

Protection Motivation Theory and Environmental Health Behaviors: A Systematic Mapping

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Abstract

This study aimed to explore the themes and parameters of environmental health behaviors based on Rogers' protection motivation theory through a systematic mapping review. Using a systematic approach, a literature review was conducted of articles that adopted Rogers' protection motivation theory. A total of 11 articles on protection motivation theory using participants and environmental health as outcomes were identified in a search of CINAHL, Cochrane Library, EMBASE, Eric, PsycARTICLES, PubMed, and RISS between September 1 and September 8, 2021. Themes related to the environment and personal behaviors between 2002 and 2021 were extracted. The parameters based on protection motivation theory were identified through systematic mapping as fear appraisal, rewards of maladaptive response, severity, vulnerability, costs of adaptive response, response efficacy, self-efficacy, and intention. Self-efficacy and response efficacy considerably affected environmental health behaviors. Emotional fear appeal related to environmental hazards motivates an internal process that alters the threat appraisal and their coping appraisal. Environmental behavior perception and intention influenced on environmental health behaviors with small effect sizes. Therefore, a deeper understanding of the severity of environmental health issues could lead to the development of helpful, effective, and intensive interventions to promote healthcare among the vulnerable population.

Keywords: Fear, Health behavior, Review, Motivation, Coping

1. INTRODUCTION

The human desire to maintain and promote environmental health manifests as health behaviors for minimizing environmental exposure [1,2]. Rogers' protection motivation theory (PMT) [3] and revised protection motivation theory (rPMT) [4] are health behavior theories for the evaluation and promotion of behavioral changes in response to environmental threats. The PMT emphasizes human emotional factors and can be used to examine individual behaviors related to environmental health threats [5]. Rogers' theory suggests that humans form behavioral intentions and adopt health behaviors based on their internal sensitivity and feeling of vulnerability toward environmental threats and their beliefs concerning the effectiveness of their health behaviors [4]. After Bandura's [6] concept of self-efficacy emerged, PMT was revised to more elaborately explain how self-efficacy acts as an important variable for the promotion of health behaviors [4].

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Given that PMT is useful for evaluating threats and explaining the motivations of individuals concerning health behaviors, several studies have been published in recent years that have used PMT to examine considerations related to environmental health. PMT has been applied in the areas of infectious disease prevention, exercise, diet, and self-examination [7]. Studies examining health management behaviors [8] and women's environmental health behaviors have been conducted in South Korea [9]. Therefore, a systematic mapping using PMT of the internal perceptions and subsequent behavioral changes individuals make when evaluating environmental threats has implications for future research on environmental health.

Systematic mapping in a literature review is a method of concept mapping that helps to summarize outcomes to illuminate the structure and systems of interest [10]. This study presents the results of a literature review, which differs from a traditional systematic review in that the research questions were wide-ranging with an emphasis on the overall scope rather than a detailed analysis, and high-level concepts were classified [11]. The study results are not presented as a meta-analysis, but rather as a thematic analysis. Among the 14 literature review methodologies introduced by Grant and Booth [12], the systematic mapping method classifies the existing body of literature according to a specific topic and can be used for in-depth and extensive conceptualization. Systematic mapping can yield useful results for policymakers, can be conducted in accordance with a theoretical point of view, and can be used to present and discuss important future research directions.

It is necessary to examine the concepts of the theory when applied and to explore the trends related to applied research. This study aimed to examine the use of concepts from PMT in environmental health studies and to extract common parameters and themes. This study will contribute to the growing body of literature on changes in human health behaviors in response to environmental threats such as climate change and the spread of infectious diseases. In addition, this study provides basic data for designing practical interventions and conducting future research that can improve public health outcomes. This study aimed to identify key concepts related to the application of PMT in research on environmental health topics (themes) and related variables (parameters). The specific purpose of this study was to examine the themes, methods, concepts, and results related to Rogers' PMT [3,4] found in studies on environmental health.

2. MATERIALS AND METHODS

This review study used a systematic mapping method to examine studies on environmental health that applied Rogers' PMT [3]. The procedure of the literature review using systematic mapping in this study was as follows. First, the research question was determined using PO, and the participants were determined using the PMT, with the outcome being environmental health. The specific research question was, "What are the subjects, methods, and results of studies that apply the PMT to examine environmental health?" Searches of CINAHL, Cochrane Library, EMBASE, Eric, PsycARTICLES, PubMed, and the domestic database Research Information Sharing Service of Korea (RISS) were then conducted, and hand searches were also undertaken to decrease bias. The search was conducted using CINAHL heading, Emtree, and MeSH with the advanced search option in each electronic database. The inclusion criteria were: 1) studies that applied the PMT or rPMT to environmental health-related outcome variables; 2) peer-reviewed, full-text papers published in English or Korean; 4) papers that applied a wide range of methodologies, including quantitative and qualitative research; and 5) papers published between January 1, 1971 and September 1, 2021. Initial research period was designated for reflecting the publication regarding protection motivation theory [3]. Exclusion criteria were: 1) dissertations, books, or gray literature (such as conference reports or institutional reports); 2) papers that used only some concepts from PMT without incorporating the full theory; and 3) papers that did not present research results. The keywords 'protection motivation theory,' 'motivation,' 'environment,' and 'environmental health'

were added to the search terms. The literature search was conducted from September 1 to September 9, 2021. The selection of studies and extraction of themes were carried out as follows. The advanced search term "TX AND environment protection motivation theory" identified 29 articles in CINAHL, out of which 1 was selected. The search term "protection motivation theory in Title Abstract Keyword AND environment in Title Abstract Keyword" identified 11 articles in the Cochrane Library, from which 1 was included. The search term "(('protection motivation theory'/exp OR 'protection motivation theory' OR (('protection'/exp OR protection) AND ('motivation'/exp OR motivation) AND ('theory'/exp OR theory))) AND environment: jt" identified 6 articles in EMBASE, of which 2 were selected. The search term "protection motivation theory AND environment" yielded 10 articles in Eric, from which 1 was included. The search term "protection motivation theory AND environment" resulted in 15 articles in PsycARTICLES, of which 1 was selected. The search term "Environmental Health "[Mesh] AND" Health Behavior "[Mesh] AND" Motivation "[Mesh]" yielded 10 articles in PubMed, of which 1 was included. The search terms 'protection motivation theory, a modified protective motivation theory,' 'Rogers,' 'environment,' and 'environmental health' identified 29 articles in RISS, from which 2 were selected. A total of 7 English-language articles and 2 Korean articles were found, and 1 duplicate article was excluded. Three further articles were identified using a hand search from the reference list (Figure 1). Researcher reviewed articles, extracted themes, and coded impact parameters in a case report form. The 11 selected papers were summarized and synthesized using a coding frame. The case report included the first author, publication year, country, themes, study design, theoretical framework, setting, participants, number of participants, impact parameters (affecting factors), and result variables (effect size). If unclear results were found for extraction from consultation, researcher compared two case reports and full text articles through a meeting. Lastly, the categories and relationships between influencing factors were visualized.

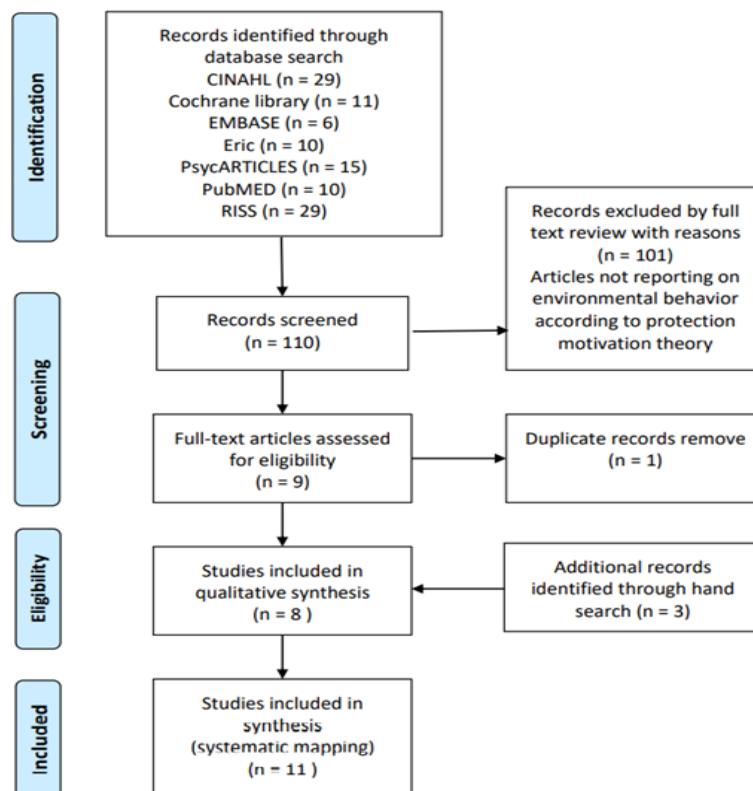


Figure 1. Literature search flow for systematic mapping

3. RESULTS

3.1 Themes of environmental health-related studies that applied the PMT

A total of 11 relevant studies were published between 2002 and 2021 [9,13-22]. The topics of the studies could be classified as environment-oriented behaviors and individual-oriented behaviors. The studies on environment-oriented behaviors included 2 on pro-environmental behaviors [13,14], 1 on energy and resource-saving behaviors [15], 1 on public responses to chemical, biological, radiological, and nuclear (CBRN) incidents [16], 1 on sustainable waste management behaviors [17], and 1 on environmentally conscious behaviors [18]. The studies on individual-oriented behaviors included 2 on women's environmental health behaviors [9,19], 1 on the environmental behaviors of female adolescents [20], 1 on environmental behaviors related to pregnancy [21], and 1 on behaviors related to fine dust prevention [22] (Appendix 1).

3.2 Methods of environmental health-related studies that applied PMT

There were 6 studies from South Korea [9,17-21], 1 from the United States [13], 1 from the United Kingdom [16], 1 from the European Union [15], 1 from Iran [14], and 1 from Thailand. In terms of research methods, 7 studies were surveys [13-15,17,18,21,22], 3 were scale development studies [9,19,20], and 1 was a review article [16]. The PMT was applied in 8 articles [9,15-18,20-22], and the rPMT was applied in 3 articles [13,14,19]. The number of subjects ranged from 136 to 27,881. In terms of the study subjects, there was 1 review study [16], 1 study on high school students [18], 1 on adolescents aged 18-22 [20], 2 on university students [13,14], 2 on women over 20 [9,19], 1 on women aged 20-59 [22], 1 on office workers [17], 1 on the general public [15], and 1 on pregnant women [21] (Appendix 1).

3.3 Concepts from environmental health-related studies that applied the PMT

The rPMT concepts of fear appraisal, threat appraisal (rewards, severity, vulnerability), coping appraisal (costs, response efficacy, self-efficacy), and intention were examined in this study. Topics related to fear that were found in the studies identified in our search included environmental concerns [15], health concerns [15], environmental perceptions [16], and risk perception [18]. The topics related to rewards that were identified were rewards [14] and benefits [19]. In addition, the topics related to severity that were identified were severity [18] and sensitivity [20], while vulnerability [20], susceptibility [9], and possibility [17] were identified as vulnerability-related topics. Topics related to costs included costs [16] and barriers [19]. Studies on response efficacy [13] and self-efficacy [17] were also identified. The topics related to intention were attitudes [14] and intention [9]. Other concepts that were identified were responsibility [15], communication [16], beliefs [16], justice [13], information [22], subjective norms [22], and negative affect [22] (Appendix 1).

3.4 Results of environmental health-related studies that applied the PMT

In terms of the impact of each concept from the rPMT on environmental health, environmental concerns ($\beta=-.31$) and health concerns ($\beta=.21$) had an influence on energy and resource-saving behaviors [15]. Environmental perception affected public responses to CBRN incidents, but there were no statistics reported to support this finding [16], and environmental perception was not found to affect environmentally conscious behaviors [16]. Risk perception had an effect on behaviors related to fine dust prevention ($\beta=.40$) [22].

Rewards influenced pro-environmental behaviors ($\beta=-.13$) [14], and benefits were correlated with women's

environmental health behaviors ($r=.18$) [19]. Severity affected environmentally conscious behaviors ($\beta=.16$) [18], pro-environmental behaviors ($\beta=.23$) [13], sustainable waste management behaviors ($\beta=.17$) [17], women's environmental health behaviors ($\beta=.14$) [9], and environmental behaviors related to pregnancy ($\beta=.19$) [21]. In addition, severity was correlated with women's environmental health behaviors ($r=.23$) [19]. One study also found that severity did not affect pro-environmental behaviors [14]. Sensitivity was positively correlated with the environmental behaviors of female adolescents ($r=.25$) [20]. Vulnerability did not affect environmental behaviors related to pregnancy [21], women's environmental health behaviors [9], or pro-environmental behaviors [14], and it was correlated with the environmental behaviors of female adolescents ($r=.36$) [20] and women's environmental health behaviors ($r=.55$) [19]. Possibility was found to influence sustainable waste management behaviors ($\beta=.14$) [17].

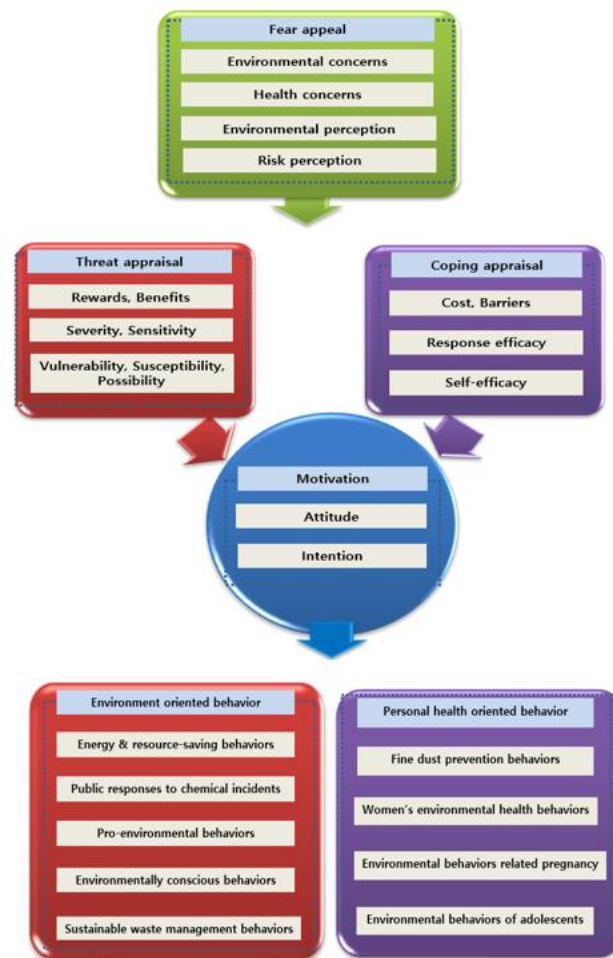


Figure 2. Mapping of protection motivation theory and environmental health behaviors

Costs had an effect on pro-environmental behaviors ($\beta=-.11$) [14], but no statistics were reported to support this finding in another study [16]. Barriers showed a positive correlation with women's environmental health behaviors ($r=.10$) [19]. Responsive efficacy did not affect environmentally conscious behaviors [18], women's environmental health behaviors [9], or Iranian university students' pro-environmental behaviors [14]. Responsive efficacy influenced the pro-environmental behaviors of US and South Korean university students ($\beta=.11$) [13], environmental behaviors related to pregnancy ($\beta=.28$) [21], and sustainable waste management

behaviors ($\beta=.38$) [17]. Responsive efficacy also showed a positive correlation with the environmental behaviors of female adolescents ($r=.26$) [20], and women's environmental health behaviors ($r=.26$) [19]. Self-efficacy affected pro-environmental behaviors in 2 studies ($\beta=.23$, $\beta=.26$) [13,14], environmentally conscious behaviors ($\beta=.67$) [18], and sustainable waste management behaviors ($\beta=-.04$) [17]. Self-efficacy positively correlated with women's eco-friendly health behaviors ($r=.51$) [19]; however, it did not affect women's environmental health behaviors [9], environmental behaviors related to pregnancy [21], or the environmental behaviors of female adolescents [20].

Intention affected behaviors related to fine dust prevention ($\beta=.27$) [22], and attitudes affected pro-environmental behaviors in 2 studies ($\beta=.25$, $\beta=.29$) [13,14]. Other concepts affected pro-environmental behaviors ($\beta=.12$) [13], environmental behaviors related to pregnancy ($\beta=.17$) [21], and energy and resource-saving behaviors ($\beta=-.10$) [15]. In addition, gender was found to affect energy and resource-saving behaviors by one study ($\beta=-.12$) [15]. Responsibility ($\beta=-.22$) was found to influence energy and resource-saving behaviors [15], while communication and beliefs were found to affect public responses to CBRN incidents, though statistics were not reported to back this finding [16]. Justice had an effect on pro-environmental behaviors ($\beta=.09$) [13], while information ($\beta=.24$) [22], subjective norms ($\beta=.29$) [22], and negative affect ($\beta=.36$) [22] were all found to impact behaviors related to fine dust prevention (Figure 2).

4. DISCUSSION

This study conducted a literature review of environmental health-related studies that applied the PMT [3] or rPMT [4] using a systematic mapping method, and visualized the identified themes and results to provide further insight. The 11 articles identified were classified as examining either environment-oriented behaviors or individual-oriented behaviors, with environment-oriented behaviors referring to behaviors that are undertaken to cultivate a more sustainable society free from environmental risks such as climate change and environmental pollution. Individual-oriented behaviors refer to behaviors that are undertaken to prevent environmental health problems among demographic groups such as women, university students, pregnant women, or the general public. The concepts from PMT supported the dependent variable as a relevant variable in environmental health-related studies.

Of the relevant responses, fear is the most influential and can cause reactions, set parameters, and evoke emotions that trigger changes in behavior [23]. For example, when an individual recognizes the dangers of fine dust inhalation, it can cause feelings of discomfort, anxiety, and stress about fine dust. In contrast to other health behavior theories, the PMT provides a unique perspective on setting the trigger point for health behaviors through fear. Researchers, nursing practitioners, advocates, and policymakers have made attempts to use fear to influence health behaviors. It is natural for humans to avoid fear and select behavioral responses through trial and error [24]. For example, if a person declines to receive a vaccine or decides to smoke, a stimulus that prompts him or her to feel fear related to the possibility of a maladaptive response may influence him or her to choose positive, protective behaviors that promote good health [23]. Such choices are not directly expressed through actions, but are motivated by a cognitive process [3]. The regular sharing of simple and repetitive information that stimulates fear can eventually cause fatigue, dullness, and apathy toward the topic [22]. In this study, environmental and health concerns affected energy and resource-saving behaviors and risk perception affected behaviors related to fine dust prevention.

Rewards, as a result of maladaptive responses when applied to environmental health behaviors, can be understood as benefits resulting from not undertaking environmental health behaviors [23]. For example, it may be satisfying for individuals to consume foods with many unhealthy additives or it may be convenient to use single-use, disposable products. If one's vulnerability to harms is higher or the consequences of maladaptive

responses are more severe, healthy foods may be more appealing to individuals due to their benefits, outweighing the short-term benefits of unhealthy foods [23]. The rPMT [4] subsequently introduced a calculation in the model by which threat appraisal could be determined by balancing severity and vulnerability with the benefits of maladaptive responses:

$$\{\text{Rewards of maladaptive response} - (\text{severity} + \text{vulnerability}) = \text{threat appraisal}\}$$

If the degree of severity or vulnerability is high, the healthy behavior is more likely to be chosen due to the decreased attractiveness of the reward, and if the attractiveness of the reward is greater than the sum of severity and vulnerability, the maladaptive behavior is more likely to be selected [24]. In this study, since compensation and benefits were found to affect pro-environmental behaviors [14,19], health professionals aiming to promote environmental health behaviors should devise strategies to reduce the attractiveness of rewards for not engaging in environmental health behaviors.

Severity and vulnerability are the concepts presented in the health beliefs model. In the health beliefs model, individuals interpret severity and vulnerability as mental paths, maximizing their outcomes in a way that corresponds to their values and expectations [23]. For example, recognition of the harmfulness of atopic dermatitis, an environmental health problem, reflects the perceived severity of the condition, while the belief that one may be diagnosed with atopic dermatitis reflects one's perceived vulnerability to the condition. In this study, the effect size for severity ranged from .14 to .23 across 6 out of the 11 studies [9,13,14,17,18,21], indicating that the variables relevant to severity were relatively consistent with regard to their influence on environmental health problems, although the influence was not substantial. In terms of vulnerability, moderate correlations were found, with coefficients of .36 and .55 in 2 out of the 11 studies [19,20], but the findings related to vulnerability were not statistically significant in several other studies [9,14,20]. This can possibly be attributed to the simultaneous perception of severity with regard to environmental health problems while also not being convinced of one's own vulnerability to health threats, possibly caused by common defense mechanisms by which individuals psychologically refuse to believe that they are vulnerable [24].

The costs of adaptive responses with regard to the PMT and environmental health behaviors can be understood as the negative effects of positive environmental health behaviors [23]. For example, costs could refer to the economic burden of buying organic foods or the time and effort required to collect and separate one's garbage and recyclables. Coping appraisal can be evaluated by calculating the costs of adaptive responses in relation to the degree of response efficacy and self-efficacy in the rPMT model [4].

$$\{(\text{Response efficacy} + \text{self-efficacy}) - \text{costs of adaptive response} = \text{coping appraisal}\}$$

If response efficacy and self-efficacy outweigh the costs and the involvement of the individual requires energy exertion, coping appraisal will be increased, which in turn strongly motivates environmental health behaviors. However, if the costs outweigh the response efficacy and self-efficacy, the individual is likely to be less willing to undertake healthy behaviors [23]. In this study, costs affected the environmentally conscious behaviors of university students [14], though there were only 3 studies that examined the concepts of costs and compensation [14,16,19]. Therefore, it is necessary to consider assessments of costs during the internal decision-making process when conducting research and devising policies related to environmental health behaviors.

In this study, response efficacy was found to have effect sizes ranging from .11 to .28 across 5 of the 11 studies [13,17,18,20,21]. Response efficacy refers to an assessment of the ability of environmental health

behaviors to prevent health problems. For example, it is commonly known that wearing a face mask prevents the inhalation of fine dust, thereby leading to fewer respiratory health problems. The effect sizes of self-efficacy showed wide variation, ranging from $-.04$ to $.67$. Self-efficacy was examined in 5 of the 11 studies [13,14,17,18,19] and was the most influential relevant variable. Self-efficacy is a concept added by Rogers [4] to the rPMT model that assesses an individual's ability to perform health acts independently. Although self-efficacy was added as a variable later, it was found to be the strongest predictor of health behaviors [4]. This is because self-efficacy is a variable that is formed relatively later as a result of an internal judgment of severity, vulnerability, and response efficacy in relation to one's own particular situation [7].

The last relevant variable, intention, refers to one's motivation for undertaking a health behavior following the threat appraisal and coping appraisal [4]. In this study, intention was examined in 3 out of the 11 studies [13,14,22], which also examined the standardized regression coefficient for fine dust prevention [13] and pro-environmental behaviors [14,22]. Intention has been shown to influence environmental health behaviors, although not to a significant degree, with effect sizes ranging from $.25$ to $.29$. In future studies, it will be necessary to measure individuals' intentions or level of motivation to undertake environmental health behaviors, and the findings of future research should be used to devise interventions to promote environmental health behaviors.

5. CONCLUSION

The concepts from PMT supported the dependent variable as a relevant variable in environmental health-related studies. The environmental health-related studies that were identified in this study and the concepts they examined within the theoretical framework of PMT suggest implications for future research. The following research directions are proposed in response to this study's findings resulting from the use of the systematic mapping method to examine topics and concepts related to the PMT. First, fear and other emotions influence environmental health behaviors as a result of internal cognitive processes, and further studies are needed to understand in greater depth individual emotions related to pollution and other environmental health problems. Second, future studies should convey the seriousness of environmental health problems in terms of threat assessment and provide scientific, real-life information that is specific and not heuristic. Third, the health of women, pregnant women, children, adolescents, and economically vulnerable groups, all of whom are high-risk and environmentally vulnerable, should be monitored, and interventions should be routinely conducted to recognize vulnerabilities and minimize their effects. Fourth, individuals should be provided with education on how to undertake healthy activities that can be easily practiced in their daily lives and provide information utilizing various media to enhance the response and self-efficacy. Fifth, environmental health studies should incorporate analyses of compensation and costs.

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