

# Validation of the Chinese version of the Health Cognitions Questionnaire in Chinese college students

This article was published in the following Dove Press journal:  
*Neuropsychiatric Disease and Treatment*

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**Purpose:** The cognitive behavioral model is considered the most comprehensive for explaining the pathogenesis of health anxiety (HA). The model proposes 4 dysfunctional beliefs that play a vital role in developing and sustaining HA: a) the likelihood of contracting or having an illness, b) awfulness of the illness, c) difficulty coping with illness, and d) inadequacy of medical services. The Health Cognitions Questionnaire (HCQ), widely used in English populations, was developed for assessing these core cognitions. As HA is a growing problem in China, we translated the HCQ into a Chinese version (CHCQ) and examined its psychometric properties. These core cognitions were compared among individuals with and without medical conditions.

**Methods:** A set of questionnaires that included the CHCQ and the Short Health Anxiety Inventory (SHAI) was used to gather data from 1,319 Chinese college students. After 4 weeks, 145 of the students completed the CHCQ again. The validity, reliability, and measurement invariance were evaluated among individuals with various medical conditions.

**Results:** The final CHCQ included 19 items. A 4-factor structure was well suited to the data. Good internal consistency (Cronbach's  $\alpha$  for total score was 0.849, subscales ranged from 0.753 to 0.841), test-retest reliability (the interclass correlation coefficient for total score was 0.762, subscales ranged from 0.626 to 0.683), and criterion validity of the CHCQ were demonstrated. Measurement and structural invariance were established. Individuals with a diagnosed disease scored higher on the likelihood-of-illness subscale (Cohen's  $d = 0.22$ ,  $p < 0.01$ ) than those without an illness.

**Conclusion:** The CHCQ shows promise for the assessment of 4 core HA-related cognitions in the Chinese population.

**Keywords:** health anxiety, dysfunctional beliefs, health cognitions, cognitive behavioral model

## Introduction

Health anxiety (HA) is a specific form of anxiety that has attracted greater interest in the last 5 years. The core features of HA are excessive concern about one's health and fears of currently (or will be) experiencing a serious illness.<sup>1</sup> Research suggests that HA is a dimensional rather than a category construct.<sup>2</sup> A high level of HA is worth noting. In a community study carried out in Germany, 8.3% of the respondents scored higher than 8 on the Whiteley Index-14, which indicates a high degree of HA.<sup>3</sup> In a national survey in Australia using a structured diagnostic interview, 5.7% of the general population was affected by HA during their lifespan, and the

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current prevalence of HA was 3.4%.<sup>4</sup> The situation was worse in Hong Kong where the prevalence of HA was 40% on the Whiteley Index-7.<sup>5</sup> Though the measurements used in these studies differed, it is reasonable to believe that high HA is a common experience around the world. The extreme form of HA is usually classified as hypochondriasis.<sup>6</sup> In the latest Diagnostic and Statistical Manual of Mental Disorders (DSM-5) of the American Psychiatric Association, the diagnostic and classification criteria of hypochondriasis have changed radically.<sup>7</sup> It now emphasizes the experience of distress and somatosensory misattribution caused by this disorder, rather than focusing on the complaint and quantity of somatic symptoms. Thus, the important role of the cognitive characteristics of HA is highlighted.

Since Salkovskis et al proposed the concept of HA in 1986,<sup>8</sup> the cognitive behavioral model has been the most popular and well-researched in explaining and intervening in HA. Some researchers have even suggested replacing the diagnosis of hypochondriasis in DSM-IV with “health anxiety disorder.”<sup>9</sup> From the perspective of cognitive behavioral theory, HA begins and is maintained by the interaction of cognitive, behavioral, and emotional factors.<sup>10</sup> When health-related events occur, individuals who hold dysfunctional beliefs tend to misinterpret events in a catastrophic way, leading to increased anxiety that arouses physical reactions. Thus, a vicious cycle of negative emotion is produced. These dysfunctional beliefs are latent until they are activated by internal or external triggers. The role of cognitive constructs in HA has been examined in numerous studies,<sup>11</sup> and several measurements were created to assess the overall level of related cognitions of HA according to the cognitive behavioral model, such as the short version of the Health Anxiety Inventory (SHAI)<sup>12</sup> and the Illness Anxiety Scale (IAS)<sup>13</sup> for overall assessment of HA; the Body Vigilance Scale (BVS),<sup>14</sup> the Somatosensory Amplification Scale (SAS),<sup>15</sup> and the Anxiety Sensitivity Index (ASI)<sup>16</sup> for specific cognitive aspects of HA. In addition to the cognitive variables mentioned above, 4 core dysfunctional beliefs were identified by Salkovskis and Warwick as playing a vital role in the pathogenesis of HA,<sup>10</sup> including a) the likelihood of contracting or having an illness, b) awfulness of the illness, c) difficulty coping with illness, and d) the inadequacy of available medical services for treating the illness, but little research has been done within these 4 cognitions, and no target assessment exists. A systematic review indicated that latent HA-related beliefs are intriguing and may help enhance this cognitive behavioral model.<sup>11</sup>

For overcoming this limitation, Hadjistavropoulos et al developed a 20-item measurement—the Health Cognitions Questionnaire (HCQ)—to evaluate these 4 specific cognitions in HA.<sup>17</sup> On this basis, they found that these cognitions are uniquely related to HA, even after controlling negative emotions, such as depression and anxiety. In order to get a more accurate assessment of these 4 cognitions, the HCQ was designed with 2 descriptors per item, one each for individuals with and without a current medical condition. Not surprisingly, health problems can be the direct cause of HA. In a study by Bleichhardt and Hiller, subjects who had a physical problem felt higher levels of HA.<sup>18</sup> The rates of HA are around 10% for all patients in primary care<sup>19</sup> and close to 20% of medical outpatients.<sup>20</sup> Consistent with these data, Hadjistavropoulos et al found that the difference in the HCQ indeed existed in people with different health conditions.<sup>17</sup> These results suggest that we must treat individuals distinctly, in both research and in clinical practice, who do or do not have existing medical conditions.

The HCQ has proven to be an appropriate tool for assessing the 4 core cognitions with good reliability and validity in western countries.<sup>21</sup> To achieve a more comprehensive understanding of the stability and applicability of HA, and the mechanism behind it in different cultures, evidence from other countries of the psychometric properties of the HCQ is needed. In China, the most populous country in the world, research about HA and its related cognitions is rare. One of the reasons is the lack of relevant measuring tools. To address this problem, this study aimed to translate the HCQ into Chinese and test the validity and reliability of the Chinese version of the Health Cognitions Questionnaire (CHCQ) in a Chinese population. Subsequently, we will further explore the difference of the 4 core cognitions between those individuals with and those without medical conditions.

## Method

### Participants

Using convenience sampling, 1,400 college students were recruited from 2 universities in Hunan Province in China. Questionnaires were distributed during a class break, and participation was voluntary; written informed consent forms were obtained. No credits or other rewards were given. In the questionnaire brochure, students were asked, “Are you currently suffering from any diagnosed medical conditions?” and if so, they were asked to indicate exactly

what disease(s). After excluding questionnaires from 81 participants due to missing data (if more than half the questionnaire was blank), a total of 1,319 fully completed questionnaires were collected; the effective return ratio was 94.21%. Four weeks later, 145 students completed the CHCQ again to evaluate test-retest reliability. This study was approved by the local ethics committee and conducted in accordance with the Declaration of Helsinki.

## Measures

### The Chinese version of HCQ

The original HCQ<sup>17</sup> consists of 20 items and has 4 subscales for assessing core cognitions identified by the cognitive behavioral model of HA: likelihood of illness (4 items), awfulness of illness (4 items), difficulty coping (8 items), and medical service inadequacy (4 items). There are 2 statements per item, such as, “I feel like I am likely to experience further health problems,” for those with a diagnosed medical condition, and “I feel I am likely to experience health problems,” for those without. Items are evaluated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The total HCQ score ranges from 20 to 100, with higher scores indicating a high level of HA-related dysfunctional beliefs. Following the guidelines from Beaton et al, the CHCQ was created in several steps.<sup>22</sup> First, after obtaining permission of the author of the HCQ, the scale was translated into Chinese by 2 bilingual psychological researchers and synthesized into a single translation. Two psychology professors examined the translation for its surface-level relevance to the construct of interest and the suitability of each item in a Chinese context. Minor revisions were made. Second, the Chinese version was back-translated into English by 2 psychology experts proficient in English and Chinese who had not read the original HCQ. This second English version was reviewed and modified by the author of the HCQ and a bilingual expert until it was judged to express the same meaning as the original scale and to be in line with Chinese culture.

### Short Health Anxiety Inventory (SHAI)

The SHAI consists of 18 items evaluating and monitoring the levels of health concern.<sup>12</sup> In this study, it was used for exploring criterion validity. Items of the SHAI are rated on a 4-point Likert scale, ranging from 0 (I do not ...) to 3 (I spend most of my time ...). It involves 2 subscales: illness likelihood (14 items) and negative consequences (4 items). Scores on the SHAI are calculated by adding all the

responses to the items. Evidence has been provided to support the psychometric properties for use within a Chinese population.<sup>23</sup> In the current study, the total of the Cronbach's alpha coefficient of SHAI was 0.803.

## Data analysis

### Item analysis

Descriptive statistics and item analyses were evaluated for each item of CHCQ using SPSS 22.0 for preliminary testing of scale items. Corrected item-total correlations and Cronbach's  $\alpha$  if-item-deleted were estimated for homogeneity, and should be above 0.30 and less than Cronbach's  $\alpha$  of the total scale respectively.<sup>24</sup> Further, the discrimination of items was tested.

### Validity

The CHCQ assessed individuals with and without medical conditions in differentiating statements. Thus, we evaluated the construct validity of the CHCQ to test whether the items and dimensions formed in western culture fit in the eastern culture. For this purpose, the sample was divided into 3 subsamples. Students who did not report a clearly identifiable medical condition ( $n=1,110$ ) were randomly split into 2 equal groups ( $n=555$  each) using the SPSS algorithm: one (Sample 1) for exploratory factor analysis (EFA) and the other (Sample 2) for confirmatory factor analysis (CFA). In Sample 1, we identified the latent variables by principal axis factoring (PAF) and promax rotation. The eigenvalues, scree plot, parallel analysis, and factor loading were inspected. According to the suggestion of Ender and Bandalos,<sup>25</sup> the primary factor loading in pattern matrix should be higher than 0.40. The parallel analysis was performed by syntax script from O'Connor.<sup>26</sup> The rest who reported one or more diagnosed medical conditions was a separate subsample ( $n=209$ , Sample 3). In Samples 2 and 3, in order to be more robust, the CFA was conducted using Mplus 7.0 with maximum likelihood estimation (MLM), which reported a mean-adjusted Chi-square test statistic (Satorra-Bentler  $\chi^2$ ).<sup>27</sup> Because Chi-square is sensitive to sample size,<sup>28</sup> 4 other indices were used, according to the criteria proposed by Hu and Bentler:<sup>29</sup> comparative fit index (CFI), Tucker-Lewis index (TLI), root mean squared error of approximation (RMSEA), and the standardized root mean square residual (SRMR). The cutoff value of these indices in different papers was inconsistent. Integrating the views of different scholars and relevant theory, the CFI and TLI values should exceed a recommended cutoff value

of 0.90 (more liberal) or 0.95 (more strict).<sup>29,30</sup> The RMSEA and SRMR being less than 0.08 were considered a good fit.<sup>29</sup> The criterion-related validity was documented by Pearson's correlation coefficient between the CHCQ score and SHAI score.  $P$ -value  $<0.05$  was considered statistically significant.

### Reliability

The reliability of the CHCQ was validated by internal consistency and test-retest reliability. Cronbach's  $\alpha$  coefficient was performed for internal consistency, while the interclasscorrelation coefficient (ICC) was assessed for test-retest reliability. The number of test items may affect the value of alpha.<sup>31</sup> In consideration of the number of items in the CHCQ, a value of alpha above 0.70 was regarded as acceptable.<sup>24</sup> According to the criteria proposed by Landis et al.,<sup>32</sup> ICC of 0.40 or lower was considered low, with 0.41 to 0.60 as normal, 0.61 to 0.81 as moderate, and above 0.81 as high values.

### Measurement invariance

Multigroup CFA was conducted to test the measurement invariance between individuals with (Sample 3) and without medical conditions (Sample 2). There were 4 models to test: configural invariance, metric invariance, scalar invariance, and strict invariance.<sup>33</sup> If measurement invariance fit the data well, the structural invariance would be tested further. Then, we would compare the mean difference between the 2 groups. Among different consecutive models, the changes in CFI ( $\Delta$ CFI), TLI ( $\Delta$ TLI), RMSEA ( $\Delta$ RMSEA), and the Bayesian information criterion (BIC) values were established as evidence of invariance. A  $\Delta$ CFI,  $\Delta$ TLI,  $\Delta$ RMSEA equal or lower than 0.010, and a descent BIC value were considered measurement invariance.<sup>34</sup>

## Results

### Descriptive statistics of study subjects

No missing data existed for all information and scales in the 1,319 participants. The mean age of participants was 19.40 (SD =1.43), ranging from 17 to 29. Most were female ( $n=792$ , 60%); there was no significant age difference observed between the 2 gender groups ( $t=1.432$ ; 95% CI:  $-0.042-0.267$ ;  $p=0.152$ ). Most were Han Chinese ( $n=1,189$ , 89.9%) and urban residents ( $n=836$ , 63.4%). There were 209 respondents (15.85%) who reported a diagnosed medical condition, including rhinitis ( $n=63$ , 30.14%), gastrointestinal disease ( $n=48$ , 22.97%), dermatosis ( $n=33$ , 15.79%), orthopedic diseases (eg, ligament reconstruction, cervical spondylosis;  $n=21$ , 10.04%), calculus ( $n=15$ , 7.18%), female diseases (eg, polycystic ovary syndrome, endometrial polyp;  $n=12$ , 5.74%), respiratory disease (eg, tracheitis, phthisis;  $n=9$ , 4.31%), diabetes ( $n=5$ , 2.39%), and heart disease ( $n=3$ , 1.44%). The remaining 1,110 respondents (84.15%) were in a good state of health.

Skewness ranged from  $-0.80$  to  $0.66$ , and kurtosis ranged from  $-0.64$  to  $0.69$ , revealing that all items of the CHCQ fell within the recommended range (above 3 and 10, respectively).<sup>30</sup> The distribution of each item was reasonably normal. As shown in Table 1, the mean score of CHCQ total was  $55.01 \pm 9.54$ , and the scores of the 4 subscales were  $11.02 \pm 3.08$  (likelihood of illness, CHCQ-L),  $12.74 \pm 3.23$  (awfulness of illness, CHCQ-A),  $21.51 \pm 4.86$  (difficulty coping, CHCQ-C), and  $9.73 \pm 2.53$  (medical service inadequacy, CHCQ-M). There was no floor effect or ceiling effect shown in either total or subscale scores.<sup>35</sup>

### Item analysis

The results of item analyses are shown in Table 2. The corrected item-total correlations were all statistically

**Table 1** Descriptive statistics for age and measurements ( $n=1,319$ )

	N	Mean (SD)	Minimum	Maximum	%Minimum	%Maximum
Age	1,319	19.40(1.43)	17	29		
CHCQT	1,319	55.01 $\pm$ 9.54	20	91	0.23	0.08
CHCQ-L	1,319	11.02 $\pm$ 3.08	4	20	2.27	0.83
CHCQ-A	1,319	12.74 $\pm$ 3.23	4	20	2.43	1.59
CHCQ-C	1,319	21.51 $\pm$ 4.86	8	40	1.14	0.23
CHCQ-M	1,319	9.73 $\pm$ 2.53	4	20	3.03	0.08
SHAI	1,319	11.51 $\pm$ 5.30	0	35		

**Abbreviations:** CHCQT, the total score of Chinese version of Health Cognitions Questionnaire; CHCQ-L, likelihood of illness; CHCQ-A, awfulness of illness; CHCQ-C, difficulty coping with illness; CHCQ-M, medical services inadequacy; SHAI, Short Health Anxiety Inventory.

**Table 2** The results of item analysis (n=1,319)

Item	Corrected item-total correlation	Cronbach's $\alpha$ if-item-deleted	t
1	0.368	0.852	-14.920**
2	0.417	0.850	-17.000**
3	0.348	0.853	-13.399**
4	0.369	0.851	-14.204**
5	0.415	0.850	-16.502**
6	0.520	0.845	-21.717**
7	0.303	0.854	-11.602**
8	0.460	0.848	-18.169**
9	0.524	0.846	-22.198**
10	0.510	0.846	-21.087**
11	0.436	0.849	-17.482**
12	0.490	0.847	-19.492**
13	0.521	0.845	-20.823**
14	0.466	0.848	-17.951**
15	0.378	0.851	-14.669**
16	0.428	0.849	-16.136**
17	0.525	0.845	-20.778**
18	0.398	0.850	-14.776**
19	0.453	0.848	-19.382**
20	0.490	0.847	-20.282**

Note: \*\* $p < 0.01$  (two-tailed).

significant, ranging from 0.303 to 0.525, which were all higher than the recommended criterion of 0.300.<sup>24</sup> The Cronbach's  $\alpha$  was 0.855; and Cronbach's  $\alpha$  if-item-deleted was all below 0.855. Ranking the CHCQ total score in a descending order, the score of the top 27% was significantly higher than the score of the lowest 27% in each item ( $ps < 0.01$ ).

## Validity

### Exploratory factor analysis

The EFA was conducted in Sample 1 (n=555). The results of Bartlett's sphericity test ( $\chi^2=3,876.346$ ,  $p < 0.001$ ) and the Kaiser-Mayer-Olkin score (KMO = 0.827) both were significant, indicating the data were suitable for EFA.<sup>36</sup> The eigenvalues greater-than-one rule and scree plot all suggested 5 factors. The 5-factor solution accounted for 61.92% of the variance, but there was only 1 item in Factor 5 (Item 16), which could not represent the connotation of this factor. We deleted item 16 from the CHCQ. Thus, a 19-item CHCQ was developed. The EFA was performed again and results supported a 4-factor structure. The factors accounted for 57.21% of the variance. Parallel analysis was conducted and also showed the eigenvalues of 4 factors exceeding values obtained from a random dataset. The factor loadings of the model in pattern matrix were acceptable<sup>37</sup> and are shown in

Table 3. There were 7 items which loaded high in Factor 1 (CHCQ-C). Meanwhile, 4 items loaded high in Factor 2 (CHCQ-A), Factor 3 (CHCQ-L), and Factor 4 (CHCQ-M). The factor attribution of each item was consistent with the original scale.

### Confirmatory factor analysis

Different factorial structures may emerge in different samples;<sup>30</sup> thus, we conducted CFA in Sample 2 (n=555) and Sample 3 (n=209) to examine the replicability of the EFA identified by the 4-factor structure. The 4-factor model fit the data well in both the nonmedical condition sample (Sample 2):  $SB\chi^2/df = 3.046$ ,  $p < 0.001$ , RMSEA = 0.054, SRMR = 0.051, CFI = 0.923, TLI = 0.910, and the medical condition sample (Sample 3):  $SB\chi^2/df = 1.825$ ,  $p < 0.001$ , RMSEA = 0.059, SRMR = 0.070, CFI = 0.930, TLI = 0.918.

### Criterion validity

In theoretical conceptualizations and empirical research, dysfunctional beliefs were regarded as playing a key role in the development and maintenance of HA.<sup>38</sup> In line with these, the SHAI, which measured the severity of HA, was chosen for evaluation of criterion validity. The total score of CHCQ was significantly positively correlated with SHAI ( $r=0.458$ ,  $p < 0.01$ ). The correlation between scores of 4 subscales and SHAI was also significant ( $ps < 0.01$ ). These results indicated the criterion validity of CHCQ was adequate (Table 4).

### Reliability

As presented in Table 4, the intercorrelations between subscales ranged from 0.259 to 0.382 ( $p < 0.01$ ), and correlations between each subscale and the total score ranged from 0.599 to 0.752, indicating that these subscales were related but were evaluating different aspects of dysfunctional beliefs. To test internal consistency, Cronbach's  $\alpha$  was calculated and all were above the recommended cutoff of 0.70.<sup>39</sup> This index of CHCQ total was 0.849; the alphas coefficient of subscales was 0.771 (CHCQ-L), 0.818 (CHCQ-A), 0.841 (CHCQ-C), and 0.753 (CHCQ-M). The 4-week test-retest reliability coefficient was moderate.<sup>32</sup> The ICC was 0.762 for CHCQ total ( $p < 0.01$ ), 0.667 for CHCQ-L ( $p < 0.01$ ), 0.683 for CHCQ-A ( $p < 0.01$ ), 0.656 for CHCQ-C ( $p < 0.01$ ), and 0.626 for CHCQ-M ( $p < 0.01$ ).

## Measurement invariance and structural invariance

Based on the results of CFAs in Samples 2 and 3, we further compared the difference between samples with and



**Table 3** Factor loading in pattern matrix after revision (n=555)

Items	Factor				Factor in original Health Cognitions Questionnaire
	1	2	3	4	
10	0.827	-0.054	-0.019	-0.030	Difficulty coping with illness
19	0.694	0.102	-0.097	-0.046	
20	0.681	-0.004	0.023	0.003	
9	0.618	0.102	-0.029	0.029	
2	0.614	-0.054	0.018	-0.002	
4	0.544	-0.078	-0.029	0.047	Awfulness of illness
6	0.535	-0.024	0.187	0.004	
14	-0.108	0.806	0.035	-0.002	
13	0.081	0.768	-0.038	-0.004	
17	0.105	0.686	-0.036	0.025	
1	-0.085	0.617	0.068	-0.006	
8	0.036	-0.078	0.796	-0.004	Likelihood of illness
5	-0.010	0.027	0.703	-0.067	
3	-0.075	0.067	0.570	-0.012	
12	0.051	0.032	0.543	0.111	
7	-0.030	-0.053	-0.084	0.799	
15	0.017	-0.0056	-0.025	0.794	Medical services
18	-0.008	0.110	0.046	0.523	Inadequacy
11	0.034	0.073	0.126	0.491	

**Table 4** Intercorrelations between scales and reliability

	Pearson r					$\alpha$	ICC
	1	2	3	4	5	n=1,319	n=145
1.CHCQT	-					0.849	0.762**
2.CHCQ-L	0.670**	-				0.771	0.667**
3.CHCQ-A	0.688**	0.382**	-			0.818	0.683**
4.CHCQ-C	0.752**	0.259**	0.274**	-		0.841	0.656**
5.CHCQ-M	0.599**	0.266**	0.265**	0.288**	-	0.753	0.626**
6.SHA1	0.458**	0.363**	0.333**	0.306**	0.249**		

**Note:** \*\* $p < 0.01$  (two-tailed).

**Abbreviations:** CHCQT, the total score of Chinese version of Health Cognitions Questionnaire; CHCQ-L, likelihood of illness; CHCQ-A, awfulness of illness; CHCQ-C, difficulty coping with illness; CHCQ-M, medical services inadequacy; SHA1, Short Health Anxiety Inventory; ICC, interclass correlation coefficient.

without medical conditions on the CHCQ. The descriptive statistics and intercorrelations of CHCQ in Samples 2 and 3 are presented in Table 5. The obvious mean of CHCQ-L in Sample 3 was higher than in Sample 2 ( $t = -2.694$ ,  $p < 0.01$ , Cohen's  $d = 0.22$ ), and no statistically significant difference existed in other subscales or in total score ( $ps > 0.05$ ) between Samples 2 and 3. Cronbach's  $\alpha$  coefficients were similar across the samples, as was the pattern of correlations between subscales.

To further explore the difference between these 2 samples, we conducted 4 levels of measurement invariance

analysis in the following order: configural invariance, metric invariance, scalar invariance, and strict invariance. As shown in Table 6, the data fit every model well, and measurement invariance was supported: the  $\Delta CFI$ ,  $\Delta TLI$ , and  $\Delta RMSEA$  values were  $< 0.01$  and the BIC values decreased between any 2 models. Comparing the configural model and metric model across samples, the  $\Delta CFI = -0.003$ ,  $\Delta TLI = 0.001$ ,  $\Delta RMSEA = 0.000$ , and the BIC decreased by 69.616. Comparing the metric model and scalar model across samples, the  $\Delta CFI = -0.007$ ,  $\Delta TLI = -0.004$ ,  $\Delta RMSEA = 0.001$ , and the BIC decreased by 46.498.

**Table 5** The descriptive analysis and intercorrelations in Samples 2 and 3

	Nonmedical sample (Sample 2) n=505					Medical sample (sample3) n=209					t	
	1	2	3	4	5	1	2	3	4	5		
1.CHCQ-L	-					-					-2.694**	
2.CHCQ-A	0.369**	-				0.477**	-				0.581	
3.CHCQ-C	0.208**	0.294**	-			0.394**	0.360**	-			-0.247	
4.CHCQ-M	0.230**	0.254**	0.301**	-		0.286**	0.397**	0.359**	-		0.116	
5.CHCQ-T	0.646**	0.697**	0.740**	0.603**	-	0.725**	0.746**	0.797**	0.632**	-	0.076	
Mean	10.95	12.76	19.25	9.78	52.94	11.64	12.61	19.33	9.76	53.33		
SD	3.13	3.18	4.26	2.59	8.96	3.19	3.39	4.76	2.48	10.21		
$\alpha$	0.804	0.818	0.832	0.765	0.847	0.758	0.847	0.883	0.726	0.884		

Note: \*\*p<0.01 (two-tailed).

**Abbreviations:** CHCQT, the total score of Chinese version of Health Cognitions Questionnaire; CHCQ-L, likelihood of illness; CHCQ-A, awfulness of illness; CHCQ-C, difficulty coping with illness; CHCQ-M, medical services inadequacy.

**Table 6** Fit indices of measurement invariance

Model	S-B $\chi^2$	df	CFI	TLI	RMSEA (90% CI)	SRMR	Model comparison	$\Delta$ CFI	$\Delta$ TLI	$\Delta$ RMSEA	BIC
Model1 (configural invariance)	711.163	292	0.925	0.912	0.056 (0.050–0.062)	0.057					34,521.013
Model2 (metric invariance)	741.081	307	0.922	0.913	0.056 (0.050–0.061)	0.058	2 vs 1	-0.003	0.001	0.000	34,451.397
Model3 (scalar invariance)	794.212	322	0.915	0.909	0.057 (0.051–0.063)	0.059	3 vs 2	-0.007	-0.004	0.001	34,404.899
Model4 (strict invariance)	853.042	341	0.908	0.908	0.058 (0.052–0.063)	0.059	4 vs 3	-0.007	-0.001	0.001	34,337.595
Model5 (structural invariance)	868.738	351	0.908	0.910	0.057 (0.051–0.062)	0.069	5 vs 4	0.000	0.002	-0.001	34,286.923

**Abbreviations:** df, degree of freedom; CFI, comparative fit index; TLI, Tucker–Lewis index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual;  $\Delta$ CFI, CFI change;  $\Delta$ TLI, TLI change;  $\Delta$ RMSEA, RMSEA change; BIC, Bayesian information criterion.

Comparing the scalar and the strict models across samples, the  $\Delta CFI = -0.007$ ,  $\Delta TLI = -0.001$ ,  $\Delta RMSEA = 0.001$ , and the BIC decreased by 67.304. Based on the well-fitting strict invariance, the structural invariance could be further tested, and the factor covariance was set to be equal in these 2 samples. Comparing the strict and the structural models across samples, the  $\Delta CFI = 0.000$ ,  $\Delta TLI = 0.002$ ,  $\Delta RMSEA = -0.001$ , and the BIC decreased by 50.672, indicating the structural invariance was tenable. The results suggested that all items of CHCQ implied equivalent meaning and got the same reaction pattern in individuals with different medical conditions, and we could compare the observed mean score of the CHCQ directly.

## Discussion

To better understand and measure the core cognitions underlying HA in the Chinese population, we translated the HCQ into Chinese and developed the 19-item Chinese version of the HCQ to gather data from a sample of more than 1,000 Chinese college students. The CHCQ scores in individuals with and those without medical conditions were further explored in this study. The quality of data was satisfactory; the effective return ratio was 94.21% with no missing data. No floor effects and ceiling effects were present in our study.

At first, we did item analysis for the translated CHCQ to evaluate the relevancy and fitness of the items. The results showed appropriate discrimination and homogeneity of each item. Then, we tested the construct validity of CHCQ and explored whether the 4-factor model suggested by previous studies fits the data well.<sup>17</sup> The results of EFA indicated a 5-factor solution, but there was only one item (Item16: "If I developed a chronic health problem, I would no longer be in control of my life," or "If I developed another chronic health problem or my condition worsened, I would no longer be in control of my life") in Factor 5 that could not represent the connotation of this factor. In the original HCQ, this item belongs to subscale difficulty coping with illness which contains a description of the ability to cope with illness or enjoy life after illness. We discussed the details of Item 16 to rule out possible problems in the translation process. It seems there is a distinction between enjoying life and controlling it in the Chinese context. In considering these findings together, we deleted Item 16 from the CHCQ. Then, in its final version the CHCQ contained 19 items. The EFA was run again and results supported a 4-factor structure. In view of the characteristics of this scale, we conducted further

CFAs in samples with and without medical conditions, and the 4 factors were confirmed, which was consistent with the English version of the HCQ.<sup>17</sup> Moreover, good criterion validity was supported by correlations between CHCQ total score and SHAI total score. These results were consistent with previous studies and provided empirical evidence for the cognitive behavioral theory of HA.<sup>21</sup> In the reliability analyses, internal consistency and test-retest reliability were tested. As with the original version of the HCQ, the CHCQ exhibited adequate internal consistency, with alpha coefficient of 0.849 for total and 0.753–0.841 for 4 subscales. The stability of the CHCQ was also satisfactory, with ICC values of 0.762 for total and 0.626–0.683 for subscales after a 4-week interval. In light of the above information, the Chinese version of the HCQ is an appropriate tool for measuring HA-related core cognitions among Chinese individuals.

In Hadjistavropoulos's study, cognitions involved in HA indeed differed between individuals with and without medical conditions.<sup>17</sup> This was reflected by 1) the predictor variables for HA and poor responses to reassurance being different in the 2 groups and 2) measurement and structural invariances not being established in the study. Thus, we did further comparisons of these 4 core cognitions among the medical condition and nonmedical condition samples. Inconsistent with results reported previously, both measurement and structural invariances were verified in our study. This result may be attributed to the sample selection. Participants in the current study were college students who may be healthier than the general population, and the medical conditions of students were mainly mild and chronic, such as rhinitis (30.14%), gastrointestinal disease (22.97%), and so on. This suggested that not only the medical conditions but also the severity of disease need to be considered in future research. Another explanation may be the effect of culture on cognitions about health which needs further research and exploration. On the basis of measurement and structural invariance, the comparison of obvious mean can be the representative of latent construct. The independent samples *t*-test results of the CHCQ between the 2 samples indicated that students with medical conditions scored significantly higher on the likelihood-of-illness subscale. Consistent with previous research,<sup>17</sup> this indicated that people suffering from disease may consider themselves more susceptible. This result needs to be taken seriously in future measurement and intervention of patients with high HA.



Although providing some novel information on understanding the cognitive behavioral model of HA, there are some limitations to be taken into account. First, the samples in this study are college students, most of them young females in good health. Further studies based on clinical samples are needed to replicate the factor structure and study findings. Second, there are few tools assessing HA-related cognitions for Chinese, so SHAI was the only external criterion chosen in this study. For better understanding the phenomenon of HA and the mechanism behind it, future studies should develop more measurements with good psychometric properties to evaluate the related construct in the Chinese context.

In conclusion, the CHCQ was confirmed to have sufficient reliability and validity in a sample of Chinese college students. More importantly, this research can broaden our understanding of the core cognitions of HA and identify some differences in these dysfunctional beliefs among individuals with or without medical conditions. The CHCQ will be an appropriate tool to measure HA-related core cognitions and a promising tool for further exploration of the mechanism of HA in a Chinese population.

## Ethical approval

The Institutional Review Board (IRB) of the Third Xiangya Hospital in Hunan approved the study (2017-S208).

## Acknowledgments

We would like to thank Dr. Hadjistavropoulos for her permission to translate the HCQ into Chinese and useful suggestions during the revision process. This research was supported by the Science and Technology Innovation Plan of Hunan Province, China (grant no. 2017SK50127).

## Author contributions

All authors contributed to the data analysis, drafting or revising the article, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

## Disclosure

The authors report no conflicts of interests in this work.

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