

Stress coping and health risk behavior in public health crises: An extended model applying Dubin's method

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Objectives: Stress coping theory conceptualizes individual health risk behaviors as arising from the stress process shaped by interactions between individuals and their environment, yet it incompletely captures coping and health risk behavior during public health crises. This study develops an extended conceptual framework integrating stress coping theory with risk perception research. **Methods:** Using Dubin's theory-building procedures, we conducted a construct analysis of peer-reviewed studies published in English and Korean between January 2003 and June 2023. Literature identification and selection were documented with reference to the PRISMA 2020 statement. Searches covered PubMed and two Korean databases (the Korean Studies Information Service System and Research Information Sharing Service). A total of 3,754 records were initially identified through database searching and 98 studies were ultimately included for construct analysis. **Results:** The proposed model specifies a dual stress process that differentiates crisis-context stressors from specific socioeconomic stressors. Contextual, socioeconomic, and disease-related stressors shape primary and secondary cognitive appraisal; with risk perception represented by both appraisal-oriented judgments and affect-laden responses. Coping resources moderate the stress process and stress-related emotions contribute to the onset or exacerbation of health risk behaviors. **Conclusion:** Broadening stress coping models to explicitly incorporate crisis context and risk perception may improve understanding of health risk behaviors during future infectious disease outbreaks and support sustained health promotion efforts.

Key words: public health crisis, health risk behavior, stress coping, cognitive appraisal, risk perception

I. Introduction

Health risk behaviors, such as excessive alcohol consumption, smoking, and physical inactivity, are a significant public health concern, as they increase the risk of chronic diseases and associated mortality (Linardakis et al., 2013; Rabel et al., 2019). Traditionally, these behaviors have been explained through theoretical frameworks such as the Health Belief Model (HBM), the Theory of Planned Behavior (TPB), and the Transtheoretical Model (TTM). Notably, Stress Coping Theory conceptualizes individual health risk behaviors as outcomes of a continuous "stress

process" shaped by interactions between individuals and their environment (Lazarus & Folkman, 1984; O'Cleirigh et al., 2003). This theory identifies multidimensional stressors, explains the mechanisms by which individuals recognize these stressors, and describes coping strategies employed in response (Folkman, 2020; Lazarus & Folkman, 1984; Umberson et al., 2008).

The COVID-19 pandemic, which led to widespread global infections, was a major driver of heightened stress and anxiety (O'Cleirigh et al., 2003). Beyond infection risks, this 'public health crisis' functioned as a significant stressor by disrupting daily life, reducing

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income, and causing job losses. In response to these stressors, individuals may have engaged in or intensified health risk behaviors as a coping mechanism (Lazarus & Folkman, 1984; Umberson et al., 2008). Recent literature has documented increased vulnerability to such behaviors following the COVID-19 pandemic. Studies have shown increased sedentary behavior and decreased physical activity (Rogers et al., 2020). Substance use, including alcohol and cannabis, has risen (McBride et al., 2021), and empirical studies have also highlighted potential health consequences associated with such vulnerability, including poorer health-promoting behaviors and adverse health outcomes (Badura-Brzoza et al., 2022).

Considering public health crises in relation to individual health risk behaviors is particularly important not only in the context of the COVID-19 pandemic but also in comparable infectious disease outbreaks. Individuals' risk perception and emotional responses play a critical role in these situations (Paek & Hove, 2017). Such crises, including pandemics, inherently evoke fear and can rapidly amplify anxiety and public distress (Sandman et al., 1998). Ultimately, heightened emotional responses contribute to increased stress levels, which, in turn, influence individual behaviors (Keng et al., 2022).

Literature suggests that the synergistic effects of stress, emotions, and risk perception triggered by public health crises can lead to changes in individual responses, including health risk behaviors (Kassel et al., 2003). A longitudinal study across 86 countries found that COVID-19-induced economic hardship led to poorer meal and sleep quality and increased smoking, with those facing both high economic difficulty and high infection risk showing the worst outcomes (Keng et al., 2022). Risk perception is also a key determinant of preventive behaviors, influencing behavioral responses to health threats (Paek & Hove,

2017; Renner et al., 2008). Moreover, it affects stress levels, which in turn shape behaviors such as alcohol consumption and smoking (Renner et al., 2008). These findings underscore the need to consider public health crisis conditions and incorporate risk perception into analyses of health behaviors during pandemics and similar crisis contexts.

However, most studies on stress, health risk behaviors, and pandemics treat these concepts separately (Keng et al., 2022; McBride et al., 2021; Rogers et al., 2020). More importantly, prior research has rarely integrated these elements into a single explanatory framework that captures how public health crisis conditions function as structured stressors, how such stressors are cognitively and emotionally appraised, and how such processes may contribute to the onset or intensification of health risk behaviors. In particular, risk perception has often been discussed in relation to preventive behaviors, whereas its role in shaping health risk behaviors under crisis conditions remains theoretically underdeveloped (Paek & Hove, 2017; Renner et al., 2008). Given the potential for future infectious disease outbreaks, there is a need to integrate theoretical frameworks that explain health risk behaviors in crisis contexts like the COVID-19 pandemic.

To address this gap, this study develops an extended conceptual framework for understanding health risk behaviors in public health crises. Building on stress coping theory and incorporating insights from risk perception research, this study conceptualizes public health crisis conditions as part of the stress process and proposes a dual stress process that distinguishes between crisis-context stressors and specific socioeconomic stressors. It further positions crisis-related risk perception and affect-laden responses within the cognitive appraisal process and links these processes to health risk behaviors (Folkman, 2020; Kassel et al., 2003; Lazarus

& Folkman, 1984; Paek & Hove, 2017; Sandman et al., 1998). Through this approach, the study aims to provide a broader theoretical explanation of how health risk behaviors may emerge and change in public health crises.

II. Methods

This study applies Dubin's (1978) theory-building methodology to develop an extended theoretical model. To enhance transparency in literature identification and selection, the search and screening process was documented with reference to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement (Page et al., 2021). In this study, Dubin's approach served as the principal methodological framework for theory building, while PRISMA was used as a reporting aid for the literature search and selection process.

Dubin's approach systematizes deductive theory-building by providing a structured framework for constructing empirically grounded models (Holton & Lowe, 2007). As refined by Holton and Lowe (2007), this methodology has been applied across a range of disciplines in the social and applied sciences. The process begins with a review of existing knowledge, which forms the basis for modifying, integrating, or developing theory (Holton & Lowe, 2007). The model is then developed through the identification of key concepts (units), specification of interactions, definition of system boundaries, and characterization of system states.

Units are the fundamental components of the model and represent the key variables or factors that define the concept or theory. They are identified through literature review and empirical observation and may include multiple conceptual dimensions (Dubin, 1978; Lynham, 2002). Interactions describe the relationships

among units, although they do not necessarily imply causality (Dubin, 1978; Lynham, 2002). Boundaries define the scope of the model and may be either closed, involving no interaction with external elements, or open, allowing exchanges with external conditions (Dubin, 1978; Lynham, 2002). System states refer to the conditions under which the model operates (Dubin, 1978; Holton & Lowe, 2007). Finally, a conceptual framework is developed, from which the analytical model is constructed. Because not all components are empirically testable, the final model is refined based on feasibility and available resources. As the present study focuses on theoretical model construction, the process concludes at this stage (Dubin, 1978; Lynham, 2002). The detailed process used in this study is outlined below.

1. Phenomena understanding

An initial literature review was conducted to examine stress coping theory-based research on health risk behaviors and prior studies on health behaviors during the COVID-19 pandemic. This process refined the need for model expansion and clarified the research problem, as outlined in the introduction.

2. Literature search and selection

To establish the foundational data for construct analysis, studies examining individual health risk behaviors in public health crises from the perspectives of stress theory or risk perception research were systematically searched and selected. The literature identification and selection process was documented with reference to the PRISMA 2020 guideline, and the overall process is summarized in [Figure 1] (Page et al., 2021).

Since this study aimed to develop an extended theoretical model, a systematic literature search was

conducted to identify knowledge gaps in existing research. Additionally, while a number of empirical studies have explored health risk behaviors through the lens of stress theory (Ensel & Lin, 2004; House et al., 1986; Marks et al., 2022; Pearlin & Radabaugh, 1976; Umberson et al., 2008), research incorporating public health crises, such as pandemics, remains limited. The specific research strategies and methods are detailed below.

1) Target literature

This study examines peer-reviewed journal articles published in English and Korean on individual health risk behaviors in public health crises from the perspectives of stress theory and risk perception research. The search period was set from January 1, 2003 through June 30, 2023. The starting point of 2003 was selected to capture the period in which scholarly discussion of infectious disease-related public health crises became more visible following the SARS outbreak, thereby allowing the review to encompass SARS, MERS, and COVID-19-related contexts. The end point of June 2023 reflects the final search cut-off used for theory development in the present study.

2) Search strategy

The literature search was conducted using internet-based electronic databases. Because the aim of this study was theory building through construct identification rather than a conventional effectiveness review or meta-analysis, the international search was centered on PubMed. Boolean operators and MeSH terms were used to refine the search, and the search was restricted to titles and abstracts to ensure the retrieval of relevant documents. For Korean-language literature, the Korean Studies Information Service System (KISS) and the Research Information Sharing Service (RISS) were additionally searched to capture

domestic studies relevant to the public health crisis context.

Search terms were determined through a pilot test, using various keyword combinations derived from the initial literature review. The pilot test refined the search strategy by eliminating irrelevant terms and formulating the final search query. The theoretical review covered three primary research areas: health risk behavior studies (Berrigan et al., 2003), stress research (Folkman, 2020; Lazarus & Folkman, 1984; Umberson et al., 2008), and risk perception and health behavior studies during COVID-19 (Keng et al., 2022; Sandman et al., 1998). Based on these insights, the final search terms applied in the literature search are as follows.

The following search terms were used for the English-language literature search: (“Stressor” [Title/Abstract] OR “Psychological Trauma” [MeSH Terms] OR “Cognitive Appraisal” [Title/Abstract] OR “Risk Perception” [Title/Abstract] OR “Outrage” [Title/Abstract] OR “Determinant” [Title/Abstract] OR “Factor” [Title/Abstract] OR “Mediator” [Title/Abstract] OR “Moderator” [Title/Abstract]) AND (“COVID-19” [MeSH Terms] OR “Severe acute respiratory syndrome-related coronavirus” [MeSH Terms] OR “Middle East Respiratory Syndrome Coronavirus” [MeSH Terms] OR “Pandemics” [MeSH Terms] OR “Communicable Diseases” [MeSH Terms]) AND (“Health Behavior” [Title/Abstract] OR “Health Risk Behaviors” [Title/Abstract] OR “Alcohol Drinking” [MeSH Terms] OR “Smoking” [MeSH Terms] OR “Exercise” [MeSH Terms]). For the Korean-language search, the same keywords were applied after a secondary pilot test based on the English-language search results.

3) Inclusion and exclusion criteria

To ensure the selection of relevant literature, this study included English- and Korean-language

publications that examined individual health risk behaviors in public health crises from the perspectives of stress theory or risk perception research. Even if a study did not explicitly mention stress theory, it was included if it reported the influence of key components of stress coping theory. Additionally, studies investigating the effects of risk perception or crisis-induced emotions on health behaviors during events like the COVID-19 pandemic were also included.

Exclusion criteria were as follows. Studies were excluded if they did not analyze health risk behaviors as outcome variables, such as those focusing on preventive behaviors (e.g., mask-wearing, handwashing) or vaccination uptake. Studies using indirect indicators rather than actual health risk behaviors, such as behavioral intentions, secondhand smoke exposure, or fitness app usage, were also omitted. Research that examined reverse causality, where health risk behaviors were predictors rather than outcomes, was excluded. Additionally, studies focusing on risk perception related to specific health behaviors (e.g., perceived severity of smoking risks) rather than public health crisis-related risk perception were not considered. Finally, non-peer-reviewed articles, including conference proceedings, research reports, duplicate studies, and studies available only in abstract form, were excluded from analysis.

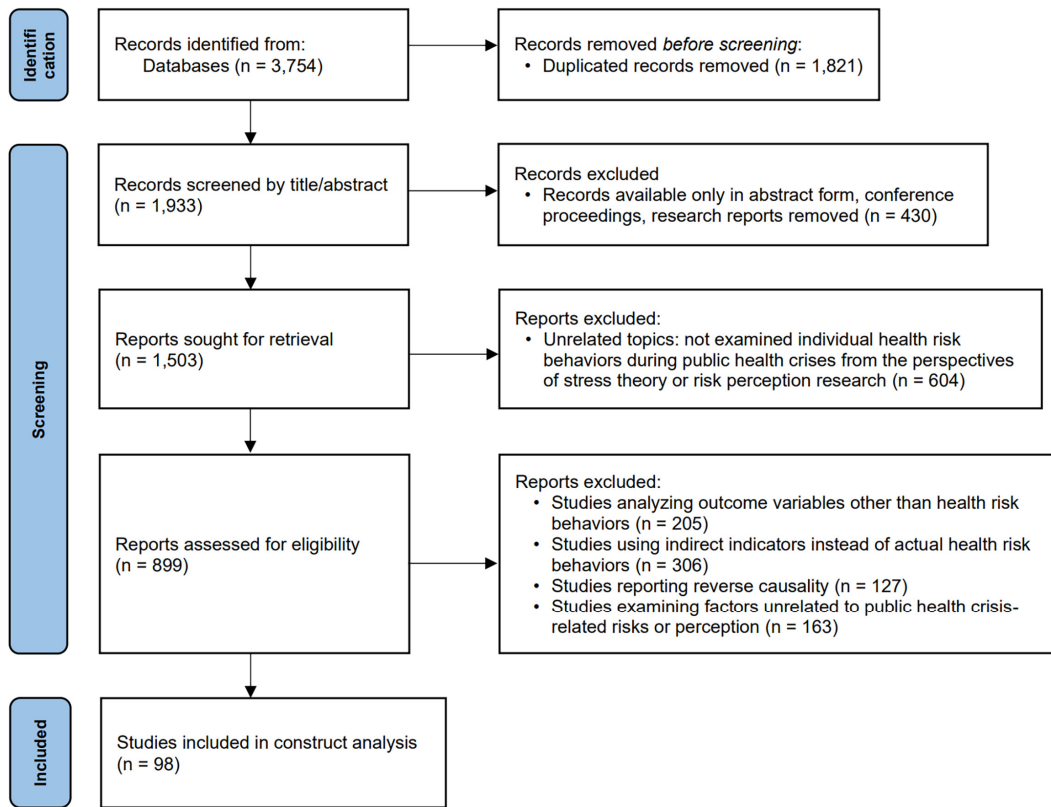
4) Literature selection process

The literature selection process was conducted according to predefined inclusion and exclusion criteria and documented with reference to the PRISMA 2020 framework [Figure 1]. A total of 3,754 records were initially identified through database searching. After 1,821 duplicate records were removed, 1,933 records remained for title and abstract screening. At this stage, 430 records available only in abstract form,

conference proceedings, or research reports were excluded, leaving 1,503 records for further screening. Of these, 604 records were excluded because they did not examine individual health risk behaviors during public health crises from the perspectives of stress theory or risk perception research. Consequently, 899 full-text reports were assessed for eligibility. Of these, 801 reports were excluded for the following reasons: outcome variables other than health risk behaviors ($n=205$), use of indirect indicators instead of actual health risk behaviors ($n=306$), reverse causality ($n=127$), and examination of factors unrelated to public health crisis-related risks or perceptions ($n=163$). Ultimately, 98 studies were included in the construct analysis, comprising 68 international studies and 30 domestic studies.

3. Construct analysis

In the construct analysis phase, the 98 selected studies were systematically examined to identify and synthesize theoretical constructs, which formed the basis for selecting units in the developing theoretical model. Constructs included in the analysis met one of two criteria: (1) they were key variables in stress coping theory (Folkman, 2020; Lazarus & Folkman, 1984; Umberson et al., 2008) or risk perception research, or (2) they appeared in at least four studies. The threshold of four studies was chosen based on a preliminary inspection of the frequency distribution, which showed an inflection point and a steep decline in occurrences below this level, and to balance parsimony with inclusiveness in unit selection. Constructs meeting this criterion were considered well-established in prior research, increasing their likelihood of inclusion in the final theoretical model (Holton & Lowe, 2007).



[Figure 1] PRISMA flow diagram of literature identification, screening, and inclusion

4. Conceptual framework building

Based on the literature review and construct analysis, a conceptual framework was developed following Dubin's (1978) methodology. This process addressed four key questions:

- 1) What are the units of the model?
- 2) What are the laws of interaction within the model?
- 3) What are the boundaries of the model?
- 4) What are the system states of the model?

To ensure theoretical validity and reliability, each stage of framework construction adhered to Patterson's (1986) criteria: importance, accuracy and clarity, parsimony and simplicity, comprehensiveness, operationalizability, validity (empirical testability), fruitfulness, and practicality.

III. Results

1. Construct analysis results

The 98 selected studies were systematically analyzed, including 68 international studies and 30 domestic studies, and the identified constructs were organized into a frequency-based analysis summarized in <Table 1>. The total count represents the number of study-by-construct occurrences, where a single study could contribute to multiple constructs if reported. Based on the analysis, key concepts were identified and integrated using stress coping theory and risk perception and health behavior research.

According to stress coping theory, health risk behaviors arise through a sequential process involving stressors, the stress process, and stress responses (Lazarus & Folkman, 1984; Umberson et al., 2008).

Stressors, as antecedent variables, initiate the stress process and may include both daily stressors and major life events, such as COVID-19 infection or quarantine experiences. The stress process consists of primary and secondary cognitive appraisal, coping mechanisms, and coping resources at both the individual and social levels (Umberson et al., 2008). In response to this process, health risk behaviors may emerge, ultimately influencing health outcomes.

Key concepts from risk perception research can be integrated with stress coping theory (Lazarus & Folkman, 1984). In this study, risk perception is treated as a component of primary cognitive appraisal, reflecting an intuitive evaluation of threat and its anticipated consequences (Renn & Rohrmann, 2000). Consistent with the literature emphasizing both cognitive judgments and affective responses in risk perception, the framework distinguishes an appraisal-oriented component (COVID-19 risk perception) and an affect-laden component (COVID-19-related outrage) within primary appraisal, while acknowledging that they jointly represent the perceived risk in a public health crisis context (Folkman, 2020).

As a result, the identified units were reorganized according to their theoretical position within stress coping theory, specifically under stressors, the stress process, and stress responses. These constructs were then synthesized into constructs with corresponding sub-constructs, as summarized in <Table 1>.

Firstly, the category of stressor units includes contextual, socioeconomic, and disease-related stressors, representing broad stress factors linked to the public health crisis and other infectious disease outbreaks. Contextual stressors are divided into situational factors and control measures. Situational factors include the onset and duration of the pandemic, COVID-19-related death counts, and lockdown periods. Control measures refer to

pandemic-related policies such as lockdown/containment measures, social distancing, business hour restrictions, Shelter-in-Place (SIP) mandates, and Movement Control Orders (MCOs) (Bösch & Inauen, 2023; Geets Kesic et al., 2021; Gu et al., 2023; Wharton et al., 2023).

Socioeconomic stressors include negative life events, Crisis-related negative life events, workplace stressors, and socioeconomic factors. Negative life events encompass relational problems, job loss, business closure, school expulsion, violence, discrimination, stigma, bereavement, divorce, and other traumatic events (Bornscheuer et al., 2022). Crisis-related negative life events specifically refer to financial problems due to COVID-19, additional parental stress, employment loss, education loss, unwanted telecommuting, and social isolation (Keng et al., 2022; Lindsey et al., 2021; Molsberry et al., 2021; Pocuca et al., 2022; Watanabe et al., 2022). Workplace stressors include job insecurity, burnout, workplace bullying, long working hours, performance pressure, fatigue, loneliness, absenteeism/presenteeism, and employment in blue-collar occupations (Fond et al., 2022; Park, 2009). Socioeconomic factors encompass low income, income instability, poverty, employment status, homeownership, residential area, and education level (Pocuca et al., 2022). For disease-related stressors, disease-related experiences include COVID-19 infection and quarantine experiences, either personally or among close acquaintances (Molsberry et al., 2021).

Secondly, the category of stress process factors includes primary and secondary cognitive appraisal, coping strategies, and coping resources. For primary cognitive appraisal, the identified subcategories were COVID-19 risk perception, COVID-19-related outrage, and stress related appraisal. COVID-19 risk perception includes perceived susceptibility or severity of infection, appraisal of COVID-19 as a threat or

opportunity, perceived impact of COVID-19, and self-identification as high-risk group (Keng et al., 2022; Krok et al., 2023). COVID-19-related outrage, considered part of risk perception, include fear, anxiety, and health concerns related to the pandemic (Bösch & Inauen, 2023; Pocuca et al., 2022; Han, et al., 2022; Zvolensky et al., 2020). Stress related appraisal includes in-depth processing of stressful events that can lead to positive cognitive reappraisal (O’Cleirigh et al., 2003). For secondary cognitive appraisal, the key subcategory was perceived coping capacity, including perceived resilience, sense of self-control, self-efficacy, and self-esteem (Bösch & Inauen, 2023; Krok et al., 2023; O’Cleirigh et al., 2003; Tudehope et al., 2022).

Coping strategies were categorized into problem solving/avoidance-oriented/social support-oriented coping, active/passive coping strategies, problem/meaning-focused coping, positive/negative coping strategies, adaptive/maladaptive coping strategies, negative problem orientation, and acceptance (Gu et al., 2023; O’Cleirigh et al., 2003). Coping resources, which act as buffers in the stress process, were divided into personal protective factors and social protective factors. Personal protective factors included vaccination history, subjective health status, personality traits, and genetic predispositions. Social protective factors included perceived or received social support, social interactions, trust in COVID-19 information sources, and government financial support (O’Cleirigh et al., 2003).

The third category, corresponding to stress responses, includes stress-related emotions and psychological distress, which are conceptually aligned with the health risk behaviors examined as outcome variables in this study. Stress-related emotions encompass mood states such as boredom, discomfort, anxious, frustration, and general negative affect (Amatori et al., 2020; Zhang et al., 2020). Psychological

distress at pathological levels includes perceived stress, depression, anxiety, post-traumatic stress disorder (PTSD), obsessive-compulsive disorder (OCD), and suicidal ideation (Fond et al., 2022; Lindsey et al., 2021).

2. Conceptual framework development

Based on the literature review and construct analysis, this study develops a conceptual framework. The framework defines units, interactions, model boundaries, and system states, forming the foundation for the final extended theoretical model (Dubin, 1978).

1) Units (Constructs)

The units, representing the individual variables or factors included in the conceptual framework, were categorized into eight higher-order constructs, each with corresponding sub-factors. These eight units were organized into three broader categories: stressors, stress process factors, and stress responses, and the final selected units are summarized in <Table 2>.

The first category, stressors, includes contextual, socioeconomic, and disease-related stressors, all of which represent broad sources of stress during public health crises. Contextual stressors consist of situational factors and control measures. Socioeconomic stressors are divided into Crisis-related negative life events and socioeconomic factor. Disease-related stressors involve COVID-19 infection and quarantine experiences, either personal or among close others.

The second category, stress process factors, builds on primary and secondary cognitive appraisal from stress coping theory while integrating public health crisis-related constructs. In primary appraisal, the framework integrates risk perception related to the public health crisis and the cognitive evaluation of specific stressors (stress related appraisal). Secondary cognitive appraisal consists of perceived risk

〈Table 1〉 Results of construct analysis applying the stress theory

Unit: *n* (%)

Construct	Sub-construct	Construct details found	Number of times construct found
Stressor			
Contextual stressor	Situational factor	Pre-post COVID-19 pandemic onset, Period of the COVID-19 pandemic, Lockdown period, COVID-19 death count	8 (5.0)
	Control measure	Lockdown/containment measures, Social distancing, Lacking access: Shelter-in-Place (SIP), Movement Control Order (MCO) restrictions, Modified reopening orders	16 (9.9)
Socioeconomic stressor	Negative life event experience	Relationship problems, Job loss/unemployment, School expulsion, Violence, Discrimination, Stigma experience, bereavement, Divorced/Separated experience, Traumatic life experience	24 (14.9)
	Crisis-related negative life event	Financial problems due to COVID-19, Additional parental stress, Employment loss, Education loss, Unwanted telecommuting	8 (5.0)
	Workplace stressor	Job insecurity, Burn-out, Sustained bullying, Working longer than expected, Fragmentation/unpredictability, Complexity/intensity, Decision-making latitude, Absenteeism/presenteeism, Fatigue, Loneliness, Performance pressure, Blue-collar employment	9 (5.6)
Disease-related stressor	Socioeconomic factor	Low income/Poverty, Income security, Employment, Home ownership, Residential area, Education	12 (7.5)
	Disease-related experience	COVID-19 confirmation/isolation experience of me or closed people	6 (3.7)
Stress process			
Primary cognitive appraisal	COVID-19 Risk perception	COVID-19 susceptibility/severity risk perception, Threats/opportunities cognitive appraisal of COVID-19, Perceived impact of COVID-19, Self-classification to the COVID-19 high-risk group	7 (4.3)
	COVID-19-related outrage	COVID-19-related fear, COVID-19-related anxiety, health worries of me and loved ones	7 (4.3)
Secondary cognitive appraisal	Stress related appraisal	Positive cognitive appraisal change (depth processing)	1 (0.6)
	Perceived self-coping potential	Perceived resilience, Self-control, Self-efficacy, Self-esteem	11 (6.8)
Coping strategy	Coping strategy	Problem solving/avoidance-oriented/social support-oriented coping, Active/passive coping strategies, Problem/meaning-focused coping, Positive/negative coping strategies, Adaptive/maladaptive coping strategies, Negative problem orientation, Acceptance	10 (6.2)
Coping resource	Personal protective factor	Vaccination, Subjective health, Inhibited personality traits, Genetic factor	5 (3.1)
	Social protective factor	Perceived/received social support, Social interactions, Trust in COVID-19 information sources, Governmental benefits	11 (6.8)
Stress response			
Psychological response	Stress related emotion	Emotional/mood state (e.g., feeling bored, discomfort, anxious and frustration), General negative emotions	4 (2.5)
	Psychological distress	Perceived stress, Depression, Anxiety, PTSD, OCD, Loneliness, Psychological distress, Suicidal ideation	22 (13.7)
Total			161 (100.0)

〈Table 2〉 Final selected units (constructs)

Construct	Sub-construct
Stressor	
Contextual stressor	Situational factor
	Control measure
Socioeconomic stressor	Crisis-related negative life event
	Socioeconomic factor
Disease-related stressor	Disease-related experience
Stress process	
Primary cognitive appraisal	Risk perception
	Stress related appraisal
Secondary cognitive appraisal	Risk controllability appraisal
	Self controllability appraisal
Coping resource	Personal protective factor
	Social protective factor
Stress response	
Psychological response	Stress related emotion
Behavioral response	Health risk behavior

controllability and perceived self-coping capacity (self-controllability appraisal). Coping resources, which buffer the stress process, are divided into personal and social protective factors.

The third category, stress responses, includes behavioral and psychological reactions, with health risk behaviors as the primary outcome variables. Psychological responses include anxiety, worry, anger, and embitterment as crisis-related negative emotional responses, summarized in the framework as stress-related emotions. Since health risk behaviors function as coping mechanisms within stress coping theory, coping strategies identified in the construct analysis were excluded from the final model to maintain conceptual clarity.

2) Laws of interactions

Based on the literature review and construct analysis, the interactions between units were defined and visually represented in the conceptual framework using arrows. Units are expected to be associated with health risk behaviors, either directly or indirectly through the stress process, while sub-factors within

the same construct are assumed to share conceptual covariance rather than representing independent dimensions. To maintain parsimony and simplicity, the number of interactions was minimized following Patterson's (1986) recommendations.

The framework follows a sequential structure, aligning with stress coping theory, where stressors, the stress process, and stress responses interact systematically. Notably, this study introduces an expanded model by structuring the stress process as a dual process, distinguishing between the public health crisis context and specific socioeconomic stressors. The specific laws of interaction between units are detailed below, with the conceptual framework illustrated in [Figure 2].

a. Contextual stressors → Disease-related & socioeconomic stressors

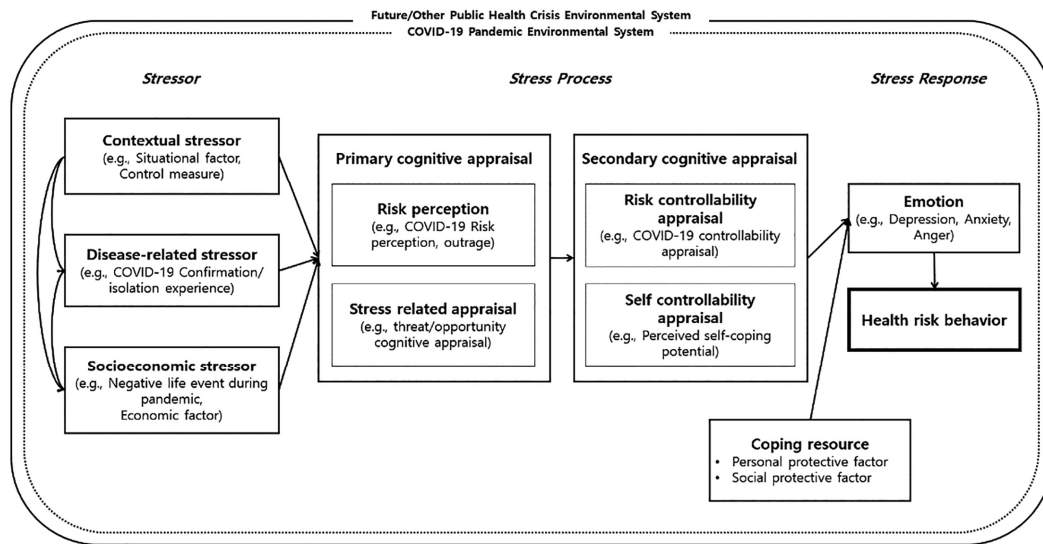
Contextual stressors function as background conditions that influence other stressors. Additionally, socioeconomic stressors and disease-related stressors are interrelated, indicating their correlation.

b. Contextual, disease-related, & socioeconomic stressors → Primary cognitive appraisal

As antecedent variables, the stressors trigger the stress process through cognitive appraisal (Folkman, 2020; Lazarus & Folkman, 1984). In the dual stress process framework, cognitive appraisal occurs separately for public health crises and specific stressors, with different stressors influencing each process.

c. Primary cognitive appraisal → Secondary cognitive appraisal

Primary cognitive appraisal, which assesses public health crises and specific stressors, directly influences secondary cognitive appraisal (Folkman, 2020; Lazarus & Folkman, 1984).



[Figure 2] An extended model of stress coping and health risk behavior in public health crises

- d. Secondary cognitive appraisal → Stress-related emotions & health risk behaviors

Secondary cognitive appraisal shapes individual stress responses, influencing both psychological reactions (stress-related emotions) and behavioral responses (health risk behaviors) (Folkman, 2020).

- e. Stress-related emotions → Health risk behaviors

Emotions such as anxiety, worry, depression, and anger further impact health risk behaviors, shaping coping responses and influencing engagement in risk behaviors (Lazarus & Folkman, 1984).

- f. Coping resources as moderators of the stress process

Coping resources function as moderators in the stress process and are positioned in the model to influence stress-related emotions, thereby mitigating or exacerbating their effects.

3) Model boundaries and system states

Finally, the boundaries and system state of the model were established to define its scope and

operating conditions. The COVID-19 pandemic environment is conceptualized as an open-boundary system, in that contextual conditions such as policy responses, information environments, and infection dynamics can vary over time and interact with the stress process. At the same time, the core stress-process structure specified in this model is intended to remain stable across public health crises, allowing selective adaptation of crisis-specific contextual stressors while retaining the same set of units and their functional roles.

IV. Discussion

This study proposes an extended conceptual framework to explain individual stress coping and health risk behaviors in public health crises. To achieve this, a theoretical investigation was conducted on latent concepts within stress coping theory and risk perception research. The extended model was developed using Dubin's (1978) methodology, with construct analysis performed on literature selected following a systematic search and selection process.

Through this approach, the study seeks to elucidate the mechanisms underlying the emergence of health risk behaviors in the context of public health crises, including the COVID-19 pandemic.

The proposed extended model is structured around a sequential relationship among stressors, the stress process, and stress responses. A key feature is the dual stress process, which differentiates between public health crisis-related stressors and specific socioeconomic stressors. The model explains how individual health risk behaviors are influenced not only by socioeconomic stressors, such as unemployment or financial crises, but also by broader stressors embedded in the public health crisis context itself, including infection threat, quarantine or isolation experiences, mobility restrictions, disruptions to daily routines, and policy-related constraints. In this framework, emotional responses such as fear and anxiety are positioned not as the crisis context itself, but as stress-related reactions arising through cognitive appraisal of these crisis conditions. Through cognitive appraisal and coping mechanisms, these stressors can trigger or intensify health risk behaviors. While the model was developed in close relation to the COVID-19 pandemic literature, it is intended to be applicable to broader public health crisis contexts involving infectious disease outbreaks.

The model consists of eight units organized into three broader domains. The stressor domain includes contextual stressors, socioeconomic stressors, and disease-related stressors. The stress-process domain includes primary cognitive appraisal, secondary cognitive appraisal, coping resources, and stress-related emotions. The response domain consists of health risk behaviors, which serve as the principal outcome of the model. Furthermore, psychological responses triggered by stressors are included, as they interact with the stress process and influence health risk behaviors.

The theoretical implications of this study are as follows. Given the widespread impact of COVID-19 and the potential for future infectious disease outbreaks, it is crucial to examine how public health crises influence individual health risk behaviors. Building on Folkman and Lazarus's (1984) stress coping theory, this study contributes by reconceptualizing existing theories to explore the mechanisms linking public health crises and health risk behaviors. This study broadens the scope of interpretation by integrating key concepts from stress coping theory and risk perception research, which have often been examined separately (Folkman, 2020; Kassel et al., 2003; Lazarus & Folkman, 1984; Paek & Hove, 2017; Sandman et al., 1998). More specifically, the study contributes by locating public health crisis conditions within the stress process itself, by incorporating crisis-related risk perception and affective responses into cognitive appraisal, and by distinguishing crisis-context stressors from more specific socioeconomic stressors within a dual stress-process structure. While the proposed framework is limited as an extended model, its significance lies in its ability to theoretically explain stress coping and health risk behaviors within the unique context of public health crises.

Several limitations should be noted. First, although the literature search and selection process were conducted systematically, the present study was designed for theory building rather than as a conventional systematic review or meta-analysis. Second, the search period ended in June 2023, reflecting the cut-off point used for conceptual model development, and studies published thereafter were not included. Third, the international literature search was centered on PubMed, with Korean-language studies additionally identified through KISS and RISS; therefore, some relevant studies indexed in other international databases may not have been captured.

In addition, because the literature search was conducted using a limited number of databases, some potentially relevant constructs or contextual factors may not have been captured. Furthermore, the use of a frequency-based threshold for unit selection may have reflected prevailing research trends and may have excluded potentially meaningful constructs that appeared less frequently in the literature. Accordingly, future research may refine, update, and empirically test the proposed framework using broader database coverage and more recent evidence.

Despite these limitations, the present study offers a structured conceptual basis for understanding how health risk behaviors may emerge or intensify under public health crisis conditions. In this respect, the model may serve as a useful framework for future empirical research and for the interpretation of behavioral vulnerability in infectious disease crisis settings.

V. Conclusion

This study emphasizes the importance of sustained attention to individual health risk behaviors and continuous public health promotion efforts, even in public health crises. During the COVID-19 pandemic, health promotion issues, including health risk behaviors, were often deprioritized in public health agendas. However, this study highlights the need to recognize that pandemic-induced stress and disruptions to daily life can lead to negative behavioral outcomes. While infection prevention responses are often the top priority, it is equally important to acknowledge that individual health behaviors may deteriorate under such conditions.

In this respect, the present study provides an extended conceptual framework for understanding how public health crisis conditions may be linked to

stress coping processes and health risk behaviors. By highlighting the role of contextual stressors, cognitive appraisal, emotional responses, and coping resources, this study underscores the need for health promotion perspectives to be maintained alongside infection-control responses during public health crises. Although the framework was developed in close relation to the COVID-19 pandemic, its conceptual structure may also inform the interpretation of health risk behaviors in future infectious disease outbreaks and comparable public health crisis contexts.

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