adults in the US, for example, the authors reported unhealthy behavior (eg, poor diet) in 40% of males versus only 22% of females. Conversely, some scholars have reported no evidence of a link between gender and the practice of unhealthy behaviors.[24] Given the link between gender and health behavior reported in these studies, both age and gender were used as independent control variables in the analysis of COVID-19 prevention behaviors of the participants in this study.

In sum, the aim of the present study was to improve understanding of underlying factors in the performance, improvement, and management of COVID-19 prevention behaviors by using EPPM as an explanatory framework. Context-specific factors considered in the analysis of COVID-19 prevention behaviors included self-esteem and demographic characteristics (ie, age and gender).

Prevention Behaviors During the COVID-19 Pandemic

Escalation of the COVID-19 pandemic in the past year has motivated studies of disease prevention behaviors related to COVID-19. Three streams of research related to the COVID-19 pandemic have emerged in the behavioral science literature: recommended preventive behavior, comparative analysis, and cognitive behavior.

Studies of recommended preventive behavior during the COVID-19 pandemic include an empirical survey performed in China by Ye et al[25] that compared the adoption of basic, advanced, and excessive preventive behaviors in different groups of demographic characteristics. They found that predictors of proper preventive behavior include perceived sensitivity, perceived severity, perceived benefits, cues to action, and knowledge levels whereas predictors of excessive prevention behavior included perceived sensitivity and knowledge levels. Goh et al[26] investigated the problem of controlling COVID-19 transmission in Taiwan prisons. Their prison-specific guidelines for responding to COVID-19[27] included supplying each inmate with two surgical masks per week, requiring the use of surgical masks during any social interaction, checking body temperature twice daily, and enforcing the practice of social distancing during all activities. Additionally, all prison staff were required to wear surgical masks and were required and perform health self-monitoring, including body temperature check. Equipment, fixtures, and areas of the prison accessible by the prison population were disinfected daily with a 75% alcohol solution. To minimize the effects of psychosocial risk factors (ie, stress and negative emotions), Ricci and colleagues[28] recommend behavior strategy for prevention of global health and psychosocial stress during the current lockdown, including encouraging older persons to be physically active, and eating and sleeping on a regular schedule.

Comparative analysis, which is the second stream of research in COVID-19 prevention behavior, includes Lin et al[29] who investigated factors associated with adoption of social distancing behaviors in China and Israel. The authors found that constraints are negatively related to the adoption of social distancing behaviors whereas confidence is positively related to these behaviors. Constraints and behaviors were directly related in Israel but were indirectly related in China. A possible explanation for the inconsistency is cultural differences.[30] In another study by Chen and Chen,[31] a comparison of COVID-19 prevention behaviors between urban and rural residents in China found that prevention behaviors were more likely in rural residents. However, urban and rural residents did not significantly differ in behavioral intention, subjective norms, or knowledge of preventive behaviors. The probable explanation is that rural residents have relatively less media exposure and less experience and skill in appraising the veracity of health-related information. Thus, health information regarding COVID-19 prevention behavior should consider the urbanization level of the target audience and should be tailored accordingly.

In the early stage of the pandemic, Meier and colleagues[32] compared public belief in the effectiveness of protective measures and identified the communication channels commonly used to acquire COVID-19 information in three European countries (Netherlands, Germany, and Italy). The authors reported that the perceived effectiveness of a complete social lockdown was lower in the Netherlands compared to Germany, and Italy. Additionally, compared to residents of Germany and the Netherlands, residents of Italy practiced social distancing more frequently and were more likely to practice self-imposed hygiene measures and social distancing to avoid infection. Moreover, healthcare officials and professionals were the COVID-19 information sources most preferred by European residents. The least preferred information sources were social media, friends, and family.[33] In contrast, for Hong Kong residents, most preferred sources of COVID-19 pandemic information are social media and the Internet.[34] Although the populations of Norway and

Sweden have similar ethic and sociodemographic profiles, similar age distributions, and similar healthcare systems, the public reaction to the COVID-19 pandemic differed between the two countries.[35] According to Helsingen et al-[35], Swedes have relatively more trust in their healthcare authorities. In contrast, Norwegians tended to have a higher risk tolerance during the pandemic. The level of trust in the healthcare system and self-reported compliance with preventive measures were high in both countries despite the differences in infection control measures. Interestingly, they also found that compared to Swedes, Norwegians were more likely to adopt a sedentary lifestyle during the pandemic and were more likely to overeat.

The third stream of research in COVID-19 prevention behavior is cognitive behavior. Human behavior is shaped and controlled by personal cognition in a social environment.[36] Cognitive behavior is a major focus of the previous literature on the adoption of preventive health behaviors. For example, Storopoli et al[37] applied recreancy theory in a Brazil study of factors associated with the adoption of preventive behavior to cope with the pandemic crisis. They reported that the effect of perceived vulnerability depends on confidence in oneself and confidence in social institutions (ie, government, hospitals, the media, etc.);[38] moreover, they found that risk perceptions are associated with the adoption of preventive behaviors. In contrast, another study by Bashirian et al[39] applied Protection Motivation Theory to predict COVID-19 prevention behaviors practiced by healthcare workers. The authors concluded that threat perception and coping appraisal were predictors of protection motivation to practice COVID-19 prevention behaviors. Moreover, they suggested that hospital managers should support and encourage the development of self-efficacy in their staff and that training programs for hospital staff should provide knowledge in the effectiveness of protective behaviors.[40] Furthermore, Li and Zheng[41] applied a Risk Information Seeking and Processing model to identify the key determinants of online information-seeking behavior and disease prevention intent during the COVID-19 outbreak in China. Compared to younger respondents in their sample, older respondents were less likely to seek COVID-19 information on the Internet and had lower intention to adopt preventive behaviors. Therefore, they recommended that health authorities should specifically target older populations by using online communication platforms preferred by this age group (eg, WeChat for social media).

Generally, the recent literature has not only substantially enhanced understanding of how intrinsic and extrinsic factors impact individual behaviors and attitudes associated with the adoption of disease prevention behaviors during the COVID-19 pandemic.

Research Model and Hypotheses

Figure 1 is the research model (plus or minus signs in parentheses indicate positive or negative relationships, respectively, between two constructs in research hypotheses). To understand the relationships among several constructs, all hypotheses were posited and examined.

Perceived Threat and Fear Arousal

Empirical studies by Chen & Yang[8] found that a fear appeal can motivate individuals to engage in disease prevention behavior by increasing the perceived threat of the disease and by arousing fear of the threat. A subsequent study by Ellis et al[42] reported similar results in a population of HPV patients, ie, a public health campaign effectively motivated HPV patients to undergo regular testing by arousing their fear of death from HPV. These studies indicate that threat orientation impacts how an individual responds to a fear appeal.[43] Thus, we hypothesize the following:

H1. Perceived threat is positively related to the fear aroused by the threat of a disease.

Perceived Efficacy and Fear Arousal

Previous research supports the notion that perceived efficacy is an important determinant of preventive health behaviors. Perceived efficacy is also an important determinant of the fear aroused by the threat of a disease, ie, ability to control fear increases as perceived efficacy increases.[43,44] An empirical study by Shi & Smith[4] found that people engage in danger control processes (ie, fear control processes) when they perceive that their self-efficacy is higher than the threat. Thus, we propose the following hypothesis:

H2: Perceived efficacy is negatively related to fear arousal by the threat of a disease.

Fear Arousal and Prevention Behavior

Achar et al[44] reported that the purpose of a fear appeal during a disease outbreak is to encourage the practice of disease prevention behavior by individuals. Moreover, Smith et al[45] and Kotowski et al[46] used the EPPM to evaluate the effectiveness of a fear appeal for encouraging

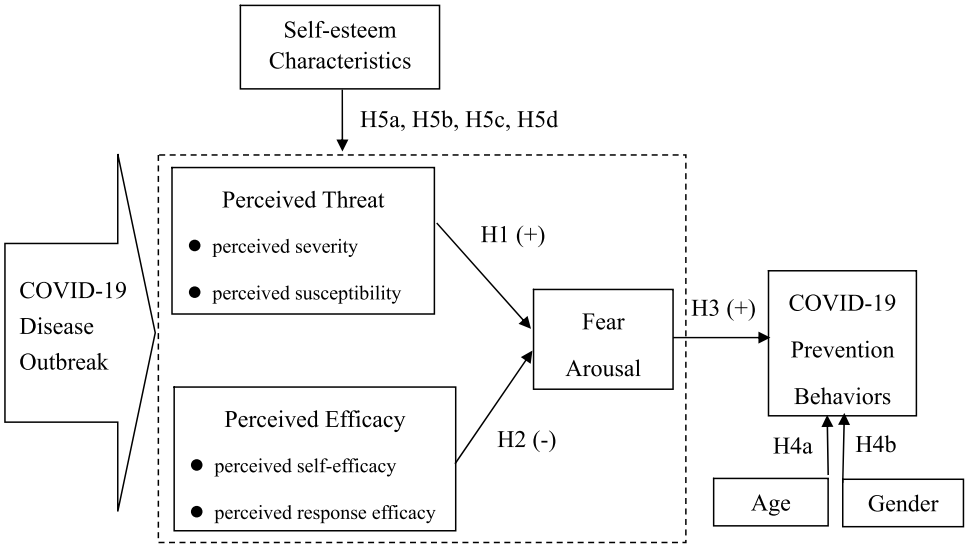

Figure 1 Research model.

the use of hearing protection, eg, hearing protection in construction workers. They found that, when a fear appeal was used to encourage the use of hearing protection, use of hearing protection was more likely in individuals who perceived that the threat of noise-induced hearing loss was high and had high self-efficacy compared to those who perceived that the threat was low and had low self-efficacy. Thus, we propose the following hypothesis:

H3. Fear aroused by a fear appeal is positively related to COVID-19 prevention behavior.

Age and Gender Differences in Prevention Behavior

Holahan and Suzuki[47] and Levy and Myers[48] found that, compared to younger people, elderly people (especially those classified as young-old, ie, age 65–74 years) were more likely to take action to prevent health problems because they were more focused on achieving health maintenance goals. Ek[49] supported the general view that older people are generally viewed as being more health conscious compared to younger people, and who tend to less concerned about the health consequences they will experience later in life. These age differences in health behavior patterns tend to increase as age increases.

In terms of gender, Ek[49] reported that women have more interest in and pay more attention to potential global pandemics compared to men. Compared to men, women usually have better health-promoting practices and behaviors compared to men. Moreover, women tend to engage in prosocial behavior more frequently than men do.[50] Therefore, women may be more likely to practice COVID-19 prevention behavior compared to men. Thus, we propose the following hypotheses:

H4a: The practice of COVID-19 prevention behavior is better in the elderly than in the young.

H4b: The practice of COVID-19 prevention behavior is better in women than in men.

Role of Self-Esteem Characteristics

Self-esteem is a personal trait. Blank et al[51] reported that people with high self-esteem have a high tolerance for risks associated with unhealthy behavior (eg, frequent and/or heavy drinking) because they tend to perceive that the risk of such behaviors is low. Kavussanu and Harnisch[52] reported that high self-esteem is significantly associated with high task-orientation as well as high perceived efficacy. Furthermore, people with high self-esteem tend to engage in risky behavior to cope with fear, anxiety, and failure or to satisfy their need for excitement. People with high self-esteem are also characterized by excessive optimism, a sense of invulnerability, and a tendency to set unrealistic goals.[53] Based on the above literature, we hypothesized that high self-esteem was a moderating variable in the associations among perceived threat, perceived efficacy, and fear arousal.

Regarding low self-esteem characteristics, van der Heijden et al[54] investigated the interaction between self-esteem and outcome cognition and concluded that people with low self-esteem tend to have either a negative or neutral self-concept. Thus, compared to people with high self-esteem, those with low self-esteem are relatively less likely to exhibit positive

Table 1 Demographic and Socioeconomic Characteristics of Respondents (n=1012)

		Frequency (persons)	Frequency (%)
Gender	Male	623	61.6%
	Female	389	38.4%
Age, years	20–29	191	18.9%
	30–39	151	14.9%
	40–49	208	20.5%
	50–59	344	34.0%
	≧60	118	11.7%
Monthly income, USD	≦833	222	21.9%
	834–1666	293	29.0%
	1667–2666	283	28.0%
	≧2667	214	21.1%
Education level	High school or below	77	7.6%
	Bachelor degree	507	50.1%
	Graduate degree	428	42.3%

cognition (eg, high perceived efficacy) about themselves but are more sensitive to negative cognition and more likely to exhibit negative cognition (eg, high perceived threat) than positive cognition.[55] In brief, self-esteem is a moderating variable regardless of self-esteem.[56,57] Thus, we propose the following hypotheses:

H5a: High self-esteem decreases the positive impact of perceived threat on fear arousal.

H5b: High self-esteem increases the negative impact of perceived efficacy on fear arousal.

H5c: Low self-esteem increases the positive impact of perceived threat on fear arousal.

H5d: Low self-esteem decreases the negative impact of perceived efficacy on fear arousal.

Methods

Participants and Procedure

This study adopted an approach of convenience and cross-sectional sampling for data collection. Empirical data were collected by an online questionnaire survey performed from May 24 to June 10, 2020. Google Doc was used to construct an online questionnaire. All participants were adults on the "friend community" lists in the LINE app used by the authors. Those who received the survey message were asked to send it to others in their "friend community". Out of 1013 questionnaires retrieved, 1012 were valid and complete. Of the 1012 participants with valid and complete questionnaires, 623 (61.6%) were men, and 389 (38.4%) were women. The largest age cohort was 50–59 years (344, 34.0%) followed by 40–49 years (208, 20.5%). The age and gender of the participants were consistent with the demographic data for LINE mobile app users reported by LINE Corporation Taiwan in the year 2019 (58% male and 42% female).[58] In terms of age and gender, therefore, the sample was considered representative of the overall population of LINE users in Taiwan. Monthly income was 834–1666 USD in 29.0% (293) of the participants and 1667–2666USD in 28.0% (283) of the participants. Additionally, 50.1% (507) of the participants had a bachelor's degree, and 42.3% (428) had a graduate degree. Table 1 shows the demographic and socioeconomic characteristics of the respondents in this study.

Instruments

To ensure scale validity, measurement items were adapted from the literature. Three experts in public health, medical informatics, and nursing were invited to review the measurement items before the survey was performed. Specifically, the experts evaluated the logical consistency, ease of understanding, and sequence of the questionnaire items and evaluated their relevance in the context of the COVID-19 outbreak. Based on their suggestions, minor modifications of the questionnaire were made. Next, a pilot test of the questionnaire was performed in 55 participants. Based on their comments and suggestions, the measurement items were further modified. All survey items were measured using a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

The questionnaire was divided into two parts. The first part collected basic demographic and socioeconomic data such as gender, age, income, and education. The second part collected data used for measurements of the study variables. This

instrument contained 23 items in five main constructs: the trait self-esteem was measured with four items adapted from Altmann and Roth.[59] Two aspects of perceived threat were surveyed: perceived severity and perceived susceptibility. Perceived severity was measured with three items and perceived susceptibility was measured with two items adapted from Gerend et al[60]. Perceived efficacy included perceived self-efficacy and perceived response efficacy. Perceived self-efficacy was measured with four items adapted from Gerend et al[60] whereas perceived response efficacy was measured with three items adapted from Cooper et al[61]. Fear of death was measured with three items adapted from Ingrid and Michael[62]. Prevention behavior was measured with four items adapted from Cooper et al[61].

Data Analysis and Results

The SmartPLS 3 and SPSS version 22 software were used for statistical analyses. The SmartPLS software was used because it supported partial least square (PLS) structural equation modeling (SEM) techniques and their objectives, such as predicting key target constructs and exploring or extending an existing structural theory.[63] Hair et al[63] suggested that a minimum sample size of 100–150 is needed to perform SEM techniques. The total sample size in this study met the requirement for SEM with maximum likelihood assessment.

Data analysis was performed using the two-step approach suggested by Anderson and Gerbing:[64] estimating a measurement model and then examining structural relationships among latent constructs. The main purpose of the two-step approach was to assess the reliability and validity of the measures before applying them in the full model.

Measurement Model Assessment

The measurement model was evaluated by reliability and validity analyses. Table 2 shows Cronbach α, combined reliability (CR), and average variance extracted (AVE) values for the measurement model. In reliability tests, Cronbach α values for all indicators exceeded 0.7, which indicated acceptable construct reliability.[65] Convergent

Table 2 Measurement Model Statistics

Constructs	Item #	Factor Loading	Cronbach α	Composite Reliability	Average Variance Extracted
Self-esteem	SE1 SE2 SE3 SE4	0.551* 0.830 0.844 0.835	0.869 (0.887)	0.854 (0.875)	0.601 (0.700)
Perceived Threat	PS1 PS2 PS3 PSu1 PSu2	0.636 0.848 0.868 0.815 0.791	0.786	0.895	0.633
Perceived Efficacy	PSe1 Pse2 Pse3 Pse4 PRE1 PRE2 PRE3	0.726 0.795 0.772 0.752 0.771 0.726 0.679	0.897	0.898	0.558
Fear Arousal	FA1 FA2 FA3	0.700 0.578* 0.762	0.753 (0.713)	0.702 (0.729)	0.522 (0.535)
Prevention Behavior	PB1 PB2 PB3 PB4	0.841 0.833 0.875 0.756	0.721	0.897	0.685

Notes: Parentheses indicate parameters after scale revision. *Items dropped from the final scales.
Abbreviations: PS, perceived severity; PSu, perceived susceptibility; PSe, perceived self-efficacy; PRE, perceived response efficacy.

Table 3 Construct Correlations and Square Roots of Average Variance Extracted (AVE)

Constructs	Mean	S.D.	Self-Esteem	Perceived Threat	Perceived Efficacy	Fear Arousal	Prevention Behavior
Self-esteem	5.405	0.883	***0.775***				
Perceived Threat	4.195	1.098	0.052*	***0.796***			
Perceived Efficacy	5.618	0.971	0.411***	−0.056*	***0.747***		
Fear Appeal	3.521	1.464	−0.064*	0.602***	−0.154***	***0.722***	
Prevention Behavior	6.102	0.940	0.397***	0.087**	0.562***	0.014*	***0.828***

Notes: For each latent construct, the square root of AVE is displayed in italics and bold. Correlations significant at *p<0.05, **p<0.01, ***p<0.001.

validity was tested according to factor loadings, AVE and CR. All factor loadings exceeded 0.5. Factor loadings for two items (SE1: 0.551, FA2: 0.578) were lower than the standardized threshold of 0.7,[65] and both items were excluded from the analysis. All AVE values exceeded 0.5, and all CR values exceeded 0.7. Thus, the scale had high convergent validity and validity.

Discriminant validity was tested by comparing the square root of AVE with the correlation coefficient between the indicators. Table 3 shows the discriminant validity results. For all indicators, correlation coefficients were less than the square root of AVE, which indicated good discriminant validity as defined in Fornell and Larcker.[66] Generally, the questionnaire in this study had high reliability and validity.

Since smartPLS does not provide a measure of the overall goodness of fit to the data, R-square value was used to measure the goodness of fit.[67] The R-square values were 31.5% for fear arousal and 19.0% for prevention behavior. An R-square value below 10% implies a poor model fit to the data.[68] All R-square values for the research model in the current study exceeded 10%.

Structural Model Assessment

Figure 2 shows the normalized path coefficients and path significance values (ns: non-significant, *p<0.05, **p<0.01, ***p<0.001). Perceived threat had a significant positive effect on fear arousal (β=0.268, t=9.007, p<0.001), which supported H1. Perceived efficacy did not significantly affect fear arousal (β=−0.019, t=−0.619, p>0.05), which did not support H2. Fear arousal had a significant positive effect on prevention behavior (β=0.119, t=4.603, p<0.001), which supported H3. Regarding relationships between demographic characteristics and prevention behavior, age had a significant positive association with prevention behavior (β=0.136, t=4.990, p<0.001), which supported H4a. Gender did not have a significant association with prevention behavior (β=−0.045, t=−1.418, p>0.05), which did not support H4b.

Moderating Effects

This study used hierarchical regression analysis to verify the moderating effect of self-esteem characteristics on the relationship between individual perceptions of the COVID-19 epidemic (ie, perceived threat of the disease,

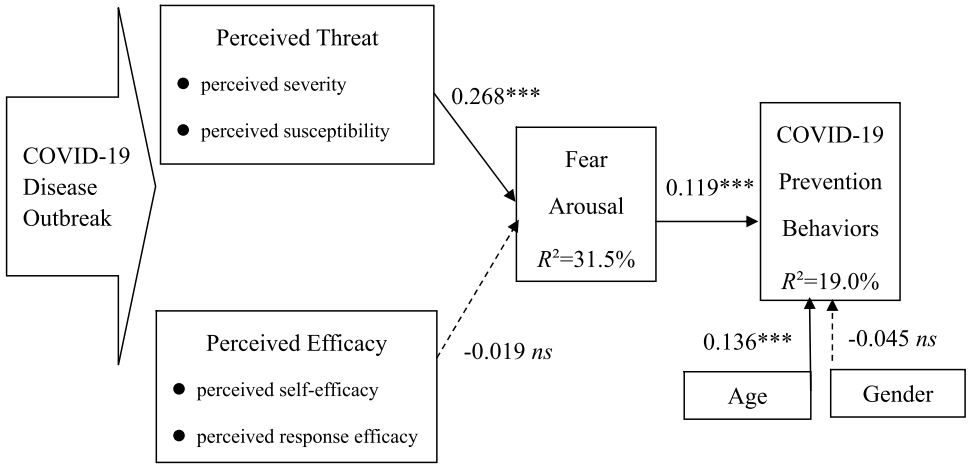

Figure 2 Structural equation modeling analysis results for research model.
Notes:***p<0.001; ns, non-significant.

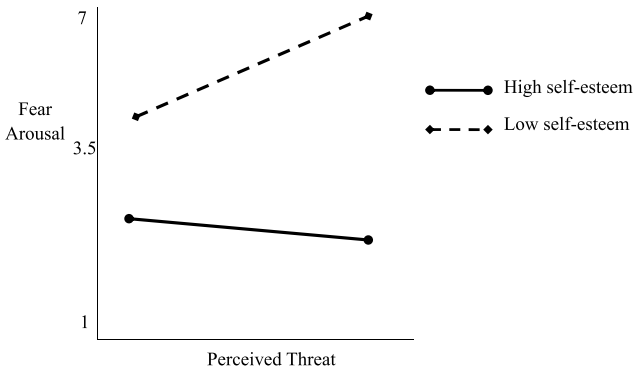

Figure 3 Moderating effects of self-esteem characteristics on the relationship between perceived threat and fear arousal.

perceived efficacy of the response, and fear arousal). Figure 3 shows that high self-esteem had a significant negative moderating effect on the relationship between perceived threat and fear arousal (β=−0.472, t=−17.694, p<0.001). However, high self-esteem did not have a significant moderating effect on the relationship between perceived efficacy and fear arousal; hence, H5a was supported, but H5b was not.

On the other hand, low self-esteem had a significant moderating effect on the relationship between perceived threat and fear arousal (β=0.606, t=26.303, p<0.001) while a low self-esteem had no moderating effect on the relationship between perceived efficacy and fear arousal; thus, H5c was supported, but H5d was not.

Discussion

In this study, a theoretical model based on EPPM was used to explore psychological response mechanisms and prevention behavior in individuals in the context of the COVID-19 outbreak. This study had several meaningful findings.

First, the applicability of the EPPM perspective of disease prevention behavior during the COVID-19 epidemic was verified. Two critical psychological dimensions of perceptions were examined in the participants: perceived threat and perceived self-efficacy. According to the results of this study, perceived threat increases fear arousal while perceived efficacy decreases fear arousal. In the context of the COVID-19 outbreak, perceived threat is a key factor in fear arousal. This finding is partially supported by Ellis et al[42] in a study of HPV patients, who reported that a high perceived threat of HPV triggers a high fear of death whereas high perceived efficacy decreases fear of death.

Steinhart and Jiang[69] used Terror Management Theory to explore how perceived environment threat and perceived efficacy affect mortality salience. They found that, in a high-threat situation, fear and anxiety about the threat may intrude on the decision-making process; additionally, egotism may decrease self-knowledge. According to Social Cognitive Theory developed by Bandura,[36] individuals are unlikely to perform a specific behavior (eg, a COVID-19 prevention behavior) if they lack confidence in their ability to perform the behavior (ie, if they have low self-efficacy), particularly in the case of a voluntary behavior. Therefore, we speculate that these results may be explained by the unique circumstances of the emergence of COVID-19, a novel infectious disease that has high mortality and transmission rates and has no known medication treatment or vaccines. Thus, the typical psychological response to the high perceived threat of COVID-19 disease was low self-confidence in the ability to cope with the disease.

Secondly, the results demonstrate that fear arousal has a significant positive association with COVID-19 prevention behavior. This finding is consistent with Cooper et al[61] who reported that fear arousal is a strong predictor of individual health-related behavior. The current study provides additional empirical evidence that fear arousal in response to a health threat is positively associated with an action to protect against the threat.

Regarding the role of demographic characteristics, our results revealed that age had significant positive associations with COVID-19 prevention behaviors. That is, the practice of COVID-19 prevention behavior tended to be better in older participants compared to younger participants.

The survey results are consistent with the finding by Yu[70] that the COVID-19 prevention behavior of elderly people in South Korea reduced infection risk not only in their own age group, but in all age groups. The finding that prevention behavior is better in older participants has important healthcare implications because people in older age groups are generally more health conscious than those in younger age groups.[49] Notably, however, our survey results revealed no significant gender difference in COVID-19 prevention behaviors. In contrast, prior studies, eg, Hayashi et al[51], Ek[50], Yu et al[71] have reported that women tend to practice health-promoting behaviors more frequently than men do. Since the perceived health threat of COVID-19 was generally much higher than that of other chronic or infectious diseases, we speculate that, regardless of gender, all participants who perceived a high COVID-19 threat were motivated to practice disease prevention behavior.

Finally, regarding the role of personal characteristics, this study found that self-esteem is a moderating variable

in the relationship between perceived threat and fear arousal. Participants with high self-esteem had a lower perceived risk of COVID-19 infection and lower fear arousal compared to those with low self-esteem. Additionally, improvements in perceived risk and fear arousal were larger in participants who had high self-esteem. These findings were expected since high self-esteem is associated with good self-management.[69]

Implications

A theoretical contribution of this study is the use of the EPPM framework to investigate the psychological response and the disease prevention behavior of individuals during a COVID-19 outbreak. Expanding the scope of the EPPM framework for application in the context COVID-19 confirmed that, in terms of fear arousal, perceived threat is more important than perceived efficacy. This study also revealed the roles of demographic characteristics (ie, age and gender) in disease prevention behavior, which has not been discussed in the previous literature on COVID-19. Finally, this study revealed that self-esteem has a moderating effect on the relationship between perceived threat and fear arousal. Clarification of the moderating role of this personality trait enriches the theoretical framework and improves understanding of the roles of psychological and behavioral attributes in the ability of individuals to cope with the COVID-19 epidemic.

Regarding practical implications, this study found that perceived threat, fear arousal, and prevention behavior were lower in people with high self-esteem compared to those with low self-esteem. Thus, people with high self-esteem are at higher risk of COVID-19 infection and transmission, and the designs of healthcare interventions for a COVID-19 outbreak should specifically target this group. Self-esteem was also positively associated with socioeconomic characteristics such as education and income.[72] Moreover, people with high self-esteem tend to overestimate their knowledge and competence, which limits their ability to recognize the need for behavioral change and limits their commitment to behavioral change.[13] Hence, we suggest that public health policymakers consider these personal and socioeconomic characteristics when establishing regulations for monitoring and controlling the transmission of COVID-19 during this epidemic. Additionally, self-esteem should be considered in the design of public health campaigns to encourage disease prevention behavior such as mask-wearing.

On the other hand, low self-esteem has a positive moderating effect on the relationship between perceived threat and fear arousal. From a terror management perspective,[73] we suggest that public health communications should be designed to increase the perceived threat of COVID-19 and fear arousal in people with low self-esteem in order to promote disease prevention behavior in this group.

Finally, since our results demonstrated that COVID-19 prevention behavior was better in the elderly than in the young, we suggest that education, training programs, and public communications related to disease prevention should specifically target young people. For example, public health information campaigns during a COVID-19 outbreak can target young people by recruiting television and internet celebrities to act as government spokespersons for epidemic prevention policies.[74]

Limitations

This study has some limitations. First, the investigated participants were mainly recruited from "friends" communities of LINE app users in Taiwan. The findings might not be applicable in other countries/regions. For example, the perceptions and psychological responses of the participants may have been affected by cultural characteristics unique to Taiwan. Another limitation is the potential for sample selection bias. That is, the analytical results for the constructs in this research would likely differ between a sample of LINE users and a sample of the general public. Finally, in accordance with Pfattheicher et al[75] and Lunn et al[76] fear arousal was measured primarily in relation to fear of death. However, the likelihood of death from COVID-19 is not constant across the population. For example, older people who contract COVID-19 are likely to exhibit a fear of death since COVID-19 mortality is highest in older age groups whereas younger people who contract COVID-19 are most likely to have a fear of spreading the virus to others. Thus, this limitation should be considered when interpreting and applying the results of this study.

Conclusion

In summary, the EPPM model in this study obtained clear evidence that self-esteem and demographic characteristics are predictors of COVID-19 prevention behaviors. We expect the analytical results of this study to be useful for helping healthcare professionals and administrators understand the need for a systematic, multi-faceted, and integrated approach to promoting COVID-19 prevention behavior.

Ethical Considerations

This study complied with the Declaration of Helsinki guidelines for research involving human subjects. The study protocol was certified by the ethics committee of

Taizhou University Hospital (No. 2020 079). All participants in the online-based questionnaire survey gave written informed consent to the study. All participants in the online survey gave informed consent by completing an online form designed by the authors. The study brief informed them that they were free to withdraw at any time, should they wish to do so. Survey data were stored on a password-protected computer, which housed all data.

Acknowledgments

The research did not receive any specific grant from funding agencies in the public, commercial, or non-profit sectors. Dr. Hsien Cheng Lin has recently become affiliated with College of Cultural Tourism & Comprehensive Health, Taizhou University, Taizhou City, Zhejiang Province, China.

Disclosure

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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