

Illuminating the Association Between Intolerance of Uncertainty and Health Anxiety: The Mediating Role of Worry

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Abstract

Background: Cognitive theories of health anxiety emphasize the critical importance of general Intolerance of Uncertainty (IU-general) in the development and maintenance of health anxiety. There is, however, a dearth of research on the mechanisms through which IU-general leads to health anxiety. Therefore, the aim of the current study was to test the hypothesis that intolerance of uncertainty specific to health (IU-health) and worry may sequentially mediate the association between IU-general and health anxiety. **Methods:** Three hundred and fifty-eight students completed a battery of questionnaire including measures of health anxiety, IU-general, IU-health, and worry. **Results:** Consistent with predictions generated by the hypothesis under test, a serial mediation model confirmed that the association between IU-general and health anxiety was mediated by IU-health (first mediator) and worry (second mediator). **Conclusions:** The theoretical and applied implications of these findings are discussed, and suggestions were offered concerning how future research could serve to discriminate alternative causal accounts of the presently observed associations. **Limitations:** Due to the cross-sectional design of the study, causal inferences cannot be made. Additionally, as the sample was non-clinical, the generalizability of the results to clinical populations may be limited.

Keywords: health anxiety; intolerance of uncertainty; worry; repetitive negative thinking.

Introduction

Health anxiety is characterized by heightened anxiety that is elicited by undue concerns about threats to one's health, such as the risk of contracting a disease or suffering severe consequences of illness (Abramowitz et al., 2002). Cognitive models conceptualize health anxiety as a dimensional construct that represents a continuum ranging from mild to severe disabling levels of anxiety over health-related concerns (Ferguson, 2009). In addition to its negative impacts on personal, social and occupational functioning (Asmundson et al., 2010), elevated health anxiety also imposes a heavy burden on the health care system (Fink et al., 2010). Health anxiety has been studied in a wide variety of populations including an increasing number of studies among students (e.g., Bati et al., 2018; Horenstein et al., 2019).

To illuminate the cognitive basis of health anxiety, the potential contribution of several cognitive factors has been examined. One cognitive risk factor for health anxiety that has increasingly received attention from researchers is Intolerance of Uncertainty (IU). IU, which is also a dimensional construct, is a tendency to think, feel and behave negatively to uncertain situations (Carleton, 2012; Clayton et al.,

2023). Numerous studies have shown that higher levels of IU are reported by people with heightened levels of health anxiety (Fergus & Bardeen, 2013; Fetzner et al., 2014; Norton, 2005). There is also evidence that heightened IU predicts elevated health anxiety (Gerolimos & Edelstein, 2012; O'Bryan & McLeish, 2017) and that reducing IU leads to reduced health anxiety severity (Hedman et al., 2013).

Although it has been well demonstrated that heightened IU predicts greater health anxiety, little is known about the *mechanisms* through which IU is associated with health anxiety (Fetzner et al., 2014; Shihata et al., 2017). Identifying mechanisms that explain how factors like IU are related to health anxiety is critical to develop interventions that are more effective. To date, the majority of studies that have examined the role of IU in psychopathology have used measures of IU that ask about people's ability to tolerate uncertainty in general (e.g., "Uncertainty keeps me from living a full life"; Boswell et al., 2013). Throughout this paper, we will use the term *IU-general* to describe intolerance of uncertainty in general. Though some people are generally intolerant of all uncertain situations, it has been argued that people may have particular difficulty tolerating uncertainty relating to specific domains (Mahoney & McEvoy, 2012; Thibodeau et al., 2015), and so experience anxiety relating to this particular domain in response to uncertainty related to this specific domain. It follows that individuals who are especially intolerant of uncertainty over their health may be most likely to have elevated levels of health anxiety (Mahoney & McEvoy, 2012). In the present paper we will use the term *IU-health* to describe intolerance of uncertainty that concerns health specifically. New measures of IU have been developed that assess IU specific to particular domains (Thibodeau et al., 2015). Importantly, using such measures it has been shown that *IU-health* predicts unique variance in health anxiety (Thibodeau et al., 2015).

Although it is now clear from existing evidence that IU-general predicts health anxiety, there has been little research to date that has sought to illuminate this relationship. The present study was designed to investigate the factors that potentially mediate this association. Specifically, the aim of the current study was to determine the potential mediating role of two candidate variables - IU-health, and worry. In what follows, each of these candidate variables and their proposed mediator role in the association between IU-general and health anxiety will be explained in turn.

One variable that may mediate the association between IU-general and health anxiety is IU-health. People can never have complete certitude concerning their health status (Boelen & Carleton, 2012). Those with elevated levels of health anxiety have difficulty tolerating this uncertainty about their health (Fergus & Valentiner, 2011). Current research highlights a conceptual distinction between IU-general as a dispositional trait and a common psychological vulnerability, and disorder-specific IU as a specific psychological vulnerability (Boswell et al., 2013; Carleton, 2016; Mahoney & McEvoy, 2012; Thibodeau et al., 2015). Supporting this, it has been shown that disorder-specific IU explained unique variance in respective disorder symptoms beyond IU-general (Thibodeau et al., 2015). Previous studies that examined both general IU and disorder-specific IU, proposed the latter as a factor between general IU and cognitive vulnerability of different anxiety symptomatology. For example, Shihata et al. (2017) assessed participants' general IU as a higher-order factor and disorder-specific IU as an intermediate factor between the general IU and symptoms of generalized anxiety, social anxiety, obsessive-compulsive, and panic disorder. They also examined a cognitive vulnerability factor as a potential second mediator in their models. They found that the indirect associations of IU-specific was not consistent across different anxiety symptoms. For example, for panic disorder, unlike other disorders, when disorder specific IU and cognitive vulnerability were taken into account, the IU-general did not show a direct association with panic disorder symptoms. Also, while the serial indirect associations were significant for social anxiety, panic disorder, and generalized anxiety, the same was not found for obsessive compulsive disorder. These findings indicate the importance of considering both dimensions of IU when examining the role of intolerance of uncertainty in anxiety disorders. However, no studies have yet examined whether IU specific to health may mediate the association between IU-general and health anxiety (e.g., Jensen & Heimberg, 2015).

Another candidate variable that may potentially mediate the association between IU-general and health anxiety is worry. Worry has been defined as “a chain of thoughts and images, negatively affect-laden, and relatively uncontrollable” (Borkovec et al., 1983, p. 10). Worry involves future-oriented negative thoughts about potential risks and uncertainties and has been proposed as one of the key vulnerability factors for health anxiety (Alberts et al., 2013). There is evidence that heightened worry is associated with both elevated IU-general, and with higher levels of health anxiety (Boelen & Carleton, 2012; Jansson-Fröjmark et al., 2020). It has been argued that individuals with high IU-general may engage in worry in an effort to increase certainty (Boswell et al., 2013). However, such worry will likely also serve to increase anxiety, meaning that elevated IU may serve to elevate anxiety in a manner that is mediated by worry. Thus, the association between heightened IU-general and elevated health anxiety could potentially be mediated by worry. Once again, this mediation hypothesis has not yet been empirically tested. Despite prior evidence that worry can mediate the relationship between IU-general and generalized anxiety disorder (Yook et al., 2010), no study to date has tested whether worry mediates the association between IU-general and health anxiety.

Given the theoretical arguments by previous studies that implicate disorder-specific IU and cognitive vulnerability factors as the first and second intermediary variables in the relationship between IU-general and anxiety disorders, the current study employed serial mediation to test a model in which IU-health and worry are proposed as the first and second tentative mediators between IU-general and health anxiety. Serial mediation models incorporate multiple potential mediators within a single unified framework and are designed to explore how one mediator may relate to another in sequence (Hayes, 2013). In the present study, we assessed IU-general, IU-health, worry and health anxiety in a sample of 380 students, and tested our proposed serial mediation model.

Methods

Participants

Participants were undergraduate and postgraduate students from Yazd University, Iran. The only exclusion criterion was being under 18 years of age. In total, 380 students participated in the study. Twelve participants were excluded as they had completely missed responding to one of the questionnaires. The remaining participants had minimal missing data that was replaced with the multiple imputation data. Careless responding was also checked according to the current guidelines (Curran, 2016; Ward & Meade, 2023). Specifically, multivariate outlier analysis ($p < .001$), person-total correlations (negative values), and maximum longstring (more than half of the item numbers) were employed (see the Data analysis section). The final sample comprised 358 students (48.6% female). The mean age of these participants was 23.36 years ($SD = 5.06$), with an age range of 18 to 49 years. The majority of the participants were single (77.09%), while a minority were married (21.50%). One participant was divorced. In terms of ethnicity, 86.87% participants identified themselves as Fars, 6.5% as Lur, 4% as Turk, and 2.6% as other. The students were from different fields, 51.51% were students in engineering, 40% in human sciences, and 8.49% in other fields.

Measures

Health Anxiety Measure: Short Health Anxiety Inventory (SHAI; Salkovskis et al., 2002)

The SHAI is one of the most common measures of health anxiety. The SHAI contains 18 items that assess the presence and severity of current health concerns as well as how individuals think they would have reacted if they had a serious medical illness. Each item has four statements that are scored from 0-3 and are summed for the total score. Higher scores indicate greater health anxiety symptoms. There is strong evidence for the validity and reliability of both English (Alberts et al., 2013) and Persian (Rabiei et al., 2013) versions of the SHAI. Internal consistency of the SHAI for the current study was good (Cronbach's $\alpha = 0.80$).

IU-general Measure: Intolerance of Uncertainty Scale (Buhr & Dugas, 2002)

The intolerance of uncertainty scale consisted of 27 items that measure cognitive, emotional and behavioural reactions to uncertainty (e.g., “It’s unfair having no guarantees in life”). Responses are rated on a five-point Likert scale ranging from 1=‘not at all characteristic of me’ to 5=‘entirely characteristic of me’. Higher scores indicate greater intolerance of uncertainty. The validity and reliability of this scale have been shown in several studies (Buhr & Dugas, 2002; Sexton & Dugas, 2009). The Persian version of the intolerance of uncertainty scale has also shown good psychometric properties (Khaje Mansoori et al., 2016; Mahmoud Alilou et al., 2011). In this study, internal consistency (Cronbach’s alpha) was 0.90 for the total score.

IU-health measure: Intolerance of Uncertainty for Health Anxiety Scale (Thibodeau et al., 2015)

The intolerance of uncertainty for health anxiety scale consists of three items that measure reactions to uncertainties related to health anxiety. Participants responded to the items on the same five-point Likert scale as the intolerance of uncertainty scale i.e. 1=‘not at all characteristic of me’ to 5=‘entirely characteristic of me’. The IU for health measure has shown good psychometric properties in both English (Thibodeau et al., 2015) and Persian (Zahraysi et al., 2023) populations. The internal consistency (Cronbach’s alpha) of the intolerance of uncertainty for health anxiety scale was 0.71 in the current study.

Worry Measure: Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990)

The PSWQ is the most frequently used measure to assess the severity and frequency of worry in both clinical and nonclinical populations. It consisted of 16 items that participants respond to on a 5-point Likert scale ranging from “not at all typical” to “very typical”. The construct validity and reliability of the PSWQ for both English (Molina & Borkovec, 1994) and Persian (Borjali et al., 2010; Dehshiri et al., 2010; Kami et al., 2019) versions of this questionnaire have been demonstrated consistently in different populations. In the current study, the internal consistency of the PSWQ was good (Cronbach’s alpha = 0.85).

Procedure

The current project was carried out in accordance with the Declaration of Helsinki and was approved by the University of Social Welfare and Rehabilitation Sciences research ethics board. Students on the University campus were invited to participate in the study. All participants volunteered to take part in the study after being presented with a description of the study and signing a written informed consent form. No external incentives were offered for participating in this study. Participants completed the Persian versions of the questionnaires in the following order: demographics, PSWQ, Intolerance of Uncertainty Scale, Intolerance of Uncertainty for Health Anxiety Scale, SHAI.

Data Analysis

Missing values analysis, using Little’s MCAR test (Little, 1988), indicated that data was missing completely at random, $\chi^2(1103) = 9613$, $p = .97$. Therefore, the multiple imputation method was employed to replace the missing data (Austin et al., 2021). Research has consistently shown the multiple imputation method to be an effective and reliable approach for managing missing data, preserving the integrity of statistical analyses (Li et al., 2015). Regarding careless responding, quality screening using multivariate outliers, person-total correlation, and maximum longstring methods resulted in the deletion of 10 responses. As recommended by guidelines of dealing with careless responses, the analyses were conducted once without and once with careless responses (Curran, 2016; Ward & Meade, 2023). The pattern of the results remained the same when including careless responses in the analyses.

Relationships between variables were examined using Pearson’s correlation method. Due to scores of IU-general, IU-health and the PSWQ being positively correlated, the Variance Inflation Factor was examined and found to be less than 10 (VIF indices ≤ 1.64), suggesting no evidence for multicollinearity (Kim, 2019). To empirically evaluate the hypothesis under scrutiny, serial multiple mediation was conducted to test the indirect effect of IU-general on health anxiety through the putative mediators.

Mediation analyses were conducted using the PROCESS syntax (Hayes, 2009) with a bias-corrected bootstrapping (10,000 resamples) to generate a 95% confidence intervals. PROCESS model 6 was applied for the analyses, which estimates the indirect effects of the predictor variable (IU-general) on the outcome variable (health anxiety) through at least two proposed mediators (IU-health as the first mediator and worry as the second mediator).

Results

Correlations between scale scores are reported in table 1. Scores across all scales were positively and significantly correlated ($ps < .01$).

Table 1. Descriptive statistics and bivariate correlations for study variables under the test

Measure	Health anxiety (SHAI)	IU-general	IU-health	Worry (PSWQ)
Health anxiety (SHAI)	-	.34	.43	.33
IU-general		-	.59	.41
IU-health			-	.35
Worry (PSWQ)				-
Mean	16.63	2.79	2.42	46.28
SD	7.30	0.63	0.94	9.64

Note. All correlations were significant at $p < .01$, IU-general measure was Intolerance of Uncertainty Scale and for IU-health measure was Intolerance of Uncertainty for Health Anxiety Scale

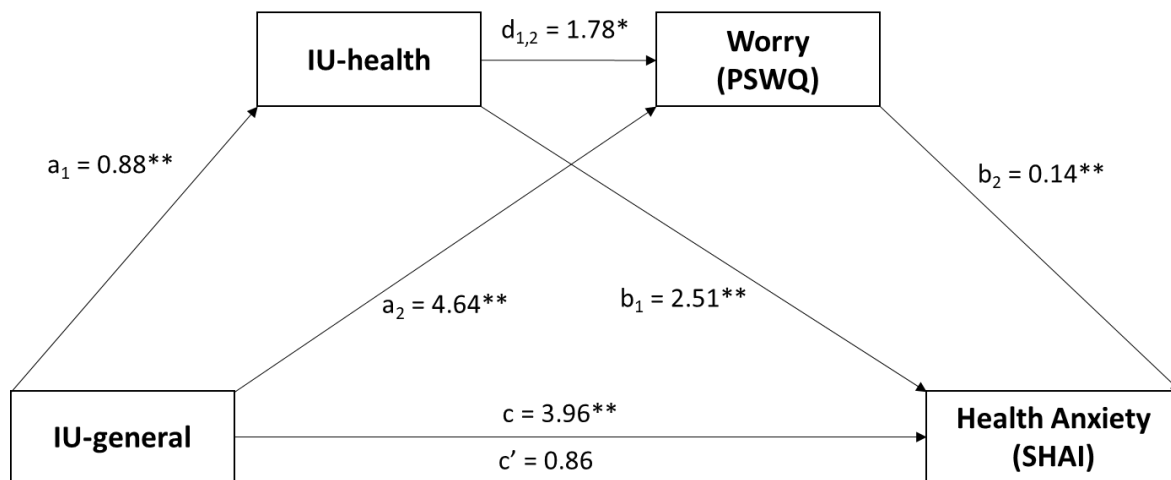
The serial mediation model was tested with IU-health and worry as mediators. In this model, the dependent variable was health anxiety as indexed by SHAI score and the independent variable was IU-general score. The IU-health score was the first mediator variable, and the worry score was the second mediator. See Figure 1 for a depiction of the serial mediation model and Table 2 for the statistics of the model's indirect effects. The total model accounted for 35% of the variance in health anxiety and was significant. This analysis confirmed that the serial mediation effect was statistically significant, confirming that IU-health and worry mediated the association between IU-general and health anxiety. Thus, the hypothesis under test was supported by the data.

In addition to this serial mediation effect, it was also found that both IU-health and worry made a further contribution to the mediation of this association outside the serial pathway, as the indirect association between IU-general and health anxiety through IU-health alone and the indirect association between IU-general and health anxiety through worry were also statistically significant.

Table 2. Bootstrapped indirect effects of the tested model. All effects were statistically significant.

	Estimate	SE	95% CI Lower	95% CI Upper
Total indirect	3.10	0.49	2.16	4.07
IU-general → IU-health → SHAI	2.21	0.43	1.37	3.06
IU-general → PSWQ → SHAI	0.67	0.23	0.27	1.16
IU-general → IU-health → PSWQ → SHAI	0.23	0.10	0.05	0.46

Figure 1. Diagram of serial mediation analysis of IU-general on health anxiety through IU-health and worry.



Note. * $p < .01$, ** $p < .001$. Unstandardized OLS regression path coefficients are shown. c is total effect of IU-general on health anxiety that does not consider mediators while c' is direct effect model with mediators included.

Discussion

This study was designed to test the validity of a proposed serial mediation model of IU specific to health and worry in the association between IU-general and health anxiety. The major findings can be summarized as below. Significant positive correlations were found between IU-general, health anxiety, IU-health, and worry. This contributes to the studies that show the association between IU-general, health anxiety and repetitive negative thinking (see Jansson-Fröjmark et al., 2020). Of more interest, the results revealed a significant serial mediation model that revealed an indirect association between IU-general and health anxiety through IU-health (first mediator) and worry (second mediator).

While some of our obtained findings are consistent with previously known effects, the present study extends our knowledge of the health anxiety literature in important ways, by empirically showing for the first time that IU-health and worry mediate the association between IU-general and health anxiety. Delineating the factors that mediate the impact of IU-general on health anxiety serves both to advance theoretical understanding of health anxiety, and also to suggest ways of potentially enhancing its treatment (Borsboom, 2017). In what follows, we discuss the theoretical and clinical implications of the current findings in more detail as well as the limitations and points to consider when interpreting the findings.

Research to date has typically focused on the relationships between IU-general and health anxiety. However, the present study suggests that IU-health makes an important contribution to this association. The significant serial mediation found in the present study indicates that IU-health may function as an intermediary between IU-general and health anxiety. While there is limited previous evidence that IU concerning specific domains potentially mediates the association between IU-general and other types of anxiety (Shihata et al., 2017), the present study is not only the first to demonstrate that IU-health mediates the association between IU-general and health anxiety, but also is the first to show that the relationship between IU-health and health anxiety is itself mediated by worry. Our findings suggest that IU-health and worry may each potentially contribute to the maintenance of health anxiety. In the sequential mediation model, supported by the present study, IU-general might contribute to elevated IU-health, which in turn heightened worrisome thoughts (Chen & Hong, 2010). Worry in turn, may act as a coping cognitive strategy (Dugas et al., 2004) and activates maladaptive safety behaviours to

decrease uncertainty such as reassurance seeking through frequent medical visits, which is ineffective in long term and maintains elevated health anxiety (Salkovskis & Warwick, 1986). Worry has been shown to be a form of repetitive negative thinking that is oriented towards the future (Ehring & Watkins, 2008). Interestingly, IU-general has also been argued to be a predominantly future-oriented construct in that it typically involves IU concerning the future, and health anxiety has been found to involve greater fear of uncertainty regarding *future* events (McEvoy & Mahoney, 2013; Moore et al., 2023). For example, Fetzner et al. (2014) found that IU focused on future events was significantly higher among participants with elevated health anxiety compared to patients with social anxiety or panic disorder.

The findings of the present study also have clinical implications. The significant indirect effect of IU-general through IU-health on health anxiety highlights the potential value of targeting IU-health in treatment protocols designed to reduce health anxiety. Similarly, the present demonstration that worry also plays a mediating role suggests that specifically targeting worry may serve to enhance the efficacy of therapeutic interventions for health anxiety. Effective methods of reducing worry already have been developed and validated (Querstret & Copley, 2013) and so their impact on health anxiety can now be evaluated by future research. Thus, given the findings obtained in the current study, we encourage clinical investigators to undertake future studies designed to determine whether interventions that reduce IU-health, and those that reduce worry, may additively or interactively contribute to the attenuation of elevated health anxiety.

Of course, certain limitations of the current study should be noted. First, it is crucial to recognize that causal inferences cannot be made, as the cross-sectional design does not allow for the establishment of temporal precedence among the variables studied. Second, the cross-sectional nature of the study precludes examining the directionality of the relationships between these variables, including testing potential bidirectional associations between health anxiety, worry, and intolerance of uncertainty over time. Therefore, we emphasize the need for future research to adopt longitudinal or experimental designs. These approaches can offer insights into the causality, sequence, and directionality of the psychological processes involved, advancing our understanding of how these variables interact.

Third, the use of a student sample introduces potential limitations that warrant further discussion. Because our participants were students, we cannot know whether the observed findings will generalize to patients with clinical health anxiety. Therefore, future studies should replicate the study using samples with clinical levels of health anxiety. Additionally, the student sample may not represent the full spectrum of health anxiety variability seen in the broader population. While specific normative data for student populations are not readily available, future studies should aim to systematically sample from populations exhibiting a more diverse range of health anxiety, utilizing normative data for those samples to guide this process.

In addition, although our study checked for careless responding using approved methods such as multivariate outlier analysis and the maximum longstring methods, we did not employ priori screening methods such as the inclusion of instructed response items or the recording of response times. We suggest that future research employ a more comprehensive approach to check the data quality of their studies (please see Bowling et al., 2016; Ward & Meade, 2023 for a review on managing careless responding).

These limitations notwithstanding, the current study contributes to the health anxiety literature by indicating that IU-general is associated with health anxiety through IU-health and worry. Delineating these associations highlights the value of differentiating between general and specific manifestations of IU and the potential importance of repetitive negative thinking in health anxiety. As such, we hope the present findings pave the way for future research that further extends our understanding of the mediation pathways revealed within the present study, by evaluating both the causal influence and clinical impact of these mediators using longitudinal designs and intervention approaches.

Additional Information

Funding

The authors did not receive support from any organization for this work.

Conflict of Interest

The authors declare that they have no competing interest.

Ethical approval

The study was performed according to all relevant guidelines and regulations, including the declaration of Helsinki. All participants gave written informed consent prior to their participation. The study was approved by the research ethics committee of the University of Social Welfare and Rehabilitation Sciences. The committee members were Dr. Hamidreza Khankeh, Dr. Homeira Sajjadi, Dr. Mohammadreza Khodaei Ardakani, and Dr. Mohsen Shati.

Data Availability

The data that support the findings of this study are openly available in the Open Science Framework at <https://osf.io/h3dau/>

Author CRediT Statement

All authors have been involved in the conceptualisation of the work and data analyses. MM and MK were involved in the data collection too. MM wrote the first draft of the work and CM and KM provided feedback. All authors have approved the final version of this study.

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References

- Abramowitz, J. S., Schwartz, S. A., & Whiteside, S. P. (2002). A contemporary conceptual model of hypochondriasis. *Mayo Clinic Proceedings*, 77(12), 1323–1330. <https://doi.org/10.4065/77.12.1323>
- Alberts, N. M., Hadjistavropoulos, H. D., Jones, S. L., & Sharpe, D. (2013). The Short Health Anxiety Inventory: A systematic review and meta-analysis. In *Journal of Anxiety Disorders* (Vol. 27, Issue 1, pp. 68–78). Elsevier Science. <https://doi.org/10.1016/j.janxdis.2012.10.009>
- Asmundson, G. J. G., Abramowitz, J. S., Richter, A. A., & Whedon, M. (2010). Health anxiety: current perspectives and future directions. *Current Psychiatry Reports*, 12(4), 306–312. <https://doi.org/10.1007/s11920-010-0123-9>
- Austin, P. C., White, I. R., Lee, D. S., & van Buuren, S. (2021). Missing Data in Clinical Research: A Tutorial on Multiple Imputation. *Canadian Journal of Cardiology*, 37(9), 1322–1331. <https://doi.org/10.1016/j.cjca.2020.11.010>
- Bati, A. H., Mandiracioglu, A., Govsa, F., & Çam, O. (2018). Health anxiety and cyberchondria among Ege University health science students. *Nurse Education Today*, 71(March), 169–173. <https://doi.org/10.1016/j.nedt.2018.09.029>
- Boelen, P. A., & Carleton, R. N. (2012). Intolerance of uncertainty, hypochondriacal concerns, obsessive-compulsive symptoms, and worry. *The Journal of Nervous and Mental Disease*, 200(3), 208–213. <https://doi.org/10.1097/NMD.0b013e318247cb17>
- Borjali, A., Sohrabi, F., Dehshiri, G. R., & Golzari, M. (2010). Psychometrics properties of Farsi version of Penn State Worry Questionnaire for college students. *Applied Psychology*, 4(1), 67–75.
- Borkovec, T. D., Robinson, E., Pruzinsky, T., & DePree, J. A. (1983). Preliminary exploration of worry: Some characteristics and processes. In *Behaviour Research and Therapy* (Vol. 21, Issue 1, pp. 9–16). Elsevier Science. [https://doi.org/10.1016/0005-7967\(83\)90121-3](https://doi.org/10.1016/0005-7967(83)90121-3)
- Borsboom, D. (2017). A network theory of mental disorders. *World Psychiatry : Official Journal of the World Psychiatric Association (WPA)*, 16(1), 5–13. <https://doi.org/10.1002/wps.20375>

- Boswell, J. F., Thompson-Hollands, J., Farchione, T. J., & Barlow, D. H. (2013). Intolerance of uncertainty: a common factor in the treatment of emotional disorders. *Journal of Clinical Psychology, 69*(6), 630–645. <https://doi.org/10.1002/jclp.21965>
- Bowling, N. A., Huang, J. L., Bragg, C. B., Khazon, S., Liu, M., & Blackmore, C. E. (2016). Who cares and who is careless? Insufficient effort responding as a reflection of respondent personality. *Journal of Personality and Social Psychology, 111*(2), 218–229. <https://doi.org/10.1037/pspp0000085>
- Buhr, K., & Dugas, M. J. (2002). The Intolerance of Uncertainty Scale: psychometric properties of the English version. *Behaviour Research and Therapy, 40*(8), 931–945. [https://doi.org/10.1016/s0005-7967\(01\)00092-4](https://doi.org/10.1016/s0005-7967(01)00092-4)
- Carleton, R. N. (2012). The intolerance of uncertainty construct in the context of anxiety disorders: theoretical and practical perspectives. *Expert Review of Neurotherapeutics, 12*(8), 937–947. <https://doi.org/10.1586/ern.12.82>
- Carleton, R. N. (2016). Into the unknown: A review and synthesis of contemporary models involving uncertainty. *Journal of Anxiety Disorders, 39*, 30–43. <https://doi.org/10.1016/j.janxdis.2016.02.007>
- Chen, C. Y., & Hong, R. Y. (2010). Intolerance of uncertainty moderates the relation between negative life events and anxiety. *Personality and Individual Differences, 49*(1), 49–53. <https://doi.org/https://doi.org/10.1016/j.paid.2010.03.006>
- Clayton, M., Renna, M., Weingast, L., Panjwani, A., Spaeth, P., Heimberg, R., Fresco, D., & Mennin, D. (2023). The Impact of Emotion Regulation Improvements on Intolerance of Uncertainty During Emotion Regulation Therapy. *Journal of Emotion and Psychopathology, 1*(1), 273–288. <https://doi.org/10.55913/joep.v1i1.36>
- Curran, P. G. (2016). Methods for the detection of carelessly invalid responses in survey data. *Journal of Experimental Social Psychology, 66*, 4–19. <https://doi.org/https://doi.org/10.1016/j.jesp.2015.07.006>
- Dehshiri, G., Golzari, M., Borjali, A., & Sohrabi, F. (2010). Psychometrics Particularity of Farsi Version of Pennsylvania State Worry Questionnaire for College Students. *Journal of Clinical Psychology, 1*(4), 67–75.
- Dugas, M. J., Buhr, K., & Ladouceur, R. (2004). The Role of Intolerance of Uncertainty in Etiology and Maintenance. In *Generalized anxiety disorder: Advances in research and practice*. (pp. 143–163). Guilford Press.
- Ehring, T., & Watkins, E. R. (2008). Repetitive negative thinking as a transdiagnostic process. *International Journal of Cognitive Therapy, 1*(3), 192–205. <https://doi.org/10.1680/ijct.2008.1.3.192>
- Fergus, T. A., & Bardeen, J. R. (2013). Anxiety sensitivity and intolerance of uncertainty: Evidence of incremental specificity in relation to health anxiety. *Personality and Individual Differences, 55*(6), 640–644. <https://doi.org/10.1016/j.paid.2013.05.016>
- Fergus, T. A., & Valentiner, D. P. (2011). Intolerance of Uncertainty Moderates the Relationship Between Catastrophic Health Appraisals and Health Anxiety. *Cognitive Therapy and Research, 35*(6), 560–565. <https://doi.org/10.1007/s10608-011-9392-9>
- Ferguson, E. (2009). A taxometric analysis of health anxiety. *Psychological Medicine, 39*(2), 277–285. <https://doi.org/10.1017/S0033291708003322>
- Fetzner, M. G., Asmundson, G. J. G., Carey, C., Thibodeau, M. A., Brandt, C., Zvolensky, M. J., & Carleton, R. N. (2014). How do elements of a reduced capacity to withstand uncertainty relate to the severity of health anxiety? *Cognitive Behaviour Therapy, 43*(3), 262–274. <https://doi.org/10.1080/16506073.2014.929170>
- Fink, P., Ørnboel, E., & Christensen, K. S. (2010). The outcome of health anxiety in primary care: A two-year follow-up study on health care costs and self-rated health. In *PLoS ONE* (Vol. 5, Issue 3). Public Library of Science. <https://doi.org/10.1371/journal.pone.0009873>

- Gerolimatos, L. A., & Edelstein, B. A. (2012). Predictors of health anxiety among older and young adults. *International Psychogeriatrics*, 24(12), 1998–2008. <https://doi.org/10.1017/S1041610212001329>
- Hayes, A. F. (2009). *Beyond Baron and Kenny: Statistical Mediation Analysis in the New Millennium*. 76(4), 408–420. <https://doi.org/10.1080/03637750903310360>
- Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. The Guilford Press.
- Hedman, E., Andersson, E., Andersson, G., Lindefors, N., Lekander, M., Rück, C., & Ljótsson, B. (2013). Mediators in internet-based cognitive behavior therapy for severe health anxiety. *PloS One*, 8(10), e77752. <https://doi.org/10.1371/journal.pone.0077752>
- Horenstein, A., Rogers, A. H., Bakhshaie, J., Zvolensky, M. J., & Heimberg, R. G. (2019). Examining the Role of Anxiety Sensitivity and Intolerance of Uncertainty in the Relationship Between Health Anxiety and Likelihood of Medical Care Utilization. *Cognitive Therapy and Research*, 43(1), 55–65. <https://doi.org/10.1007/s10608-018-9980-z>
- Jansson-Fröjmark, M., Bilevicius, E., El-Gabalawy, R., & Asmundson, G. J. G. (2020). Worry and Other Mental Health Problems. In A. L. Gerlach & A. T. Gloster (Eds.), *Generalized Anxiety Disorder and Worrying: A Comprehensive Handbook for Clinicians and Researchers* (First Edit, pp. 69–98). John Wiley & Sons, Ltd. <https://doi.org/doi:10.1002/9781119189909.ch5>
- Jensen, D., & Heimberg, R. G. (2015). Domain-specific intolerance of uncertainty in socially anxious and contamination-focused obsessive-compulsive individuals. *Cognitive Behaviour Therapy*, 44(1), 54–62. <https://doi.org/10.1080/16506073.2014.959039>
- Kami, M., Moloodi, R., Mazidi, M., Ehring, T., Mansoori, A. K., Nodooshan, M. B., Mazinani, Z., Molavi, M.-R., & Momeni, F. (2019). Measuring repetitive thinking in Iran: Psychometric properties of Persian version of Perseverative Thinking Questionnaire. *Personality and Individual Differences*, 148, 101–109. <https://doi.org/https://doi.org/10.1016/j.paid.2019.05.012>
- Khaje Mansoori, A., Mohammadkhani, P., Mazidi, M., Kami, M., Bakhshi Nodooshan, M., & Shahidi, S. (2016). The Role of Metacognition and Intolerance of Uncertainty in Differentiating Illness Anxiety and Generalized Anxiety. *Practice in Clinical Psychology*, 4(1), 57–65.
- Kim, J. H. (2019). Multicollinearity and misleading statistical results. *Korean Journal of Anesthesiology*, 72(6), 558–569. <https://doi.org/10.4097/kja.19087>
- Li, P., Stuart, E. A., & Allison, D. B. (2015). Multiple Imputation: A Flexible Tool for Handling Missing Data. *JAMA*, 314(18), 1966–1967. <https://doi.org/10.1001/jama.2015.15281>
- Little, R. J. A. (1988). A Test of Missing Completely at Random for Multivariate Data with Missing Values. *Journal of the American Statistical Association*, 83(404), 1198–1202. <https://doi.org/10.1080/01621459.1988.10478722>
- Mahmoud Alilou, M., Shahjoi, T., & Hashemi, Z. (2011). Comparison of intolerance of uncertainty, cognitive avoidance, negative problem orientation and positive beliefs about worry between patients with generalized anxiety disorder and normal people. *New Psychological Research Quarterly*, 5(20), 169–187.
- Mahoney, A. E. J., & McEvoy, P. M. (2012). Trait versus situation-specific intolerance of uncertainty in a clinical sample with anxiety and depressive disorders. *Cognitive Behaviour Therapy*, 41(1), 26–39. <https://doi.org/10.1080/16506073.2011.622131>
- McEvoy, P. M., & Mahoney, A. E. J. (2013). Intolerance of uncertainty and negative metacognitive beliefs as transdiagnostic mediators of repetitive negative thinking in a clinical sample with anxiety disorders. *Journal of Anxiety Disorders*, 27(2), 216–224. <https://doi.org/10.1016/j.janxdis.2013.01.006>
- Meyer, T. J., Miller, M. L., Metzger, R. L., & Borkovec, T. D. (1990). Development and validation of the Penn State Worry Questionnaire. *Behaviour Research and Therapy*, 28(6), 487–495. [https://doi.org/10.1016/0005-7967\(90\)90135-6](https://doi.org/10.1016/0005-7967(90)90135-6)

- Molina, S., & Borkovec, T. D. (1994). The Penn State Worry Questionnaire: Psychometric properties and associated characteristics. In *Worrying: Perspectives on theory, assessment and treatment*. (pp. 265–283). John Wiley & Sons.
- Moore, A., Wheaton, M. G., Rodriguez, C. I., Raila, H., & Shen, H. (2023). Compulsively seeking certainty: Clarifying the association between intolerance of uncertainty and compulsion severity in OCD. *Journal of Emotion and Psychopathology*, 1(1), 262–272. <https://doi.org/10.55913/joep.v1i1.19>
- Norton, P. J. (2005). A psychometric analysis of the Intolerance of Uncertainty Scale among four racial groups. *Journal of Anxiety Disorders*, 19(6), 699–707. <https://doi.org/https://doi.org/10.1016/j.janxdis.2004.08.002>
- O'Bryan, E. M., & McLeish, A. C. (2017). An examination of the indirect effect of intolerance of uncertainty on health anxiety through anxiety sensitivity physical concerns. *Journal of Psychopathology and Behavioral Assessment*, 39(4), 715–722. <https://doi.org/10.1007/s10862-017-9613-y>
- Querstret, D., & Cropley, M. (2013). Assessing treatments used to reduce rumination and/or worry: a systematic review. *Clinical Psychology Review*, 33(8), 996–1009. <https://doi.org/10.1016/j.cpr.2013.08.004>
- Rabiei, M., Kalantari, M., Asgari, K., & Bahrami, F. (2013). Factor Structure Analysis , Validity and Reliability of the Health Anxiety Inventory - Short Form. *Journal of Depression and Anxiety*, 2(1), 2–5. <https://doi.org/10.4172/2167-1044.1000125>
- Salkovskis, P. M., Rimes, K. A., Warwick, H. M. C., & Clark, D. M. (2002). The Health Anxiety Inventory: development and validation of scales for the measurement of health anxiety and hypochondriasis. *Psychological Medicine*, 32(5), 843–853. <https://doi.org/10.1017/s0033291702005822>
- Salkovskis, P. M., & Warwick, H. M. C. (1986). Morbid preoccupations, health anxiety and reassurance: a cognitive-behavioural approach to hypochondriasis. *Behaviour Research and Therapy*, 24(5), 597–602. [https://doi.org/https://doi.org/10.1016/0005-7967\(86\)90041-0](https://doi.org/https://doi.org/10.1016/0005-7967(86)90041-0)
- Sexton, K. A., & Dugas, M. J. (2009). Defining distinct negative beliefs about uncertainty: validating the factor structure of the Intolerance of Uncertainty Scale. *Psychological Assessment*, 21(2), 176–186. <https://doi.org/10.1037/a0015827>
- Shihata, S., McEvoy, P. M., & Mullan, B. A. (2017). Pathways from uncertainty to anxiety: An evaluation of a hierarchical model of trait and disorder-specific intolerance of uncertainty on anxiety disorder symptoms. *Journal of Anxiety Disorders*, 45, 72–79. <https://doi.org/10.1016/j.janxdis.2016.12.001>
- Thibodeau, M. A., Carleton, R. N., McEvoy, P. M., Zvolensky, M. J., Brandt, C. P., Boelen, P. A., Mahoney, A. E. J., Deacon, B. J., & Asmundson, G. J. G. (2015). Developing scales measuring disorder-specific intolerance of uncertainty (DSIU): a new perspective on transdiagnostic. *Journal of Anxiety Disorders*, 31, 49–57. <https://doi.org/10.1016/j.janxdis.2015.01.006>
- Ward, M. K., & Meade, A. W. (2023). Dealing with Careless Responding in Survey Data: Prevention, Identification, and Recommended Best Practices. *Annual Review of Psychology*, 74, 577–596. <https://doi.org/10.1146/annurev-psych-040422-045007>
- Yook, K., Kim, K.-H., Suh, S. Y., & Lee, K. S. (2010). Intolerance of uncertainty, worry, and rumination in major depressive disorder and generalized anxiety disorder. *Journal of Anxiety Disorders*, 24(6), 623–628. <https://doi.org/https://doi.org/10.1016/j.janxdis.2010.04.003>
- Zahravi, T., Saed, O., & Lauriola, M. (2023). Clarifying the Factor structure of the Intolerance of Uncertainty Inventory: Measurement Invariance and Validity in Predicting Clinical Outcomes. *Trends in Psychology*. <https://doi.org/10.1007/s43076-023-00256-0>