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The Mediating Effects of Health Locus of Control in the Relationship between Intolerance of Uncertainty and Health Anxiety

Dawon Jang[1] **Myoung-Ho Hyun**[2†]

[1]Biomedical Research Institute, Catholic Kwandong University International St. Mary's Hospital, Incheon;
[2]Department of Psychology, Chung-Ang University, Seoul, Korea

Health anxiety has received relatively less empirical attention than other anxiety domains. However, identifying the psychological factors that contribute to its development and maintenance is essential, considering its relatively high prevalence in the general population. This study examined the distinct mediating effects of the three dimensions of health locus of control (HLC), internal (IHLC), powerful others (PHLC), and chance (CHLC) in the relationship between intolerance of uncertainty (IU) and health anxiety. A total of 180 Korean adults completed self-report measures assessing IU, HLC, and health anxiety. Parallel mediation analyses using bootstrapping showed that IU significantly predicted health anxiety. Only PHLC mediated this relationship, whereas neither IHLC nor CHLC showed a significant mediating effect. These findings suggest that individuals who attribute their health outcomes to powerful others may experience greater anxiety when faced with uncertainty while those who endorse internal or chance control beliefs tend to exhibit more protective or mixed response patterns. These results highlight the importance of distinguishing each dimension of HLC when explaining individual differences in health-related anxiety and suggest that cultural context should be considered when interpreting the contributions of these dimensions in future research.

Keywords: intolerance of uncertainty, health anxiety, health locus of control

Introduction

Intolerance of uncertainty (IU) has been defined as a cognitive bias that leads individuals to construe, interpret and react negatively to ambiguous or uncertain situations (Ladouceur et al., 1997). IU is considered a relatively stable psychological disposition and affects not only the cognitive domain but also the emotional and behavioral domains (Ladouceur et al., 1998). Individuals with high levels of IU are more likely to interpret uncertainty as threatening and often form irrational beliefs that future situations are inherently distressing or aversive (Carleton et al., 2010; Rachman, 2012; Rosser, 2019; Sexton & Dugas, 2009). When uncertainty is perceived as negative and something to be avoided, however, individuals are more likely to experience excessive anxiety due to a generalized sense of lost control (Buhr & Dugas, 2002; White & Gumley, 2010). As a core factor in the development and maintenance of generalized anxiety disorder, IU has been reported to be significantly correlated with a range of adverse psychosocial conditions including anxiety, depression, obsessive-compulsive symptoms, neuroticism, and stress (Dugas et al., 1998; Mahoney & McEvoy, 2012; White & Gumley, 2010). Accordingly, IU is considered a transdiagnostic construct contributing to diverse forms

†Correspondence to Myoung-Ho Hyun, Department of Psychology, Chung-Ang University, 84 Heukseok-ro, Dongjak-gu, Seoul 06974, Korea; E-mail: hyunmh@cau.ac.kr

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of psychopathology (Buhr & Dugas, 2002; Rosser, 2019).

Health anxiety, defined as excessive concern about one's current and future health, is closely linked to general anxiety, which in turn serves as a key factor in hypochondriasis (Cox et al., 2000; Stewart & Watt, 2000; Yi, 2009). Although the distinction among health concern, health anxiety, and hypochondriasis remains an ongoing subject of discussion, earlier conceptualizations often depicted these constructs as overlapping and part of the anxiety spectrum (Salkovskis & Warwick, 1986). Health anxiety itself is viewed as more severe and pervasive and shares a cluster of clinical characteristics such as dysfunctional beliefs, avoidance, safety-seeking behaviors, and intolerance of uncertainty with anxiety disorders (Olatunji et al., 2009). As research accumulated highlighting the cognitive and behavioral similarities between health anxiety and other anxiety disorders, health anxiety has been conceptualized as a distinct yet continuous construct (Abramowitz et al., 2007; Ferguson, 2009).

Health anxiety at an adaptive level may promote positive health practices such as regular checkups and proactive health monitoring (Asmundson et al., 2010). That is, individuals who are particularly attentive to and concerned about their health are more motivated to maintain healthy lifestyle habits and avoid harmful behaviors. However, health anxiety becomes maladaptive when its severity and persistence begin to disrupt daily functioning, potentially impairing overall adaptability (Abramowitz et al., 2007; Barsky & Klerman, 1983; Rachman, 2012; Salkovskis et al., 2002; Salkovskis & Warwick, 1986). Individuals experiencing high levels of health anxiety are prone to misinterpreting normal bodily sensations and vague physical symptoms as signs of serious illness, which contribute to the maintenance of chronic anxiety by reinforcing patterns of catastrophic thinking and heightened vigilance (Hadjistavropoulos et al., 1998; Salkovskis & Warwick, 1986). These cognitive biases in health anxiety often persist even in the presence of medical reassurance, thereby exacerbating anxiety and worry (Kim & Cho, 2015).

At the behavioral level, individuals with elevated health anxiety often engage in safety-seeking behaviors such as repeatedly consulting multiple healthcare providers, known as "doctor shopping," in an effort to alleviate their anxiety (Olatunji et al., 2009). These behaviors, however, operate as avoidance strategies intended to alleviate immediate distress while preventing individuals from direct confrontation with the underlying cognitive misinterpretations, which in turn heightens health-related vigilance over time (Olatunji et al., 2009; Olatunji et al., 2011; Salkovskis, 1991). Such maladaptive behaviors may further perpetuate to cognitive preoccupation with health-related anxiety and result in psychosocial difficulties, occupational impairment, and family conflict, ultimately compromising their quality of life and psychological well-being (Deacon et al., 2008; Noyes et al., 1999; Noyes et al., 1994; Salkovskis & Warwick, 1986).

In an attempt to reduce ambiguity and manage uncertainty more effectively, individuals with high IU tend to exhibit an increased desire for control and predictability (Carleton, 2016). Such motivation can be understood as a compensatory response to the discomfort elicited by uncertainty, as a generalized sense of lost control tends to provoke anxiety while perceiving control provides psychological relief (Buhr & Dugas, 2002; Gallagher et al., 2014; White & Gumley, 2010). However, the psychological consequences of perceived control largely depend on how individuals define the source of control. Locus of control, a concept describing individuals' differences in perceived control over events, has been identified as an important predictor of health-related outcomes due to its connection to underlying motivational and cognitive mechanisms.

Health locus of control (HLC), an extension of the general locus of control framework to the health domain, refers to an individual's beliefs about the causal relationship between their behaviors and health outcomes (Wallston et al., 1978). The HLC construct is based on Rotter's (1966) unidimensional internal-external model of locus of control, which conceptualized control as derived either from one's own actions or from external forces. However, this unidimensional view was later reconceptualized by Levenson (1973b), who argued that external sources of control such as powerful others and chance are conceptually independent because individuals who perceive the world as unpredictable develop different cognitive and behavioral patterns from those who view events as orderly but determined by powerful others, not by themselves. Supporting this view, factor-analytic studies identified the I (Internality), P (Powerful Others), and C (Chance) dimensions as conceptually pure clusters with minimal item overlap, and a study with psychiatric inpatients also demonstrated that the P and C factors were

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distinct factors moderately related to each other but largely unrelated to internality (Levenson, 1973a, 1973b). Building on this multidimensional approach, Wallston et al. (1978) adapted Levenson's framework to the health context, and identified Internal HLC (IHLC), Powerful others HLC (PHLC) and Chance HLC (CHLC). IHLC indicates viewing health outcomes as the result of one's own efforts and abilities while PHLC refers to the belief that one's health is determined by influential figures like medical professionals, close family members, or other authoritative figures, and CHLC reflects the belief that it is determined by unpredictable factors like luck, fate, and chance.

On this basis, individuals with a higher IHLC have a stronger sense of personal agency, so are more likely to engage in health-promoting behaviors like regular exercise and a high-fiber diet, which in turn contributes to better health (Gale et al., 2008; Grotz et al., 2011; Seeman & Seeman, 1983; Steptoe & Wardle, 2001). On the other hand, those with a higher external HLC, especially CHLC, tend to engage more in health-risk behaviors such as smoking and alcohol consumption based on the belief that an effort is unlikely to influence their health (Ferguson et al., 2000; Marcus et al., 2007; Norman et al., 1998; Steptoe & Wardle, 2001; Wallston, 1992). These contrasts in health-related behaviors parallel similar patterns in emotional functioning as individuals with a low internal and a high external HLC have been shown to have higher levels of anxiety (Molinari & Khanna, 1981; Molinari & Niederehe, 1985).

Taken together, these findings imply that among individuals with high levels of IU, the way they perceive control over their health may differentially influence their emotional reactions. Those with a strong IHLC are likely to perceive themselves as active agents in maintaining their health, which may help buffer anxiety associated with uncertainty. In contrast, those with a more external orientation, who attribute health outcomes to powerful others or chance, are more likely to experience a sense of lost control and heightened anxiety under uncertainty. This indicates that IU and HLC may interact in explaining the development of health anxiety, and that different dimensions of HLC may exert distinct mediating effects within this relationship.

Hypochondriasis has received relatively limited societal attention compared to other mental disorders as its symptoms are generally less severe, and it does not appear to cause direct harm to others, perceived as an individual issue (Yi, 2004a). However, its lifetime prevalence has been found to be high in the general population, occurring frequently even among individuals with no history of serious illness (Barsky et al., 2001; Yi, 2004b). Also, repeated and unnecessary use of medical services, driven by the cognitive and behavioral patterns of health anxiety, may place strain on healthcare resources and contribute to rising public health costs (Fink et al., 2010). Thus, identifying and addressing the psychological mechanisms underlying health anxiety is important not only from an individual perspective, but also from a broader social perspective.

While existing studies have primarily demonstrated associations between IU and general anxiety or depression, relatively few have directly examined its relationship with health anxiety (Gerolimatos & Edelstein, 2012; Mahoney & McEvoy, 2012; Rosser, 2019). Moreover, most of the previous studies have been focused on clinical samples or individuals with specific medical conditions, making it difficult to understand the characteristics of health anxiety in the general population (Kim & Cho, 2015). To address these gaps, the present study aims to investigate the impact of IU and HLC on health anxiety in the general Korean population. The findings are expected to enhance the understanding of health anxiety in non-clinical contexts and serve as a foundation for developing practical evidence-based interventions aimed at improving psychological well-being and quality of life among individuals with elevated levels of health anxiety.

Methods

Participants and Procedure

To ensure sample diversity and facilitate recruitment, participants were recruited through both online and offline channels. For the online recruitment, a study notice was posted on a designated board of a website used to share psychology-related research. Those who agreed to participate completed the questionnaire via Google Forms, yielding a total of 141 responses. For the offline recruitment, 46 undergraduate students majoring in psychology at C University in Seoul participated in the study. All participants, regardless of recruitment method, were provided with detailed in-

formation about the study including their rights as participants, assurance of anonymity, and the option to withdraw from the study at any time without penalty. Informed consent was obtained from all participants, and they were compensated for participation in the study. To minimize order effects, all scales were presented in a randomized order across both online and offline formats. Of the 187 total responses collected, data from 7 participants were excluded due to incomplete or inattentive responses, resulting in a final sample of 180 included in the analysis. All procedures were reviewed and approved by the Institutional Review Board of the affiliated university (Approval No. 1041078-20230831-HR-253).

Measures

Intolerance of Uncertainty

Intolerance of uncertainty was measured using the Intolerance of Uncertainty Scale (IUS), originally developed by Freeston et al. (1994) and translated into Korean by Lee (2016). In the validation, the original scale was translated and back-translated to ensure linguistic equivalence, and its psychometric properties were validated through exploratory and confirmatory factor analyses. The scale consists of 27 items rated on a 5-point Likert scale ranging from 1 (not at all characteristic of me) to 5 (entirely characteristic of me), with higher total scores indicating greater intolerance of uncertainty. The Cronbach's α reported in the Korean validation study conducted by Lee (2016) was .93 and was .97 in the present study.

Health Locus of Control

Health Locus of Control was assessed using the Multidimensional Health Locus of Control Scale (MHLC) developed by Wallston et al. (1978) and first translated into a Korean version by Kim (1997). The version revised and validated by Kim (2003) was used in the present study. In the validation, the translated items were reviewed through expert consultation, and a pilot test was conducted to ensure their cultural and linguistic appropriateness. The scale consists of three subscales: Internal Health Locus of Control (IHLC), Powerful Others Health Locus of Control (PHLC), and Chance Health Locus of Control (CHLC), each comprising six items for a total of 18 items. All items are rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) with higher scores indicating stronger beliefs in the corresponding dimension of HLC. The Korean validation study by Kim (2003) reported Cronbach's α of .83 (IHLC), .79 (PHLC), and .81 (CHLC) for each subscale while the respective Cronbach's α were .67, .82, and .78 in the present study.

Health Anxiety

The Illness Attitude Scale (IAS) developed by Kellner (1987) was used to measure health anxiety. The Korean version was translated by Yi (2004b), who evaluated its content and construct validity through exploratory factor analysis. The scale includes 27 items and is composed of nine subscales: worry about illness (WI), concern about pain (CP), health habits (HH), hypochondriacal beliefs (HB), thanatophobia (TH), disease phobia (DP), bodily preoccupations (BP), treatment experiences (TE), and effects of symptoms (ES). Each subscale contains three items, and responses are rated on a 5-point Likert scale ("strongly disagree" to "strongly agree"). Higher scores indicate greater levels of health-related anxiety in each domain. Yi (2004b) reported a Cronbach's α of .86 for the total scale, with subscale coefficients of .71 (WI), .48 (CP), .55 (HH), .48 (HB), .73 (TH), .84 (DP), .63 (BP), .81 (TE), and .84 (ES) respectively. In the present study, the total Cronbach's α was .96, and the values for the subscales were .87 (WI), .64 (CP), .60 (HH), .82 (HB), .81 (TH), .91 (DP), .82 (BP), .88 (TE), and .89 (ES).

Data Analysis

Data analysis was conducted using IBM SPSS Statistics 29. Descriptive statistics were used to describe the demographic characteristics of the participants, and correlations were calculated to examine relationships among the variables. Internal consistency was assessed using Cronbach's α. To evaluate whether the measurement instruments adequately reflected each construct, a confirmatory factor analysis (CFA) was conducted using AMOS 21.0, a structural equation modeling program. Model fit was evaluated primarily using the Tucker–Lewis Index (TLI), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA), which address the limitations of the chi-square statistic and allow for a more comprehensive assessment of model adequacy (Hair et al., 2010; Hu & Bentler, 1999). TLI and CFI indicate the relative goodness of fit of the model in explaining the observed data, with values above .90 generally considered acceptable and

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values above .95 indicating excellent fit. RMSEA assesses the degree of model approximation error, and values below .08 are typically regarded as satisfactory. Additionally, the item parceling technique was applied in conducting the CFA. Item parceling is frequently used when a scale includes a large number of items as it helps to reduce excessive model complexity and improve model fit. This approach enhances model parsimony and increases the stability of parameter estimates (Hair et al., 2010; Little et al., 2002).

A parallel mediation model was tested to examine the indirect effects of IU on health anxiety through three mediators: IHLC, PHLC, and CHLC. Path analysis was conducted using Model 4 of the PROCESS Macro version 4.2 (Hayes, 2012) to estimate both the direct effects between the independent and dependent variables and the indirect effects through the mediators simultaneously. The significance of the mediation effects was tested using the bootstrapping method, with 5,000 bootstrap samples generated to construct the sampling distribution of the indirect effects and a 95% confidence interval estimated. If the confidence interval did not include zero, the corresponding indirect effect was considered statistically significant (Preacher et al., 2007).

Results

To verify the validity of the measurement instruments, a CFA was conducted. The measurement model demonstrated an excellent overall fit to the data ($\chi^2 = 91.239$, df = 44, TLI = .959, CFI = .973, RMSEA = .078), indicating that the proposed model adequately represented the observed constructs. Also, construct validity was examined through both convergent and discriminant validity. Convergent validity was assessed using factor loadings, average variance extracted (AVE), and composite reliability (CR). As presented in Table 1, all standardized factor loadings exceeded .50. The AVE values were .550 or higher, meeting the recommended threshold of .50, and the CR values were all above .707, satisfying the criterion of .70 suggested by Fornell and Larcker (1981). The findings indicate that the items consistently measured their intended constructs, supporting the convergent validity of the measurement model.

Discriminant validity was evaluated following the Fornell–Larcker criterion. The square root of each construct's AVE exceeded the inter-construct correlations as presented in Table 2. These results confirm that the five key variables examined in this study were statistically distinct, demonstrating adequate discriminant validity of the measurement model. In addition, to further verify discriminant validity more rigorously, the Heterotrait–Monotrait Ratio (HTMT) analysis was conducted. As shown in Table 3, all HTMT values among the variable pairs were below .783, satisfying the commonly recommended threshold of .85 (Henseler et al., 2015). These results further confirm that the five variables used in this study represent distinct and independent constructs.

Table 1. *Results of Convergent Validity*

Latent factor	Parcel	Factor loading	AVE	CR
IU	IU Parcel 1	.935	.892	.961
	IU Parcel 2	.971		
	IU Parcel 3	.927		
IHLC	IHLC Parcel 1	.652	.550	.707
	IHLC Parcel 2	.821		
PHLC	PHLC Parcel 1	.875	.753	.859
	PHLC Parcel 2	.860		
CHLC	CHLC Parcel 1	.737	.752	.856
	CHLC Parcel 2	.980		
HA	HA Parcel 1	.816	.789	918
	HA Parcel 2	.917		
	HA Parcel 3	.927		

IU = Intolerance of Uncertainty; HA = Health Anxiety; IHLC = Internal Health Locus of Control; PHLC = Powerful Others Locus of Control; CHLC = Chance Locus of Control; AVE = average variance extracted; CR = composite reliability.

Table 2. *Results of Discriminant Validity*

Variable	1	2	3	4	5
1. IU	**.892**				
2. IHLC	.047	**.550**			
3. PHLC	.103	.203	**.753**		
4. CHLC	.289	.085	.210	**.752**	
5. HA	.548	.055	.246	.280	**.789**

Values on the bold diagonal represent the AVE. The cells below the diagonal show the squared correlations.

Table 3. *Results of HTMT*

Variable	1	2	3	4	5
1. IU	-				
2. IHLC	.266	-			
3. PHLC	.354	.583	-		
4. CHLC	.597	.381	.538	-	
5. HA	.783	.295	.564	.600	-

Regarding participants' demographic characteristics, of the 180 participants, 64 (35.6%) were male, and 116 (64.4%) were female. The most common age group was 31-35 years with 51 participants (28.3%), followed by 25-30 years (26.1%), 18-24 years (22.8%), 36-40 years (17.8%), and 41 years and older (5.0%). A total of 135 participants (73.9%) had completed a bachelor's degree or currently enrolled while 10 participants (5.6%) had a high school diploma or less, 27 (15.0%) had or were currently enrolled at the associate level, and 10 (5.6%) had or were currently enrolled at the graduate level. Additionally, 25 participants (13.9%) reported a medical history of disease or surgery. Preliminary analyses showed no significant differences in all variables across demographic factors such as gender, age, education level or medical history, suggesting that the observed mediation effects are unlikely to be confounded by demographic factors.

The correlations, means, and standard deviations for the variables are presented in Table 4. All variables showed significant correlations with each other (all $p < .01$). In particular, IU was positively and significantly correlated with HA ($r = .74$, $p < .01$). IU also showed significant positive correlations with all three mediators: IHLC ($r = .22$, $p < .01$), PHLC ($r = .32$, $p < .01$), and CHLC ($r = .54$, $p < .01$). HA was positively and significantly correlated with IHLC ($r = .23$, $p < .01$), PHLC ($r = .50$, $p < .01$), and CHLC ($r = .53$, $p < .01$). In addition, IHLC showed significant positive correlations with both PHLC ($r = .45$, $p < .01$) and CHLC ($r = .29$, $p < .01$). A significant positive correlation was also found between PHLC and CHLC ($r = .46$, $p < .01$). Given that the mediation analysis involves regression, the assumption of normality in the variables is recommended to be examined even though it is not strictly required due to the use of bootstrapping. As the absolute values of skewness and kurtosis for all variables did not exceed two, the assumption of normality was supported.

Table 4. *Correlations, Means and Standard Deviations of Main Variables (N = 180)*

	1	2	3	4	5
1. IU	-				
2. HA	.74**	-			
3. IHLC	.22**	.23**	-		
4. PHLC	.32**	.50**	.45**	-	
5. CHLC	.54**	.53**	.29**	.46**	-
Mean	2.59	2.67	3.36	3.51	3.27
SD	.90	.82	.63	.76	.77
Skewness	.51	.51	-.52	-.56	-.55
Kurtosis	-.26	.18	.27	.27	.41

SD = Standard Deviation.
***p < .01.*

Prior to testing the research hypotheses, multicollinearity among the independent variables was examined. Specifically, tolerance and the variance inflation factor (VIF) were assessed. All tolerance values were above .617, with specific values of .703 (IU), .787 (IHLC), .677 (PHLC), and .617 (CHLC), exceeding the commonly accepted threshold of .10. The VIF values ranged from 1.271 to 1.622, specifically 1.423 (IU), 1.271 (IHLC), 1.478 (PHLC), and 1.622 (CHLC), which are well below the conservative cutoff value of 10 (Hair et al., 2010). These results indicate that no evidence of multicollinearity was found among the independent variables.

The results of the path analysis showed that the independent variable, IU, had significant effects on all three mediators as shown in Table 5 and Figure 1. Specifically, IU had positive effects on IHLC (B = .151, $p < .01$), PHLC (B = .272, $p < .001$), and CHLC

Table 5. *Results of Direct Effects*

Path	B	*SE*	β	*t*	Boot 95% CI	
					LLCI	ULCI
IU → IHLC	.151**	.051	.216	2.946	.050	.252
IU → PHLC	.272***	.060	.321	4.514	.153	.390
IU → CHLC	.456***	.054	.538	8.505	.351	.562
IU → HA	.561***	.050	.615	11.174	.462	.660
IHLC → HA	-.067	.068	-.051	-.983	-.200	.067
PHLC → HA	.306***	.060	.284	5.071	.187	.425
CHLC → HA	.090	.063	.084	1.423	-.035	.214

SE = Standard Error; LLCI = Lower Limit Confidence Interval; ULCI = Upper Limit Confidence Interval.
***p < .01, ***p < .001.*

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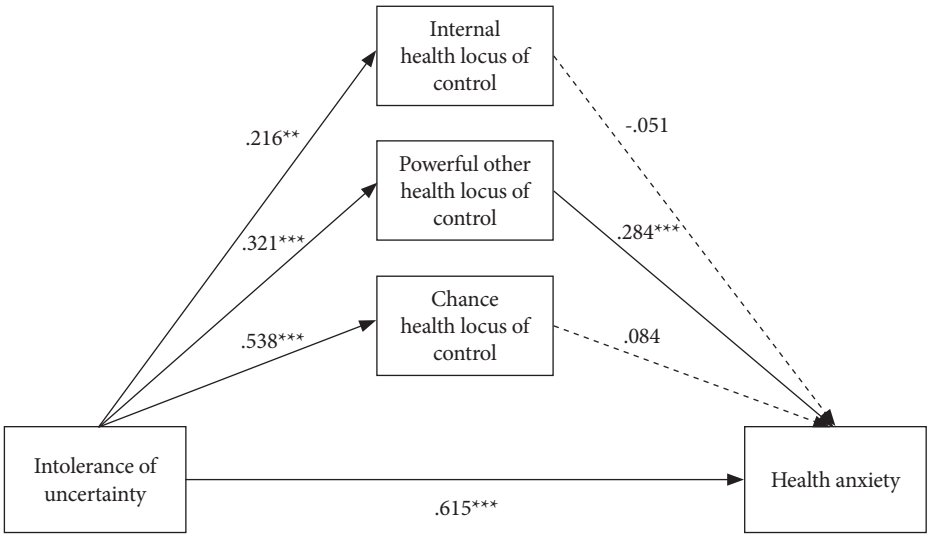

Figure 1. *Parallel mediation model of the effects of intolerance of uncertainty on health anxiety through three dimensions of health locus of control. **p < .01, ***p < .001.*

Table 6. *Results of Indirect Effects*

Path	B	*SE*	β	Boot 95% CI	
				LLCI	ULCI
IU → IHLC → HA	-.010	.011	-.011	-.036	.009
IU → PHLC → HA	.083	.026	.091	.037	.138
IU → CHLC → HA	.041	.030	.045	-.020	.101

(B = .456, $p < .001$). IU also had a significant positive direct effect on the dependent variable, health anxiety (B = .561, $p < .001$). Regarding the effects of the mediators on the dependent variable, the path from IHLC to health anxiety was not statistically significant (B = –.067, $p > .05$). In contrast, PHLC had a significant positive effect on health anxiety (B = .306, $p < .001$), suggesting that PHLC may contribute to explaining the link between IU and health anxiety. The path from CHLC to health anxiety was not significant (B = .090, $p > .05$).

The results of the mediation analysis are presented in Table 6. The indirect effect of IU on health anxiety through IHLC was not significant (B = –.010, 95% CI [–.036, .009]). In contrast, the indirect effect through PHLC was significant (B = .083, 95% CI [.037, .138]), indicating that IU had a significant indirect effect on health anxiety through PHLC. The indirect effect through CHLC was not significant (B = .041, 95% CI [–.020, .101]). Accordingly, the relationship between IU and health anxiety can be interpreted as partial mediation with PHLC functioning as the key mediator.

Discussion

The present study aimed to examine the distinct mediating effects of the three dimensions of HLC, IHLC, PHLC, and CHLC, in the relationship between IU and health anxiety in a non-clinical sample. The results confirmed that IU significantly predicted health anxiety, and among the three dimensions of HLC, only PHLC significantly mediated this relationship while IHLC and CHLC did not.

With respect to the direct path, the finding that IU significantly predicts health anxiety supports the proposition that IU is a core cognitive vulnerability across anxiety-related psychopathology and is consistent with previous studies demonstrating the predictive value of IU for various anxiety disorders (Buhr & Dugas, 2002; Gerolimatos & Edelstein, 2012; Rosser, 2019). Individuals with high IU tend to respond to uncertainty with heightened vigilance toward internal cues, making ambiguous or randomly occurring bodily sensations more salient and potentially threatening. As this pattern intensifies, even minor symptoms such as a common cold or a tension headache may be misinterpreted as signs of a serious or life-threatening illness, further amplifying health-related anxiety and preoccupation. This result indicates that the influence of IU extends beyond general anxiety to more specific forms of anxiety such as health anxiety and that difficulty

tolerating uncertainty plays a critical role in the development and maintenance of health anxiety.

Notably, the finding that only PHLC among the three mediators significantly mediated the relationship between IU and health anxiety provides valuable insight into the cognitive and behavioral mechanisms underlying health-related distress. Individuals with high PHLC often rely heavily on external validation or reassurance to manage feelings of uncertainty (Wallston et al., 1978). Thus, anxiety elicited by ambiguous bodily sensations is less likely to be evaluated independently, but, instead, interpreted in a manner that attributes control over health outcomes to powerful others (Levenson, 1973b). While this reliance may offer short-term relief, however, it paradoxically reinforces underlying anxiety and diminishes one's perceived personal control (Salkovskis & Warwick, 1986; Skidmore et al., 2014). Importantly, reassurance rarely alters dysfunctional interpretations and limits opportunities to appraise or reevaluate uncertainty on one's own (Rachman, 2012; Salkovskis & Warwick, 1986). As a result, rather than supporting adaptive self-regulation, PHLC encourages individuals to consistently externalize control and remain dependent on external sources of certainty, eventually maintaining or even heightening anxiety levels.

This pattern may be salient especially in collectivist cultural contexts such as South Korea where respect and deference toward authority are culturally valued (Hofstede, 2001; Markus & Kitayama, 1991). This tendency often extends into the medical domain where physicians, whose authority is grounded in specialized expertise, are widely regarded as legitimate sources of control over health. As such, deferring to medical professionals may be viewed as an appropriate, or even responsible, way of coping with uncertainty, reflecting a culturally shaped pattern of delegated control (Cheng et al., 2013; Rothbaum et al., 1982). Within such cultural contexts, individuals high in PHLC are therefore more likely to manage their uncertainty by seeking reassurance from medical professionals. These cultural dynamics may help explain why PHLC emerged as a significant mediator in the present study, suggesting that external control orientations can take on a more complex and context-sensitive role in shaping health anxiety within collectivist cultural settings. However, the dynamics of PHLC may differ depending on whom individuals perceive as the "powerful others." Unlike the case in which individuals regard medical professionals as the primary agents of control, attributing control to non-professionals like family members or close peers in health-related contexts may involve different interpersonal mechanisms. Therefore, distinguishing among these sources of influence could provide a deeper understanding of PHLC and its psychological implications (Gerland & Prell, 2021). In future research, examining how cultural values and personal contexts shape the function of control beliefs would offer meaningful insights into the relationships among these psychological constructs.

Since both constructs represent external dimensions of HLC, the differing patterns observed for PHLC and CHLC are notable. In contrast to PHLC, CHLC showed no significant mediating effect, which may reflect its more passive and fatalistic nature that weakens the association between IU and health anxiety (Norman et al., 1998; Wallston et al., 1978). Accordingly, individuals who ascribe health outcomes to impersonal external forces may be less inclined to respond sensitively to ambiguous bodily cues or to catastrophize the likelihood of developing a serious illness, suggesting that CHLC may function as an attenuating mechanism rather than a factor that directly triggers anxiety. In other words, while PHLC reflects an active, reassurance-seeking form of externality that may maintain anxiety, CHLC represents a form of emotional indifference or passive acceptance of uncontrollable outcomes, which may help explain the inconsistent findings regarding the associations between CHLC and emotional distress (Molinari & Niederehe, 1985; Norman et al., 1998; Wallston, 1992). These distinctions emphasize that subdimensions of HLC engage differentiated cognitive and motivational mechanisms in the context of uncertainty, as emphasized by Levenson (1973a, 1973b).

Additionally, IHLC did not show a significant mediating effect in the present study, which may be understood in light of its consistent associations with positive health outcomes. IHLC is typically associated with adaptive health behaviors, emotional resilience, and self-regulation, reflecting a stronger sense of control and self-efficacy (Grotz et al., 2011; Marks et al., 1986; Steptoe & Wardle, 2001). That is, a strong internal belief in one's ability to manage health outcomes is expected to serve as a buffer against the emotional effects of uncertainty by fostering a sense of agency and perceived personal competence, as well as greater engagement

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in adaptive coping. Strengthening internal control beliefs has also been associated with reduced anxiety and depression, and with more active coping (Gale et al., 2008; Marks et al., 1986). In this context, the non-significant mediating effect of IHLC may suggest that it functions more as a protective factor than as a risk factor for anxiety. In line with this, prior work on health anxiety and HLC found that lower IHLC and higher external HLC are linked to greater anxiety (Molinari & Khanna, 1981; Molinari & Niederehe, 1985).

Based on these findings, the present study has the following clinical and theoretical implications. Clinically, the findings highlight potential targets for psychological interventions addressing health anxiety. Prior cognitive-behavioral therapy protocols developed for anxiety disorders such as generalized anxiety disorder, social phobia, and hypochondriasis have demonstrated that reducing IU can lead to significant reductions in anxiety (Dugas et al., 1998; Langlois & Ladouceur, 2004; Mahoney & McEvoy, 2012). Although intervention studies specifically targeting HLC remain limited, previous research has suggested that strengthening internal control beliefs is associated with lower levels of anxiety and depression (Gale et al., 2008; Wallston, 1992). In addition, a subjective belief in one's capacity to affect outcomes and in the effectiveness of one's actions has been recognized as a key motivational factor that facilitates engagement in health-promoting behaviors (Dijkstra & Homan, 2016; Norman et al., 1998; Ramezani & Gholtash, 2015; Rogers, 1975). Integrating these perspectives, reducing IU while reshaping control beliefs, may therefore provide a more comprehensive and clinically effective framework for individuals experiencing high health anxiety. From a theoretical standpoint, this study also contributes to the understanding of HLC by clarifying the differential roles of its three subdimensions. Examining IHLC, PHLC, and CHLC independently provided a clearer understanding of how distinct control orientations interact with uncertainty to affect health-related anxiety, which extends existing IU–health anxiety models. This study also suggests that considering the cultural context can further enrich the interpretation and application of these findings, which may be an important direction for future research.

While the findings offer meaningful insights, they should be interpreted cautiously due to the reliance on self-report measures. The use of self-reported data may introduce measurement bias and limit the objectivity of the results. Given that experiences of illness and health-related anxiety are highly subjective and may vary considerably across individuals and contexts, such reliance may fail to capture the nuanced and heterogeneous nature of these psychological phenomena. Therefore, to more fully capture the complexity of subjective illness experiences, future research might benefit from integrating qualitative techniques that allow for a deeper exploration of personal interpretations and emotional responses that may not be reflected in quantitative measures.

Author contributions statement

DWJ, a researcher at the Biomedical Research Institute, Catholic Kwandong University International St. Mary's Hospital, conceptualized the research, collected and analyzed the data, and drafted and edited the manuscript. MHH, a professor at Chung-Ang University, served as the principal investigator for the research grant, supervised the research process, and reviewed the manuscript. All authors provided critical feedback, participated in the revision of the manuscript, and approved the final submission.

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