

Health Anxiety: Latent Structure and Associations with Anxiety-related Psychological Processes in a Student Sample

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Abstract Although currently classified as a somatoform disorder, cognitive-behavioral models conceptualize hypochondriasis (HC) as a severe form of health anxiety. The Short Health Anxiety Inventory (SHAI) is a measure derived from this conceptualization that measures health anxiety symptoms across the range of severity. Previous studies have reported inconsistent findings regarding this measure's factor structure, but these studies employed factor analytic tools that did not account for the categorical nature of SHAI items. The present psychometric study was designed to address these inconsistencies using categorical factor analysis. Using data from a large student sample we found that the SHAI had two factors: *Illness Likelihood* and *Illness Severity*. We also examined the relationship between these domains and cognitive variables associated with other anxiety disorders. Results suggested that the psychological processes present in obsessive-compulsive disorder and panic disorder are also associated with health anxiety. Implications for the conceptualization and classification of severe health anxiety are discussed.

Keywords Health anxiety · Hypochondriasis · Anxiety disorders · Classification · Factor analysis

The primary feature of hypochondriasis (HC) is preoccupation with fears and beliefs about having a serious illness based on

the misinterpretation of bodily symptoms (American Psychiatric Association [APA] 2000). HC is currently classified as a somatoform disorder in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; APA 2000) because of the prominent role of body symptoms, although questions of how best to categorize this condition have recently been raised, with some suggesting that HC be re-classified as an anxiety disorder (i.e., severe health anxiety) in DSM-V.¹ Indeed, there is empirical evidence to suggest that HC, panic disorder (PD), and obsessive compulsive disorder (OCD) overlap in terms of the psychological processes and mechanisms that lead to their development and maintenance (see Olatunji et al. 2009).

Current cognitive-behavioral models of HC implicate health-related dysfunctional beliefs (e.g., “Cancer runs in my family”) that predispose individuals to be especially attentive to illness-related stimuli and their own body sensations (Warwick and Salkovskis 1990). Individuals with such beliefs catastrophically misinterpret benign bodily perturbations as being indicative of illness (e.g., a headache is a sign of a brain tumor), which causes intense anxiety (Taylor and Asmundson 2004). To reduce this anxiety, such individuals engage in safety behaviors, such as excessively checking their own body or seeking reassurance from doctors, medical references, and family members (Abramowitz and Moore 2007). These efforts may temporarily reduce anxiety, but in the long-run they maintain health-related preoccupation and prevent the individual from learning to tolerate uncertainty about

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¹ For the purposes of this study, HC refers to health anxiety severe enough to meet criteria for a diagnosis of hypochondriasis, while health anxiety refers to the broader continuum of this construct.

normal, everyday unexplained bodily sensations (Abramowitz et al. 2007a, b).

The model described above involves cognitive and behavioral mechanisms that are also implicated in other anxiety disorders, such as the tendency to catastrophically misinterpret arousal-related body sensations seen in PD (Deacon and Abramowitz 2008) and the compulsive-like checking behavior observed in OCD (Fallon et al. 1991). Whereas models of other anxiety disorders have received substantial empirical research over the last few decades, the development of a cognitive-behavioral model of HC has occurred more recently (e.g., Warwick and Salkovskis 1990). Research on HC and health anxiety has been hampered by the lack of a consensus measure for assessing this problem from a cognitive-behavioral perspective. To this end, Salkovskis and colleagues (2002) introduced the 64-item Health Anxiety Inventory (HAI) and a more user-friendly shortened version, the Short Health Anxiety Inventory (SHAI). The SHAI contains 18 items that assess worry about health, awareness of bodily sensations, and feared consequences of having an illness. This measure has promising features and has demonstrated good psychometric properties in several studies. For example, it discriminates between patients diagnosed with HC and other anxiety disorders, including OCD and panic disorder (Salkovskis et al. 2002; Abramowitz et al. 2007a, b) and performs well on various indices of reliability in both clinical and nonclinical samples (e.g., Abramowitz et al. 2007a, b), suggesting that the measure is sensitive to health anxiety concerns across the continuum of severity.

Studies on the factor structure of the SHAI, however, have reported inconsistent findings. In constructing the SHAI, Salkovskis et al. (2002) selected 14 items assessing health anxiety from the original HAI and added a 4 item subscale designed to assess the negative consequences of becoming ill. The authors reported that a principal components analysis on all 18 items revealed two distinct components, corresponding to the perceived likelihood of becoming ill and the negative consequences of having an illness. However, the authors omitted pertinent pieces of information, such as the loadings and eigenvalues, which would be essential to determine the adequacy of the solution. In a large student sample, Abramowitz et al. (2007a, b) found evidence of three factors: (a) perceived likelihood of becoming ill, (b) perceived negative consequences of becoming ill, and (c) body vigilance. In another study, Abramowitz and colleagues (2007a, b) compared the fit of the two and three factor models of the SHAI in a sample of patients with HC and a mixed anxiety disorder group. The results of this analysis did not clearly support one factor solution over the other, and on the basis of parsimony the authors adopted the two factor solution. However, of three commonly used Goodness-of-Fit indices

(RMSEA=.09, CFI=.91, NFI=.87), none met common criterion for good fit (RMSEA \leq .06, CFI \geq .95, NFI \geq .95; Hu and Bentler 1999), which suggests that neither model fit the data particularly well.

One possible explanation for the lack of consensus in the factor structure of this measure is data misspecification. Factor analysis assumes that observed variables are both normally distributed and continuous (Gorsuch 1983). Each SHAI item, however, presents respondents with a set of four statements that tap increasing severities of health anxiety and asks them to select which statement best approximates their experience. For example, in item 14, respondents are asked to choose among the following: (a) “My family/friends would say I do not worry enough about my health,” (b) “My family/friends would say I have a normal attitude about my health,” (c) “My family/friends would say I worry too much about my health,” and (d) “My family/friends would say I am a hypochondriac.” As such, the response options on the SHAI are *ordinal* categories. This type of data is not appropriate for traditional factor analytic techniques because the absolute distances between categories are unknown, making the classic model of linear association between the observed variables and the underlying factor(s) inapplicable (Woods and Edwards 2008). There are several important negative consequences of treating categorical data as continuous, including underestimation of factor loadings caused by attenuated correlation coefficients, “pseudofactors” that are artifacts of item characteristics such as extremeness, increased measurement error, and biased test statistics and standard errors (Brown 2006; Ruscio and Ruscio 2002).

The primary aim of the present study was therefore to examine the factor structure of the SHAI using factor analytic tools designed for categorical data in order to resolve the ambiguity surrounding its factor structure. Determining the true latent structure of this measure is of particular importance, as the underlying dimensions revealed by factor analysis may correspond to distinct mechanisms (Cattell 1978). Accordingly, factor analysis may be a particularly useful tool in revealing the psychological processes in health anxiety (Olatunji 2008). This is an important task as empirical research has implicated substantial overlap in the cognitive and behavioral mechanisms involved in HC and some anxiety disorders, leading some authors to suggest that HC should be re-classified as an anxiety disorder. For example, both HC and PD involve hypervigilance to bodily sensations and the tendency to misinterpret benign body fluctuations as being harmful, a phenomenon known as *anxiety sensitivity* (Reiss et al. 1986). In PD, however, the feared outcome is perceived to be imminent (e.g., “I’m having a heart attack”), while HC patients often anticipate a more chronic course for their feared malady (e.g., “I have a degenerative heart condition

that doctors can't figure out"). Several studies have implicated anxiety sensitivity (Cox et al. 1999; Abramowitz et al. 2007a, b) and body vigilance (Olatunji et al. 2007) as important psychological factors in both HC and PD.

There are also common themes in the cognitive-behavioral mechanisms of HC and OCD. The phenomenological experience of patients suffering from HC involves inordinate anxiety, uncertainty, and doubt stemming from the perception of health-related threats. Checking behaviors, such as reassurance from doctors, self-exams and scouring medical sources, are functionally akin to compulsive rituals in OCD that are similarly performed to reduce anxiety, yet that maintain or even exacerbate obsessional fears in the long run (Abramowitz et al. 2007a, b).

In one recent study, Deacon and Abramowitz (2008) examined two cognitive risk factors for panic disorder (anxiety sensitivity and body vigilance) and one for OCD (intolerance of uncertainty) in a mixed sample of patients with HC, PD and OCD. HC patients showed elevated levels of body vigilance, intolerance of uncertainty and anxiety sensitivity for cardiovascular symptoms, suggesting that HC involves cognitive-behavioral elements also observed in both panic and OCD. To extend their findings, these authors recommended that future investigations examine additional cognitive variables linked to OCD, such as *obsessive beliefs*, which include three domains: (a) the tendency to overestimate threat and personal responsibility for harm, (b) dysfunctional beliefs about the importance of and need to control thoughts, and (c) the need for certainty and perfection. Therefore, an additional purpose of the present study was to investigate how these belief domains were associated with health anxiety dimensions. On the basis of Deacon and Abramowitz (2008), we hypothesized that the need for certainty and perfection would be related to health anxiety, yet because no research has examined the other obsessive belief domains, we considered these analyses largely exploratory. Finally, we examined body vigilance and anxiety sensitivity as predictors of health anxiety dimensions and hypothesized that both of these variables would be related to aspects of health anxiety.

The current study used a large non-treatment-seeking sample of undergraduate students. Although it is important to study health anxiety in clinical samples, there are several reasons to extend this research into non-clinical populations. First, concerns about one's health exist along a continuum of severity, with the differences between health concerns in the general population and those among clinically severe individuals being quantitative rather than qualitative (Barsky et al. 1986). Second, studying health anxiety in non-clinical populations provides an opportunity to understand how these sorts of difficulties may arise and be maintained as a result of normal health-related experiences (e.g., Freeston et al. 1994). Third, clinical samples

often experience actual health problems (e.g., Deacon et al. 2008; Barlow 2002), which can confound ratings of health anxiety, while non-clinical samples reduce the likelihood of this possibility. As a result, we conducted the present study using a large, non-clinical, undergraduate student sample.

Method

Participants

A sample of 636 self-selected undergraduates enrolled in Introductory Psychology courses at a large university in the Southeast United States completed a computer-administered online questionnaire packet for this study. This group included 424 women (66.8%) and 211 men (33.2%; this distribution approximates the gender distribution of our Introductory Psychology participant pool at large, one individual did not report a gender,) and had a mean age of 19.91 years ($SD=2.24$). Approximately 74% of the sample self-identified as Caucasian, 12.1% as African American, 6% as Asian, 3.8% as Hispanic and 3.8% identified as "other."

Procedure

Participation in this study was available to all undergraduate students enrolled in Introductory Psychology classes at the study site. These classes include a research participation requirement, and all participants received course credit for their participation in the study. The study was reviewed and approved by the University IRB.

After signing up for the experiment via an Internet-based software program, participants provided consent to participate and were directed to a secure project website where they completed the study measures in the same order. All data were collected using Qualtrics, an online web survey development tool. The design of the internet version of the study questionnaires was based on empirically-derived suggestions for how to develop computer questionnaires (e.g., Hewson 2003). Coles et al. (2007) found that the administration of psychological assessment measures of anxiety symptoms using Internet-based and paper-and-pencil formats yield highly comparable results.

Upon accessing the secure project website, participants were presented with an "instructions page." A demographic questionnaire and the study questionnaires then appeared on subsequent pages. Participants were informed that all responses were confidential and that no personal identifying information would be included in the computer-generated dataset other than the date and time they completed the online study. At the end of the last questionnaire, a debriefing statement was presented.

Measures

The following measures were included in the present study:

Anxiety Sensitivity Index-3 (ASI-3) The ASI-3 (Taylor et al. 2007) is an 18-item version of the original ASI (Reiss et al. 1986) that measures beliefs about the feared consequences of symptoms associated with anxious arousal (e.g., “It scares me when I become short of breath”). Respondents indicate their agreement with each item from “very little” (coded as 0) to “very much” (coded as 4). Total scores range from 0 to 72. The ASI-3 contains three empirically established subscales relating to fears of social concerns (e.g., It is important for me not to appear nervous), fears of physical symptoms (e.g., It scares me when my heart beats rapidly), and fears of cognitive dyscontrol (e.g., It scares me when I am unable to keep my mind on a task). The measure possesses excellent psychometric properties, performing well on various indices of reliability and validity (Taylor et al. 2007). We calculated subscale scores for each of the three factors: Physical, Social and Cognitive. Internal consistency estimates for these subscales in the current study ranged from adequate to good ($\alpha=.83$, .78 and .90, respectively).

Center for Epidemiological Studies- Depression Scale (CES-D; Radloff 1977) The CES-D consists of 20 items developed as a global measure to assess psychological distress in general community samples. Participants are asked to rate how often they have felt (or behaved) in certain ways (e.g., “I felt sad”; “My sleep was restless”) over the past week, from 0 (rarely) to 3 (most of the time). Items are summed (4 are reverse scored) to obtain a total score ranging from 0 to 60. The CES-D is a widely used, reliable, and valid measure of depressed mood (e.g., Radloff 1977). Internal consistency in the present study was good ($\alpha=.90$).

Obsessive Beliefs Questionnaire (OBQ; Obsessive Compulsive Cognitions Working Group [OCCWG] 2005) The OBQ, a 44-item self-report instrument, measures dysfunctional beliefs (i.e., obsessive beliefs) thought to contribute to the escalation of normal intrusive thoughts into clinical obsessions. It contains three subscales: (a) threat overestimation and responsibility (OBQ-T/R), (b) importance and control of intrusive thoughts (OBQ-I/CT), and (c) perfectionism and need for certainty (OBQ-P/C). The instrument’s good validity, internal consistency, and test-retest reliability are described in OCCWG (2005). Internal consistency in the present study was excellent ($\alpha=.94$).

Short Health Anxiety Inventory (SHAI; Salkovskis et al. 2002) As described above, the SHAI has demonstrated

good reliability and validity in both clinical and non-clinical samples (Abramowitz et al. 2007a, b; Salkovskis et al. 2002). Internal consistency in the present study was good ($\alpha=.88$).

Body Vigilance Scale (BVS; Schmidt et al. 1997) The BVS is a four item scale that measures the tendency to attend to panic-related body sensations. The first three items assess the degree of attentional focus, perceived sensitivity to changes in bodily sensations, and the average amount of time spent attending to bodily sensations. The fourth item measures the extent to which the respondent reports attending to 15 panic-related bodily sensations (e.g., heart palpitations), which are averaged to yield a single score. The BVS has demonstrated good internal consistency and adequate test-retest reliability (Olatunji et al. 2007; Schmidt et al. 1997). Internal consistency in the present study was good ($\alpha=.82$).

Data Analytic Strategy

To investigate the factor structure of the SHAI we employed a combination of exploratory and confirmatory factor analyses as suggested in Brown (2006). First, the sample was randomly divided into two groups using the SPSS 17.0 “Random sample of cases” function. In the first analysis of the SHAI’s factor structure, we conducted an exploratory (common) factor analysis (EFA) using data from one group of students ($n=315$). Based on these results, we then generated a measurement model and used confirmatory factor analysis (CFA) to test the goodness-of-fit of this model in data from the other group ($n=322$). Both the EFA and CFA analyses were conducted with Mplus (Muthén and Muthén 2007) using a diagonally weighted least squares estimator (WLSMV), from the polychoric correlation matrix in order to account for the categorical nature of the data. This type of analysis assumes that the observed category values represent points on an unobserved continuous distribution. This approach avoids the previously mentioned pitfalls of treating categorical data as continuous. The WLSMV estimator was chosen because of evidence that it performs well even in cases of modest violations of normality (Flora and Curran 2001). Missing data, which were present in 0–0.5% of responses for the SHAI items, were handled with a pairwise approach (Asparouhov and Muthén 2007). Next, using the results of the factor analyses, we generated and tested hypotheses regarding the relationships among dimensions of health anxiety and the cognitive variables described above.

To test our hypotheses regarding relationships between HA and cognitive variables, we correlated the SHAI subscales derived from the factor analyses with the other

measures included in the study. In order to determine how much variance in the SHAI subscales could be explained by these variables, we performed multiple regression analyses with the SHAI subscales as dependent variables and the other study measures entered together as predictors. We evaluated the individual beta coefficients of each predictor to determine which variables would be significant in the model. The CES-D was included to control for general distress.

Results

Preliminary Considerations

Means and standard deviations for all study measures are presented in Table 1. Missing data were present for some scale items (range in valid $N=606-636$). The group’s scores on these instruments generally fell within the normal range. On the SHAI, no significant differences emerged by gender $t(633)=-0.45, p = ns$, Cohen’s $d=.04$. or ethnicity, $F(4, 635)=2.13, p = ns$, partial eta squared=.01. SHAI scores were also not significantly correlated with age ($r=-.04, p = ns$).

Exploratory Factor Analysis

Data from the first randomly selected group were used to conduct an exploratory factor analysis of the SHAI. The number of factors to retain was determined by parallel analysis, a statistical procedure that compares the observed eigenvalues to those obtained from multiple samplings of

random data, as recommended by Zwick and Velicer (1986). Based on the recommendations of Longman et al. (1989), parallel analyses were conducted twice, once using the mean eigenvalues and once using the 95th percentile eigenvalues from the unreduced correlation matrices. We employed an oblique (Geomin) rotation method to allow the SHAI factors to be correlated with one another.

The first four eigenvalues from the unadjusted sample correlation matrix were 8.00, 1.72, 1.22, and 0.91. Parallel analysis indicated that only the first two eigenvalues were larger than what could be expected by chance occurrence in random data (first four 95th percentile eigenvalues=1.52, 1.41, 1.34, 1.28). Table 2 presents the factor loadings and communalities for the two-factor solution. The first extracted factor accounted for 44% of the variance while the second accounted for 10% so that together the factors explained 54.0% of the item variance. The scale approximated Thurstone’s (1947) criteria for simple structure, but one item, item 13, had salient loadings on both factors. This item was not included in subsequent analyses. With the exception of this cross-loading item, the rotated factor solution was congruent with Salkovskis et al.’s (2002) two factor solution; the last four items emerged as a separate factor measuring the tendency to catastrophize about how terrible it would be to have an illness (*Illness Severity*), while the other items constituted a main factor assessing beliefs regarding the probability of being or becoming ill (*Illness Likelihood*). The two factors were moderately correlated with one another ($r=.54$).

Confirmatory Factor Analysis

To verify the two factors established in the EFA, we conducted a CFA in the second randomly selected group using the same robust weighted least squares estimator and the polychoric correlation matrix. Item 13 was not included in the measurement model because it had salient loadings on both factors. Goodness of fit was evaluated using the standardized root mean square residual (SRMR), root mean square error of approximation (RMSEA), the comparative fit index (CFI), the Tucker-Lewis index (TLI) and the weighted root mean residual (WRMR). Good model fit was defined by the following criteria (Hu and Bentler 1999): RMSEA close to .06 or below, SRMR values close to .08 or below, and CFI and TLI values close to .95 or above. Yu and Muthén (2002), recommend the WRMR over the SRMR for categorical indicators, with good fit at values close to 1.00 and below. Multiple indices were used together because they provide a more conservative and reliable evaluation of model fit relative to the use of a single fit index.

Results of the goodness of fit tests were as follows: The Chi-square value ($\chi^2=136.34, d.f.=54$) was significant

Table 1 Group means and standard deviations on study measures

Measure	Valid N	M	SD
SHAI	636	12.48	6.79
ASI-3 total	636	14.67	11.02
ASI-3 Physical	623	3.92	4.22
ASI-3 Cognitive	626	2.91	4.28
ASI-3 Social	624	7.86	4.75
BVS	636	13.85	6.92
OBQ-RT	606	52.31	14.41
OBQ-PC	607	57.09	16.59
OBQ-ICT	621	29.95	11.67
CES-D	636	17.52	8.95

SHAI-Short Health Anxiety Inventory; ASI-3 = Anxiety Sensitivity Index-3; Physical = Physical Concerns subscale; Social = Social Concerns subscale; Cognitive = Cognitive Concerns subscale; BVS = Body Vigilance Scale, OBQ = Obsessive Believe Questionnaire; RT = Responsibility/threat overestimation subscale; ICT = Importance/control of thoughts subscale; PC = Perfectionism/certainty subscale; CES-D = Center for Epidemiological Studies- Depression Scale.

Table 2 Exploratory factor analysis of SHAI: factor loadings for the two-factor solution

SHAI item	SHAI Factor		
	IL	IS	h^2
1. Time spent worrying about health	0.73	-0.17	0.43
2. Noticing aches and pains	0.66	-0.25	0.33
3. Awareness of bodily sensations/changes	0.60	-0.27	0.26
4. Ability to resist thoughts of illness	0.80	-0.08	0.58
5. Fear of having serious illness	0.80	0.02	0.66
6. Picturing self being ill	0.68	0.05	0.5
7. Ability to take mind off health thoughts	0.77	0.07	0.66
8. Relieved if doctor says nothing's wrong	0.52	0.10	0.33
9. Hear about illness and think I have it	0.56	0.15	0.43
10. Wonder what body sensations/changes mean	0.56	0.02	0.33
11. Feeling at risk for developing illness	0.75	0.07	0.61
12. Think I have serious illness	0.90	0.00	0.81
13. Ability to think of other things if notice unexplained body sensation	0.43	0.43	0.57
14. Family/friends say I worry about my health	0.66	-0.03	0.42
15. Ability to enjoy life if have an illness	0.15	0.64	0.54
16. Chance of medical cure if have an illness	0.25	0.46	0.39
17. Illness would ruin aspects of life	-0.01	0.79	0.62
18. Loss of dignity if had an illness	0.13	0.60	0.46
Eigenvalues	8.0	1.72	
% Total Variance	44.4	9.6	
% Common Variance	82.3	17.7	

Factor loadings $\geq |.40|$ are listed in boldface type. *SHAI* Short Health Anxiety Inventory; *IL* Illness Likelihood factor; *IS* Illness Severity factor.

% Total variance = 100 X (the eigenvalue for each factor divided by 18).

% Common variance = 100 X (the eigenvalue of each factor shown divided by the sum of eigenvalues). Factor correlation = .57. $N=636$

($p < .001$), but this value may be misleading as it is sensitive to sample size (Brown 2006). In contrast, the chi square difference test for nested models (see Brown 2006) suggested that the two factor model significantly improved on a one factor solution, $\chi^2_{diff}(11) = 234.16$, $p < .001$. The TLI (.94), CFI (.97), SRMR (.06) and WRMR (1.00) all approximated good fit according to the criteria described above. The RMSEA value we obtained (.07) indicated adequate model fit ($< .08$; Browne and Cudeck 1993), but surpassed Hu and Bentler's (1999) criteria for good model fit. Chen and colleagues (2008) have recommended that RMSEA values be considered in the context of other fit indices rather than solely in terms of universal cutoff points. On this basis, and considering that the other four fit indices consistently indicated a good fit, we concluded that the two factor model obtained in the EFA had acceptable fit.

Subscale Associations

Zero-Order Correlations To examine the relationships among the SHAI dimensions and the study variables, we first computed zero-order correlations. We computed two SHAI subscales by summing items based on the emergent factor structure of the scale, and elected to use subscale scores rather than factor scores for each individual to increase the interpretability of our results. Both the Illness

Likelihood ($\alpha = .86$) and Illness Severity ($\alpha = .71$) subscales demonstrated adequate reliability as assessed by Cronbach's alpha (Nunnally and Bernstein 1994). As can be seen in Table 3, the SHAI subscales were moderately but significantly correlated with one another after applying a Bonferroni correction to our alpha level = .10 (1-tailed test) / 8 = .013. The correlation between the subscales and the SHAI total were excluded from this Bonferroni calculation as they are assumed to be correlated. Whereas the SHAI total and subscale scores were significantly correlated with all of the other study measures (due to the large sample size), the SHAI-IL was most strongly associated with the physical concerns subscale of the ASI-3 and the BVS. A test of the difference in correlation magnitude using Steiger's equation for comparing correlation coefficients (Cohen and Cohen 1983) indicated that these correlation coefficients were significantly stronger than all others for the SHAI-IL ($p < .05$). The SHAI-IS subscale was only weakly to moderately associated with the other study variables.

Regression Analyses We computed two separate regressions, one with each of the SHAI subscales used as the dependent variable and the other variables entered simultaneously as predictors, to determine how much variance in subscale scores would be accounted for by the model, as

Table 3 Correlations between SHAI total and subscale scores and related measures

Measure	Correlation Coefficient		
	SHAI total	SHAI-IL	SHAI-IS
SHAI total	–		
SHAI-IL	.94	–	
SHAI-IS	.69	.44	–
ASI-3 Physical	.53	.51	.29
ASI-3 Cognitive	.44	.37	.35
ASI-3 Social	.41	.35	.36
BVS	.55	.58	.24
OBQ-RT	.38	.38	.22
OBQ-PC	.32	.27	.29
OBQ-ICT	.29	.25	.24
CES-D	.32	.28	.26

All correlations are significant at $p < .01$.

SHAI = Short Health Anxiety Inventory; IL = Illness Likelihood factor; IS = Illness Severity factor; ASI-3 = Anxiety Sensitivity Index-3; Physical = Physical Concerns subscale; Social = Social Concerns subscale; Cognitive = Cognitive Concerns subscale; BVS = Body Vigilance Scale, OBQ = Obsessive Believe Questionnaire; RT = Responsibility/threat overestimation subscale; ICT = Importance/control of thoughts subscale; PC = Perfectionism/certainty subscale; CES-D = Center for Epidemiological Studies- Depression Scale. Range in analysis $N=582-636$.

well as which cognitive variables would be significant predictors in the context of the other variables. For each regression, we applied a Bonferroni correction to our alpha level=.10 (1-tailed test) /8=.013. Summary statistics for each variable in both of the regression equations are presented in Table 4. In the first equation, predicting *Illness Likelihood*, the combined predictors accounted for 46% of the variance. In this equation, examination of individual beta weights revealed that the CES-D, OBQ-RT, BVS and ASI-3 Physical emerged as significant predictors. In the second equation, the combined predictor variables accounted for 24% of the variance in the *Illness Severity* subscale. In this equation, the beta weights revealed that the CES-D, OBQ-RT, ASI-3 Cognitive, ASI-3 Social and BVS were significant. The beta weight associated with the OBQ-ICT subscale did not meet our Bonferroni adjusted alpha value, but did trend toward significance ($p=.03$).

Discussion

The primary aim of this study was to establish the latent structure of the SHAI in order to investigate the different dimensions of health anxiety and how they relate to the cognitive variables of OCD and PD. The results of our

Table 4 Summary statistics for regression equations predicting SHAI subscales

Variable	R^2	Beta	t	p
Predicting SHAI illness likelihood				
Final model	.46			<.001
CES-D		.12	3.36	<.01
OBQ-RT		.14	3.02	<.01
OBQ-PC		.02	0.38	n.s.
OBQ-ICT		-.06	-1.27	n.s.
ASI-3 Physical		.24	4.97	<.001
ASI-3 Cognitive		.01	0.08	n.s.
ASI-3 Social		.05	1.22	n.s.
BVS		.41	11.52	<.001
Predicting SHAI illness severity				
Final model	.24			<.001
CES-D		.12	2.88	<.01
OBQ-RT		-.10	-1.89	n.s.
OBQ-PC		.14	2.79	<.01
OBQ-ICT		.11	2.25	=.03
ASI-3 Physical		-.05	-0.96	n.s.
ASI-3 Cognitive		.18	3.20	<.01
ASI-3 Social		.20	4.20	<.001
BVS		.15	3.65	<.001

CES-D = Center for Epidemiological Studies- Depression Scale; ASI-3 = Anxiety Sensitivity Index-3; Physical = Physical Concerns subscale; Social = Social Concerns subscale; Cognitive = Cognitive Concerns subscale; OBQ = Obsessive Believe Questionnaire; RT = Responsibility/threat overestimation subscale; ICT = Importance/control of thoughts subscale; PC = Perfectionism/certainty subscale; BVS = Body Vigilance Scale. $N=534$.

factor analyses were consistent across methodologies and suggest that the SHAI has two factors: one assessing the tendency to worry about the possibility of having an illness (*Illness Likelihood*) and one pertaining to concerns about the negative valence or “awfulness” of having an illness (*Illness Severity*). This model fit well in our sample. It should be noted that the last four questions (which make up the *Illness Severity* factor) are preceded by a separate instruction page, which may introduce shared method variance influencing their distinction as a separate factor. It is also important to note that item 13, which assesses the ability to shift one’s attention away from an unexplained body sensation, loaded on both factors. In the study by Abramowitz and colleagues (2007a, b), this item failed to load saliently on any of the three factors. In light of this, and in order to better approximate Thurstone’s (1947) criteria for simple structure, this item should be considered for deletion from the scale.

In line with the study hypotheses, a large proportion of the variance in the SHAI dimensions was predicted by the cognitive-behavioral variables associated with OCD and

PD. Moreover, the two dimensions of health anxiety concerns demonstrated distinctive patterns with the predictor variables. Within the context of the other predictor variables, the physical concerns domain of anxiety sensitivity was a significant predictor of *Illness Likelihood*, but not *Illness Severity*. In contrast, the social and cognitive domains of anxiety sensitivity were both significant predictors of *Illness Severity*, but not *Illness Likelihood*. This interesting pattern of associations might be related to the nature of the *Illness Severity* subscale, which is comprised of four questions that measure perceived negative consequences of becoming ill, such as loss of dignity, whether there is a medical cure, and whether one could live a happy life while being ill. Importantly, individuals are instructed to answer these questions while thinking of a serious illness that particularly concerns them. It could be the case that those who are likely to fear that anxious arousal indicates looming insanity (cognitive concerns) or social humiliation (social concerns) would think these maladies to be especially severe and debilitating according to the response options provided (e.g., incurable, undignified). The physical concerns domain of anxiety sensitivity, which pertains to the fear that arousal-related body sensations indicate a medical calamity, appears to be strongly related to concerns about the likelihood of becoming ill, although it was not a strong predictor of the perception that having a feared illness would be awful. Thus, it may be that in this sample, physical illnesses were perceived as being more dignified or curable than mental illnesses. In contrast, concerns about mental illness and its associated social consequences seem to be related to greater *Illness Severity* concerns. As in previous research, body vigilance was a significant predictor in both regression equations, suggesting that the tendency to closely monitor body sensations plays a central role in both domains of health anxiety in our sample. The CES-D was also a significant predictor in both regression equations, indicating that general distress is also a good predictor of both domains of health anxiety.

The present study is the first to investigate the relationship between health anxiety and obsessive beliefs, and our results are consistent with the notion that such beliefs are involved in health anxiety concerns. The SHAI subscales showed different patterns of association with the three domains of obsessive beliefs. The *Responsibility/Threat Estimation* domain was a significant predictor of *Illness Likelihood* when entered simultaneously with the other variables. Consistent with Tolin et al.'s (2006) finding that this domain of obsessive beliefs is not specific to OCD, but instead characteristic of anxiety disorders in general, this relationship may be explained by the presence of general expectations of threat that underlie anxiety and fear more generally and are present in health anxiety. In

predicting the *Illness Severity* subscale on the other hand, the *Perfectionism/Certainty* domain of obsessive beliefs was significant in the context of the other variables. This domain measures the extent to which individuals can tolerate mistakes and uncertainty or ambiguity. Our data suggest that difficulty with uncertainty is associated with the perceived severity of the feared illness and extends across the range of health anxiety concerns present in our sample.

In predicting the *Illness Severity* subscale the *Importance/Control of Thoughts* domain was a predictor at a trend level but failed to meet statistical significance once our bonferroni correction was applied. While caution should be taken in interpreting this result given the use of a non-treatment seeking sample, future research should more closely investigate the role of attempted thought control and thought-action fusion in health anxiety. Attempting to suppress thoughts about the negative consequences of an illness might exacerbate the problem, in the same way that thought suppression exacerbates obsessional problems as elaborated by Rachman (1997, 1998).

A number of limitations of this study should be mentioned. First, the cross-sectional design precludes us from drawing causal inferences regarding the relationships between the psychological mechanisms under study and health anxiety. It cannot be determined from this investigation whether the cognitive factors represent an etiological factor in health anxiety, or merely an epiphenomenon. In addition, all data in the current study were collected via self-report; thus shared method variance may have inflated the relationships between study variables. Future studies should include multiple assessment modalities and multiple time points in order to determine the direction of causality and increase method variance. Finally, we entered the predictor variables together to determine how much variance in health anxiety symptoms would be explained. This analysis prevented us from determining the amount of variance each variable uniquely accounted for, which should be investigated in future studies. Many of the predictors were found to be statistically significant, but their clinical significance is uncertain. While we believe there is good reason to investigate health concerns in a student population, these results should be replicated with a clinical sample of patients with clinical levels of health anxiety.

In conclusion, our results suggest that the SHAI measures two dimensions of health anxiety concerns that are uniquely related to the psychological variables implicated in the cognitive-behavioral conceptualizations of other anxiety problems, namely OCD and PD. The current DSM classification system places HC among the somatoform disorders because of the prominence of body-focused symptoms and complaints. However, Taylor and Asmundson (2008) have

recommended that theory and etiology be emphasized in the classification of HC. Our results add to a growing body of evidence suggesting that health anxiety shares psychological mechanisms in common with other anxiety disorders. Grouping disorders based on these similarities would facilitate research into underlying mechanisms of these problems as well as lead to the development of a more unified approach to treatment. We would in fact argue that placement of HC among the somatoform disorders is at least partially responsible for the lack of research and clinical progress with health anxiety compared to other anxiety-related problems. Current cognitive-behavioral treatments for health anxiety and HC (Warwick et al. 1996; Barsky and Ahern 2004; Greeven et al. 2007) bear several similarities with the extant treatments for other anxiety disorders. These functional similarities and shared mechanisms provide further evidence for the re-classification of hypochondriasis as an anxiety disorder (Olatunji et al. 2009).

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