

Validation of the 4-Item and 10-Item Uncertainty Stress Scale in a Community-Based Sample of Chinese Adults

Dan Wu¹, Tingzhong Yang², Fabian Herold³, Daniel L Hall^{4,5}, Notger Mueller³, Albert Yeung^{4,6}, Arthur F Kramer^{7,8}, Tianyou Guo¹, Liye Zou¹

¹Body-Brian-Mind Laboratory, School of Psychology/The Shenzhen Humanities & Social Sciences Key Research Bases of the Center for Mental Health, Shenzhen University, Shenzhen, 518060, People's Republic of China; ²Women's Hospital/Center for Tobacco Control Research, Zhejiang University School of Medicine, Hangzhou, 310058, People's Republic of China; ³Research Group Degenerative and Chronic Diseases, Movement, Faculty of Health Sciences Brandenburg, University of Potsdam, Potsdam, 14476, Germany; ⁴Department of Psychiatry, Harvard Medical School, Boston, MA, 02115, USA; ⁵Mongan Institute, Massachusetts General Hospital, Boston, MA, 02114, USA; ⁶Depression Clinical and Research Program, Massachusetts General Hospital, Boston, MA, 02114, USA; ⁷Beckman Institute, University of Illinois, Urbana, IL, 61801, USA; ⁸Center for Cognitive & Brain Health, Northeastern University, Boston, MA, 02115, USA

Correspondence: Tianyou Guo, Body-Brian-Mind Laboratory, School of Psychology/The Shenzhen Humanities & Social Sciences Key Research Bases of the Center for Mental Health, Shenzhen University, Shenzhen, Guangdong, 518060, People's Republic of China, Email gtyou168@126.com

Purpose: The objectives of this study were to examine the psychometric properties of the Uncertainty Stress Scale (USS) and to compare the usefulness of two versions of the scale (USS-4 and USS-10) among a large community-based sample of Chinese adults.

Participants and Methods: The Uncertainty Stress Scale was validated in 904 community residents (mean age: 32.71 ± 10.99; male: 41.7%) through an online survey conducted in February 2020. Psychometric properties of reliability (Cronbach's alpha), construct validity (confirmatory factor analysis), and criterion validity (correlation and ROC curve analyses) were evaluated using established benchmarks. To validate the USS, we used the Chinese version of the Perceived Stress Scale (CPSS). In addition, sensitivity, specificity, and suitable cutoff values of the two versions of USS were determined.

Results: Both versions of the USS had high internal consistency (USS-10: 0.941; USS-4: 0.851). Confirmatory factor analyses supported a one-factor structure for both measures. Both USS-4 and USS-10 scores were significantly positively correlated with CPSS scores, indicating acceptable criterion validity.

Conclusion: The findings of the current study confirmed that the psychometric properties of two Chinese versions of USS are acceptable. Furthermore, the 4-item USS was as effective as the 10-item USS for the measurement of uncertainty stress in our community-based sample of Chinese adults suggesting that the USS-4 is a time-efficient alternative to the USS-10 which can be used when the circumstances require a time-efficient instrument (eg, in epidemiological studies with a large test battery).

Keywords: Validation, Uncertainty Stress Scale, Community-based Sample

Introduction

Uncertainty is an increasingly common feature in modern society, where individuals often lacked of sureness about something (like life-threatening and fearful COVID-19, especially at the starting stage) in their daily lives.^{1,2} A considerable amount of empirical evidence supports the notion that uncertainty is a powerful stressor that is strongly related to physical, behavioral, and mental health.²⁻⁵ Therefore, it is of great importance to appropriately measure uncertainty in order to better understand this psychological construct and to develop efficient interventions (eg, mindfulness and exercise) to effectively cope with its associated negative consequence.^{3,6}

The literature dealing with instruments to operationalize and measure uncertainty has mainly focused on the clinical context of uncertainty in illness or assessed personality traits related to the intolerance of uncertainty.^{3,7-11} For clinical research, the Mishel Uncertainty in Illness Scale (MUIS) was developed to measure illness uncertainty in

hospitalized individuals; the original scale was later modified to measure uncertainty associated with living with chronic illness and included subscales evaluating ambiguity, complexity, unpredictability, and lack of information across the disease trajectory.^{9,12} For non-clinical research, the Intolerance of Uncertainty Scale (IUS) was initially developed in the French language to measure an individual's emotional, cognitive, and behavioral reactions to ambiguous and uncertain situations and consisted of 27 items with a five-factor structure.¹³ A stable 12-item IUS was later created which consisted of two factors: prospective anxiety and inhibitory anxiety.^{7,14–16} In addition, the Uncertainty Response Scale (URS) is another psychometric instrument used to assess emotional uncertainty, desire for change, and cognitive uncertainty.⁸ Taken together, there are several instruments to quantify the construct of uncertainty that primarily focus on the cognitive aspects of uncertainty (ie, MUIS), one's ability to tolerate it (ie, IUS), or a combination of the former two factors (ie, URS). However, existing instruments do not explicitly assess *stress* stemming from uncertainty, restricting our ability to assess and intervene in a key clinical and theoretical outcome of living with uncertainty.

The assessment of uncertainty stress is of vital importance since it is associated with negative clinical and social outcomes. Considering that uncertainty is recognized as a major stressor, uncertainty stress has been defined as “perceived stress generated by uncertain events or situations”.^{17–19} According to previous studies, uncertainty stress is associated with deliberate self-harm,⁴ unintentional injuries,²⁰ suicidal intentions,²¹ mental disorders,²² problematic alcohol use,²³ internet addiction,²⁴ late bedtimes, worse self-rated health, and poor academic performance²⁵ among college students. Moreover, uncertainty stress was observed to be positively associated with disease fear and negatively associated with self-efficacy and prevention behaviors during the COVID-19 pandemic among the general community population.²⁶ Considering the above-mentioned findings, research on uncertainty stress and its appropriate measurement is of great interest and significance for public health. Nevertheless, very few studies directly assessed perceived uncertainty from the perspective of stress tolerance. An exception is the Hilton Uncertainty Stress Scale, which was developed to assess the stress, threat, and positive feelings caused by an uncertain state.²⁷ However, this scale focusses on the assessment of uncertainty in illness-related situations.

Nevertheless, a specific tool to quantify uncertainty stress in non-clinical situations rather than illness-related situations was proposed in 2002.¹⁷ Based on the pervasiveness of uncertainty in the general society, Yang et al designed and developed the original 4-item and 10-item Chinese versions of the Uncertainty Stress Scale.^{19–21} The Chinese version of the USS is designed as a measure of uncertainty stress in the social context and thus supplements available instruments that have been designed and evaluated to measure uncertainty stress in clinical situations such as acute and chronic illnesses. The USS-4 comprises four items measuring current life uncertainty, social change uncertainty, goal achievement uncertainty, and social value uncertainty. The original version of the USS-4 shows good reliability and validity and has been successfully and widely used in previous studies.^{4,21,26,28} Given that the short item scale might influence the stability of the application, Yang et al expanded the USS to 10 items assessing the level of uncertainty in social situations and the abilities to cope with such situations.¹⁹ This USS-10 has already been applied in a study.²⁹

Although the reliability and validity of the USS were initially tested, the validity of the USS-10 has only been examined in a Chinese student population, and thus it remains unknown whether these findings can be generalized to other populations. To address this gap in the literature, we conducted a comprehensive validation for both the USS-4 and the USS-10 in a large cohort of community residents ($n = 904$) covering a wide age range (18 to 72 years). In this context, we hypothesized that (1) the USS has good psychometric properties in the community-dwelling sample, and (2) the USS-4 and USS-10 have comparable indices of reliability and validity.

Methods

Participants and Sampling Procedure

A cross-sectional survey utilizing a convenience sampling method was conducted online in February 2020. Twenty psychology students from one university in the Guangdong province were recruited as research assistants to distribute the survey links among the adults in their communities using social media (eg, WeChat groups, QQ groups, and other major social networking platforms). The survey was based on the Wenjuanxing Platform (<https://www.wjx.cn/app/survey.aspx>).

In this study, adults older than 18 years of age who lived in the local community for the past 12 months were included. Of 1148 community residents who were contacted online, 1093 (95.2%) agreed to participate, and 904 (78.7%) of them completed the questionnaires. Participants took approximately 10 minutes to complete the questionnaires. The study protocol was approved by the Ethics Committee of Shenzhen University (Ethics Approval Number 2020009), and complies with ethical principles stated in the latest version of the Declaration of Helsinki. All participants provided written consent prior to the administration of the questionnaires.

Measures

Demographic Characteristics

Demographic data including the date of birth, gender, place of residence, ethnicity, marital status, educational attainment, occupation, and per capita annual family income were collected.

Uncertainty Stress Scale

Uncertainty stress was measured by the 4-item and 10-item Chinese Uncertainty Stress Scale (USS), which was developed by Yang et al.^{4,17–19} The USS assesses the perception of stress in response to uncertain situations (eg, “life is impalpable, and fate is unpredictable”; “unexpected things often happen in life”; and “the world is changing too fast and I cannot keep up”). Items are rated on a 5-point Likert-type scale with scores ranging from 1 (very little stress) to 5 (extremely stressful). Items are summed to obtain a total score, with higher scores indicating a greater level of uncertainty stress. The Cronbach’s α coefficient for the USS-4 and USS-10 in this sample was 0.941 and 0.851, respectively.

Perceived Stress Scale, Chinese Version (CPSS)

Perceived stress was measured by the Chinese version of the 8-item Perceived Stress Scale (CPSS).^{18,30,31} This scale consists of eight items that assessed the perception of stress during the month prior to the survey (eg, “How often have you been upset because of something that happened unexpectedly?”; “How often have you felt that you were unable to control the important things in your life?”; and “How often have you felt nervous and stressed?”). The items were rated on a 5-point Likert type scale and ranged from 1 (never) to 5 (very often). The item scores were summed to yield a total stress score. A higher total score reflects a greater level of perceived stress.^{18,30,31} The internal reliability of the CPSS in this sample, measured by Cronbach’s α , was 0.805.

Data Analysis

Data were entered into Microsoft Excel and then imported into SPSS (version 22.0) for statistical analysis. A descriptive analysis was used to determine the sample distribution. The total score and item scores of the scales were described as the mean and standard deviation (SD). t-tests and one-way analysis of variance (ANOVA) were used to examine the difference in uncertainty stress by comparing the demographic subgroups. To determine reliability, internal consistency was examined using Cronbach’s alpha coefficients. Alpha values were described as excellent (0.93–0.94), strong (0.91–0.93), reliable (0.84–0.90), and robust (0.81–0.83).³² An alpha value of 0.70 or above indicated an acceptable reliability.^{32,33} To test for validity, the factor structure of the two USS versions (USS-4 and USS-10) was examined by confirmatory factor analysis (CFA) of the 904 community subjects who completed both versions of the USS. To validate that the USS-4 and USS-10 items were inter-correlated and applicable to factor analysis procedures, Bartlett’s test of sphericity was conducted. Principal component analysis (PCA) was performed to explore the factor structure. To assess the fit of the one-factor CFA model, five indicators from the Structural Equation Model analysis were calculated, including the comparative fit index (CFI), the Tucker–Lewis index (TLI), the goodness-of-fit index (GFI), the root mean square error of approximation (RMSEA), and the standardized root-mean-square residual (SRMR). A CFI or TLI score of 0.97 or more indicated good fit and above 0.95 indicated acceptable fit.³⁴ A GFI score above 0.95 indicated a good fit and above 0.90 indicated an acceptable fit. Both RMSEA and SRMR scores below 0.05 indicated a good fit, and an RMSEA below 0.08, as well as an SRMR below 0.10 indicated an acceptable fit.³⁴ To assess the criterion validity and to predict perceived stress by the USS, correlation analysis and receiver operating characteristic curve (ROC Curve) analysis were performed. The area under the ROC curve (AUC) is widely recognized as the measure of a diagnostic test’s discriminatory power. An AUC value of 0.5 or above indicates that it has a sufficient discriminative value.³⁵

Results

Sample Characteristics

The 904 community-based residents who participated in the current study included 41.7% males and 58.3% females. The mean age was 32.71 (SD: 10.99) years. More detailed information on the sociodemographic characteristics of the participants is presented in Table 1.

Both the USS-10 and USS-4 had similar distributions across sociodemographic factors. Omnibus tests revealed significant differences in several demographic characteristics (age, place of residence, marital status, occupation, and household annual income). Uncertainty stress was highest among participants who were younger, rural, divorced or widowed, work in commerce/service/operations, or earn 60,000 RMB or less annually. Males had a higher uncertainty stress score than females on the USS-10 but not on the USS-4.

Table 1 Overview of the Demographic Characteristics of the Sample

Variables	N	%	Item Mean (95% C.I.)	
			USS-10	USS-4
Age			F=6.03, p<0.001**	F=4.04, p=0.003**
<20	25	2.8	3.16(2.78–3.54)	3.18(2.77–3.59)
20–24	230	25.4	2.85(2.72–2.97)	2.86(2.73–2.99)
25–29	199	22.0	2.79(2.66–2.93)	2.78(2.65–2.92)
30–39	208	23.0	2.67(2.55–2.80)	2.67(2.54–2.80)
40+	242	26.8	2.51(2.40–2.62)	2.59(2.47–2.71)
Gender			t=2.51, p=0.012*	t=1.83, p=0.068
Male	377	41.7	2.81(2.71–2.91)	2.80(2.70–2.90)
Female	527	58.3	2.65(2.57–2.73)	2.68(2.60–2.76)
Place of residence			t=-4.73, p<0.001**	t=-4.59, p<0.001**
Urban	652	72.2	2.62(2.55–2.69)	2.64(2.57–2.72)
Rural	251	27.8	2.95(2.83–3.06)	2.97(2.85–3.09)
Ethnicity			t=-0.58, p=0.565	t=0.13, p=0.900
Han	871	96.3	2.71(2.65–2.77)	2.73(2.67–2.80)
Minority	33	3.7	2.81(2.50–3.12)	2.71(2.39–3.03)
Marital status			F=5.48, p=0.004**	F=4.97, p=0.007**
Unmarried	369	40.8	2.80(2.70–2.89)	2.82(2.72–2.92)
Married	507	56.1	2.63(2.55–2.71)	2.65(2.57–2.74)
Divorced/widowed	28	3.1	3.07(2.70–3.44)	3.08(2.71–3.46)
Education			F=1.84, p=0.138	F=2.74, p=0.042*
Junior high school or less	160	17.7	2.75(2.61–2.89)	2.80(2.66–2.96)
High school	159	17.6	2.84(2.69–3.00)	2.89(2.72–3.05)
Junior college	157	17.4	2.73(2.58–2.88)	2.73(2.58–2.89)
College or higher	428	47.3	2.65(2.56–2.73)	2.65(2.56–2.74)
Occupation			F=3.11, p=0.026*	F=4.00, p=0.008**
Public official/professionals	257	28.4	2.58(2.46–2.70)	2.57(2.45–2.69)
Enterprise personnel	238	26.3	2.77(2.65–2.88)	2.80(2.68–2.92)
Commerce/service/operations	215	23.8	2.83(2.71–2.95)	2.85(2.73–2.98)
Others	194	21.5	2.69(2.55–2.83)	2.73(2.59–2.88)
Household annual income (RMB)			F=9.82, p<0.001**	F=8.61, p<0.001**
Less than 20,000	128	14.2	2.82(2.65–2.99)	2.82(2.64–3.00)
20,000–60,000	357	39.5	2.83(2.73–2.92)	2.85(2.75–2.95)
60,000–100,000	226	25.0	2.75(2.64–2.85)	2.76(2.65–2.87)
More than 100,000	193	21.3	2.40(2.26–2.54)	2.43(2.28–2.57)

Notes: **p<0.01; *p<0.05.

Reliability

In this study, the internal consistency of the two USS versions can be rated as good, based on Cronbach's alpha coefficients of 0.941 in USS-10 and 0.851 in USS-4. For the USS-10, the Cronbach's alpha values ranged from 0.934 to 0.937 when any one of the items was removed. For the USS-4, the Cronbach's alpha values ranged from 0.795 to 0.819 if any one of the items was deleted. The composite reliability (CR) was also estimated to reflect the internal responsiveness. CR for the USS-10 and USS-4 were 0.950 and 0.900, respectively.

The total score and item mean scores for USS-10 and USS-4 are displayed in Table 2. Intercorrelations between the USS-10 items ranged from 0.548 to 0.783 suggesting acceptable homogeneity reliability (shown in Table 3). In Table 4, we present item-total correlations ranging from 0.768 to 0.836 in USS-10 and ranging from 0.816 to 0.852 in USS-4.

Table 2 Overview of the Results for Validity and Reliability Analysis for USS-4 and USS-10

Variables	Item	Reliability		Validity		Mean (SD)	
		Cronbach's Alpha	CR	KMO	AVE	Total Score	Item Score
USS-10	10	0.941	0.950	0.954	0.655	27.14(9.38)	2.71(0.94)
USS-4	4	0.851	0.900	0.815	0.692	10.93(3.89)	2.73(0.97)

Abbreviations: USS, Uncertainty Stress Scale; CR, composite reliability; AVE, average variance extracted; KMO, Kaiser-Meyer-Olkin.

Table 3 Overview of the Intercorrelations Between Uncertainty Stress Scale Items

Item	1	2	3	4	5	6	7	8	9	10
1	1									
2	0.650**	1								
3	0.560**	0.606**	1							
4	0.586**	0.648**	0.619**	1						
5	0.579**	0.580**	0.643**	0.639**	1					
6	0.587**	0.619**	0.548**	0.591**	0.614**	1				
7	0.585**	0.637**	0.613**	0.608**	0.633**	0.741**	1			
8	0.550**	0.603**	0.588**	0.600**	0.582**	0.585**	0.640**	1		
9	0.579**	0.612**	0.626**	0.618**	0.608**	0.585**	0.628**	0.667**	1	
10	0.552**	0.627**	0.661**	0.615**	0.642**	0.619**	0.643**	0.681**	0.738**	1

Note: **<0.01.

Table 4 Overview of the Factor Loadings and Reliability Analysis for the 10-Item Uncertainty Stress Scale (USS-10)

Item	Factor Loadings	Item-Total Correlation	Cronbach's α if Item Deleted	Item Content (English; Items Were Tested in Chinese)
1	0.767	0.768	0.937	Life is impalpable, and fate is unpredictable
2	0.813	0.812	0.935	Feeling things are not going well
3	0.798	0.800	0.936	Social values are chaotic, and I am experiencing confusion
4	0.806	0.806	0.935	Unexpected things often happen in life
5	0.806	0.806	0.935	The world is changing too fast and I cannot keep up
6	0.802	0.804	0.936	I do not know how to reach my own goals
7	0.833	0.834	0.934	Confused about the future
8	0.803	0.802	0.936	Many people ignore the rules and I do not know what to do
9	0.825	0.822	0.934	Inability to handle important changes in life
10	0.840	0.837	0.934	Feeling there are no rules and paths to follow

Notes: Adapted with permission from Yang T. Health Research: Social and Behavioral Theory and Methods. Beijing: People's Medical Publishing House; 2018.¹⁹

Construct Validity

The one-factor structure of the USS-4 and USS-10 was supported by the PCA. Prior to the PCA, the Kaiser–Meyer–Olkin measure of sampling adequacy was 0.954 and 0.815 in USS-10 and USS-4. The Bartlett’s test of sphericity was significant for both USS-10 and USS-4 ($P < 0.001$), suggesting that the items were correlated and fit for factor analysis.

Convergent Validity

Table 4 demonstrates the loadings of ten items on a single factor, with loading values ranging from 0.767 to 0.840. Table 5 shows the factor loading for each item of USS-4 ranged from 0.817 to 0.856. The average variance extracted (AVE) was used to evaluate the convergent validity. The one-single factor in USS-4 accounted for 69.2% of the variance, and the value of AVE in USS-10 was 0.655, which suggested that the one-single factor accounted for 65.5% of the total variance.

Factor Structure Model Fit

As shown in Table 6, the unidimensional model fits the data quite well. Goodness-of-fit results indicated a good to excellent model fit for both USS-4 and USS-10. Specifically, CFI (0.99), TLI (0.98), and GFI (0.99) for USS-4 were all higher than those of USS-10 (0.96, 0.95, and 0.94, respectively). RMSEA (0.08) and SRMR (0.03) values for USS-4 were lower than those of USS-10 (0.09 and 0.02, respectively).

Criterion Validity

External Responsiveness

As shown in Table 7, Spearman correlations indicated that USS-10 and USS-4 scores are both significantly correlated with CPSS-8 scores, with correlation coefficients of 0.497 and 0.475, respectively.

Table 5 Overview of the Factor Loadings and Reliability Analysis for 4-Item Uncertainty Stress Scale (USS-4)

Item	Factor Loadings	Item-Total Correlation	Cronbach’s α if Item Deleted	Item Content (English; Items Were Tested in Chinese)
1	0.817	0.816	0.819	Life is impalpable, and fate is unpredictable
3	0.827	0.831	0.814	Social values are chaotic, and I am experiencing confusion
5	0.856	0.852	0.795	The world is changing too fast and I cannot keep up
6	0.826	0.828	0.815	I do not know how to reach my own goals

Notes: Adapted with permission from Yang T. Health Research: Social and Behavioral Theory and Methods. Beijing: People’s Medical Publishing House; 2018.¹⁹

Table 6 Overview of the Goodness-of-Fit Indices of USS-10 and USS-4

	CFI	TLI	GFI	RMSEA	SRMR
USS-10	0.96	0.95	0.94	0.09	0.03
USS-4	0.99	0.98	0.99	0.08	0.02

Abbreviations: CFI, comparative fit index; TLI, Tucker–Lewis index; GFI, goodness of fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean-square residual.

Table 7 Overview of the Results of the Correlation Analysis Between Different Scale Scores

Variables	USS-10	USS-4	CPSS-8
USS-10	1		
USS-4	0.956**	1	
CPSS-8	0.497**	0.475**	1

Note: **<0.01.

Abbreviations: USS, Uncertainty Stress Scale; CPSS, Chinese Perceived Stress Scale.

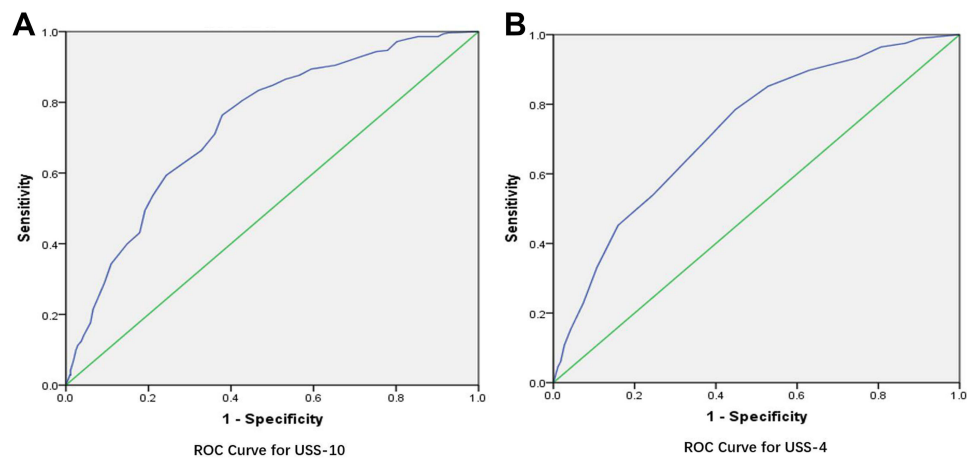


Figure 1 ROC curve analysis for predicting severe perceived stress (>3) (A) ROC curve for USS-10; (B) ROC curve for USS-4.

ROC Analysis

The area under the ROC curve in [Figure 1](#) ranged from 0.725 to 0.738, indicating that both versions of the USS had similar effectiveness as the perceived stress screening tool. To determine how well the USS performed to identify individuals with high uncertainty stress, sensitivity and specificity were further evaluated by ROC curve analysis. The sensitivity and specificity of USS-10 and USS-4 for predicting severe perceived stress are shown in [Table 8](#).

Discussion

The results suggest that the USS-10 and USS-4 have an acceptable reliability, construct validity, and criterion validity which provides convincing evidence that both versions of the USS are reliable and valid self-report measures to assess uncertainty stress in community-based samples of Chinese adults.

It is worth noting that the mean score of uncertainty stress measured by the USS-4 among Chinese urban residents in 2002 was 2.04 (SD: 0.85) and that it was 2.74 (SD: 0.89) when assessed by the USS-10 in 2016 among college students.^{18,19} The mean scores of uncertainty stress observed in the current study in the community population from the USS-10 and the USS-4 were 2.71 (SD: 0.94) and 2.73 (SD: 0.97), respectively. Since the original USS-4 was developed approximately two decades ago, the current findings of our study suggest that among the general population the level of uncertainty stress has considerably increased. These data implied that uncertainty pervades our daily lives during the transformation period of the contemporary society and supported the notion that severe uncertainty stress may become a major and global public health issue. Whether this increase is caused by a general rise in uncertainty stress, is specifically related to the current COVID-19 pandemic, or is a result of both should be assessed in more detail in future studies. However, there is some evidence that the COVID-19 pandemic has increased the level of uncertainty stress, and, in consequence, has fostered and/or exacerbated the occurrence of negative health events. For instance, one study reported that during the COVID-19 pandemic, healthcare workers with higher levels of health-related uncertainty suffered from more pronounced symptoms of anxiety, depression, and loneliness.³⁶ In addition, the COVID-19-related increase in the level of uncertainty stress has also been associated with poorer sleep status.³⁷ Although the above-presented evidence suggests that the COVID-19 pandemic is a major driver of uncertainty stress

Table 8 Overview of the Results of ROC Curve Analysis

Scale	AUC	Standard Error	p	95% C.I.	Cut Off Value	Sensitivity	Specificity	Youden's Index
USS-10→PS	0.738	0.017	0.000	0.704–0.772	2.750	0.763	0.622	0.385
USS-4→PS	0.725	0.018	0.000	0.690–0.759	2.625	0.784	0.552	0.337

Abbreviations: USS, Uncertainty Stress Scale; PS, perceived stress; AUC, area under the curve.

worsening physical and mental health,^{1,6,36,37} future longitudinal studies assessing how uncertainty stress changes over time, accounting for potential future waves of COVID-19 spread, are needed to investigate this phenomenon in more detail.

Moreover, the findings of the current study highlighted that uncertainty stress is greater among younger adults, rural residents, divorced/widowed or unmarried adults, and adults with a lower socioeconomic level. Based on the negative health consequences of uncertainty stress, more attention should be paid to these vulnerable and socially disadvantaged populations. Given that the availability and psychometric evaluation of instruments to assess uncertainty stress is currently limited, the development, validation, and cross-cultural application of the USS are urgent for both research and practical application.

Reliability

Internal consistency Cronbach's alpha values were greater than 0.80, which is considered as a good reliability for research purposes.³⁸ Cronbach's alpha coefficients for the USS-4 and the USS-10 originally measured by Yang et al were 0.821 and 0.925, respectively.^{18,19} With a sample of 4446 medical students, the internal consistency of the USS-4 was 0.81.^{4,21} For a sample of 11,942 Chinese college students, Cronbach's alpha value for the USS-4 was 0.79.^{5,23,28,39} A panel study with 102 Chinese residents also exhibited a Cronbach's alpha of 0.89 for USS-4.²⁶

Similar to the previous studies conducted in China, the Cronbach's alpha values of the USS-10 and the USS-4 in this study were both greater than 0.85. Thus, our findings complement the available literature as they suggest that the USS-10 and USS-4 have a high internal consistency for the community population as well. Specifically, the alpha coefficient of the USS-10 was 0.941, suggesting excellent reliability which is better than that of the USS-4. Moreover, composite reliability with a value of 0.95 for USS-10 and 0.90 for USS-4 was higher than 0.70, which is generally considered excellent in behavioral research.⁴⁰ Given the alpha coefficient increases with the instrument's length,³⁴ the USS-4 can still be considered a reliable tool to assess uncertainty stress.

Validity

Construct Validity

The findings of the CFA in this study paralleled the original studies during the development of the USS.^{18,19} Specifically, the results for all factor loading values were greater than 0.75, revealing a unidimensional structure with strong loadings. The AVEs for both the USS-10 and the USS-4 were higher than 0.65 indicating a good convergent validity. Furthermore, values of CFI and TLI above 0.97, GFI above 0.95, and RMSEA and SRMR below 0.05 indicated a good fit of the data to the one-factor model.³⁴ RMSEA for the USS-10 (0.09) was slightly greater than the recommended acceptable fit cutoff (0.08), indicating that it was at the threshold of acceptability. Considering the results from SEM, the single-factor structure for the two versions of the USS was confirmed, whereas the USS-4 has a superior model fit as compared to the USS-10. Similar to previous studies, a shortened version of the scale would exhibit superior factorial stability while maintaining the original measure's high reliability and construct validity.¹⁴ To our knowledge, this study is the first to investigate the goodness-of-fit of the USS in a large community-based sample of Chinese adults, which provides some evidence for the applicability of the USS in the general population.

Criterion Validity

In comparison with the perceived stress scale (PSS-8), both the USS-4 and the USS-10 showed acceptable sensitivity and specificity. Notably, the USS-10 demonstrated a higher diagnostic accuracy for perceived stress, with an AUC value of 0.738 as compared to the USS-4. The PSS is one of the most frequently used instruments to assess stress in chronic conditions and situations by asking whether people's lives seem to be unpredictable and uncontrollable.³⁰ The PSS suggested an acceptable criterion standard for screening the uncertainty stress. Furthermore, both versions of the USS score were significantly positively correlated with the CPSS-8 score, indicating that they had good concurrent validity.

Implications

The findings from the current study have some implications for research and policy. Considering the findings of our study in conjunction with the existing literature, our study highlights that both the USS-4 and USS-10 are reliable and valid

instruments that can be used in a variety of populations and settings (ie, from college students to the general community setting). Although the USS-10 has better internal consistency and criterion validity as compared to the USS-4, the data of reliability and construct validity supported that the overall performance of the USS-4 is almost equivalent to that of the USS-10. The shorter version (USS-4) provides the advantage that it is extremely easy to administer, simple to understand, and requires a minimum amount of time to be completed making it well situated for assessments in which time is a critical factor (eg, large-scale epidemiological studies with a large test battery). Thus, our findings support the notion that the USS-4 is an economical alternative to the USS-10 and can be used when the circumstances require such an application.

With respect to policy, we advocate that policymakers pay more attention to the phenomenon of uncertainty stress as it is linked to negative health consequences. More specifically, a regular monitoring by appropriate measurement instruments and the education for uncertainty stress as well as potential coping methods need to be placed on the agenda. In this context, we hope that both the USS-4 and USS-10 are seen as a useful tool for researchers and practitioners interested in the mental health promotion concerning the uncertainty stress.

Limitations

The study has some limitations that need to be acknowledged. Firstly, as we used a convenience sampling method, the generalizability of our findings is somewhat limited. However, the large sample size and geographic diversity of our community-based sample which consists of individuals with different sociodemographic backgrounds mirror, at least partly, the general Chinese adult population. Secondly, self-reported measures can be confounded by the different sources of bias such as the social desirability bias and the recall bias which, in turn, might have influenced the current findings. Thirdly, both the USS-4 and USS-10 were only applied and evaluated in adults living in mainland China but not in overseas Chinese populations. In addition, the validation of the Chinese version of the USS-4 and USS-8 did not comprise individuals of younger age groups such as children and adolescents. The previous points might limit the generalizability of our findings to some extent. Fourthly, there is no non-self-reported (objective) instrument available to directly quantify the level of uncertainty stress. Thus, future research is needed to investigate the relationships between subjective markers (ie, USS-10 and USS-4) and objective markers of uncertainty stress. Finally, because this survey was cross-sectional, test–retest reliability and sensitivity to change over time were not assessed.

Conclusion

Based on the findings from our community-based study which includes a large sample of Chinese adults and which indicates that both scales (ie, USS-10 and USS-4) have appropriate psychometric properties, the current study provided robust evidence that both the USS-10 and USS-4 are well suited to study uncertainty stress in the general and adult Chinese population.

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Disclosure

The authors report no conflicts of interest in this work.

References

1. Chi X, Chen S, Chen Y, et al. Psychometric evaluation of the fear of COVID-19 scale among Chinese population. *Int J Ment Health Addict*. 2022;20(2):1273–1288. doi:10.1007/s11469-020-00441-7
2. Greco V, Roger D. Uncertainty, stress, and health. *Pers Individ Differ*. 2003;34(6):1057–1068. doi:10.1016/S0191-8869(02)00091-0
3. Mishel MH. Perceived uncertainty and stress in illness. *Res Nurs Health*. 1984;7(3):163–171. doi:10.1002/nur.4770070304
4. Wu D, Rockett IR, Yang T, Feng X, Jiang S, Yu L. Deliberate self-harm among Chinese medical students: a population-based study. *J Affect Disord*. 2016;202:137–144. doi:10.1016/j.jad.2016.05.030
5. Yang T, Jiang S, Yu L, Cottrell RR, Si Q. Life stress, uncertainty stress and self-reported illness: a representative nationwide study of Chinese students. *J Public Health*. 2018;26(2):205–209. doi:10.1007/s10389-017-0837-9

6. Chen P, Mao L, Nassis GP, Harmer P, Ainsworth BE, Li F. Coronavirus disease (COVID-19): the need to maintain regular physical activity while taking precautions. *J Sport Health Sci.* 2020;9(2):103–104. doi:10.1016/j.jshs.2020.02.001
7. Buhr K, Dugas MJ. The intolerance of uncertainty scale: psychometric properties of the English version. *Behav Res Ther.* 2002;40(8):931–945. doi:10.1016/S0005-7967(01)00092-4
8. Greco V, Roger D. Coping with uncertainty: the construction and validation of a new measure. *Pers Individ Differ.* 2001;31(4):519–534. doi:10.1016/S0191-8869(00)00156-2
9. Mishel MH. The measurement of uncertainty in illness. *Nurs Res.* 1981;30(5):258–263. doi:10.1097/00006199-198109000-00002
10. Sorrentino RM, Short JAC, Raynor JO. Uncertainty orientation: implications for affective and cognitive views of achievement behavior. *J Pers Soc Psychol.* 1984;46(1):189–206. doi:10.1037/0022-3514.46.1.189
11. Yarcheski A. Uncertainty in illness and the future. *Western J of Nurs Res.* 1988;10(4):401–413. doi:10.1177/019394598801000404
12. Mishel MH. Reconceptualization of the uncertainty in illness theory. *J Nurs Scholarship.* 1990;22(4):256–262. doi:10.1111/j.1547-5069.1990.tb00225.x
13. Freeston MH, Rhéaume J, Letarte H, Dugas MJ, Ladouceur R. Why do people worry? *Pers Individ Differ.* 1994;17(6):791–802. doi:10.1016/0191-8869(94)90048-5
14. Carleton RN, Norton MAPJ, Asmundson GJG. Fearing the unknown: a short version of the intolerance of uncertainty scale. *J Anxiety Disord.* 2007;21(1):105–117. doi:10.1016/j.janxdis.2006.03.014
15. Khawaja NG, Yu LNH. A comparison of the 27-item and 12-item intolerance of uncertainty scales. *Clin Psychol.* 2010;14(3):97–106. doi:10.1080/13284207.2010.502542
16. Hale W, Richmond M, Bennett J, et al. Resolving uncertainty about the intolerance of uncertainty scale–12: application of modern psychometric strategies. *J Pers Assess.* 2016;98(2):200–208. doi:10.1080/00223891.2015.1070355
17. Yang T. Study on psychological stress of urban population in social transformation. *Chin J Epid.* 2022;23(6):473–475. doi:10.3760/j.issn:0254-6450.2002.06.017
18. Yang T, Huang J, Wu X, Chen B, Li L. A study of stress among the urban residents in social transition. *Chin J Behav Med Sci.* 2007;16(4):331–333. doi:10.3760/cma.j.issn.1674-6554.2007.04.017
19. Yang T. *Health Research: Social and Behavioral Theory and Methods.* Beijing: People's Medical Publishing House; 2018.
20. Peng S, Yang T, Rockett IR. Life stress and uncertainty stress: which is more associated with unintentional injury? *Psychol Health Med.* 2020;25(6):774–780. doi:10.1080/13548506.2019.1687913
21. Wu D, Yang T, Rockett IR, Yu L, Peng S, Jiang S. Uncertainty stress, social capital, and suicidal ideation among Chinese medical students: findings from a 22-university survey. *J Health Psychol.* 2021;26(2):214–225. doi:10.1177/1359105318805820
22. Wu D, Yu L, Yang T, et al. The impacts of uncertainty stress on mental disorders of Chinese college students: evidence from a nationwide study. *Front Psychol.* 2020;243. doi:10.3389/fpsyg.2020.00243.
23. Yang T, Barnett R, Peng S, Yu L, Zhang C, Zhang W. Individual and regional factors affecting stress and problem alcohol use: a representative nationwide study of China. *Health Place.* 2018;51:19–27. doi:10.1016/j.healthplace.2018.02.008
24. Yang Q, Wu Z, Yang X, Jiang S, Wu D, Oliffe JL. Associations between uncertainty stress, life stress and internet addiction among medical students. *Front Public Health.* 2021;(2021):9. doi:10.3389/fpubh.2021.809484
25. Wu D, Yang T. Late bedtime, uncertainty stress among Chinese college students: impact on academic performance and self-rated health. *Psychol Health Med.* 2022;1–12. doi:10.1080/13548506.2022.2067337
26. Peng S, Yang XY, Yang T, Zhang W, Cottrell RR. Uncertainty stress, and its impact on disease fear and prevention behavior during the COVID-19 epidemic in China: a panel study. *Am J Health Behav.* 2021;45(2):334–341. doi:10.5993/AJHB.45.2.12
27. Hilton BA. The uncertainty stress scale: its development and psychometric properties. *Can J Nurs Res Archive.* 1994;13:15–30.
28. Yang T, Yang XY, Yu L, Cottrell RR, Jiang S. Individual and regional association between socioeconomic status and uncertainty stress, and life stress: a representative nationwide study of China. *Int J Equity Health.* 2017;16(1):1–8. doi:10.1186/s12939-017-0618-7
29. Wang XL, Gao LY, Miu QF, et al. Perceived uncertainty stress and its predictors among residents in China during the COVID-19 pandemic. *Psychol Health Med.* 2022;27(1):265–279. doi:10.1080/13548506.2021.1883692
30. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav.* 1983;24(4):385–396. doi:10.2307/2136404
31. Yang T, Wu D, Zhang WF, Cottrell RR, Rockett IRH. Comparative stress levels among residents in three Chinese provincial capitals, 2001 and 2008. *PLoS One.* 2012;7(11):448971. doi:10.1371/journal.pone.0048971
32. Taber KS. The use of Cronbach's alpha when developing and reporting research instruments in science education. *Res Sci Educ.* 2018;48(6):1273–1296. doi:10.1007/s11165-016-9602-2
33. Wang T, Kuang J, Herold F, et al. Validity and reliability of the preference for and tolerance of the intensity of exercise questionnaire among Chinese college students. *Int J Ment Health Promot.* 2022;1–12. doi:10.32604/ijmhp.2022.022504
34. Schermelleh-Engel K, Moosbrugger H, Müller H. Evaluating the fit of structural equation models: tests of significance and descriptive goodness-of-fit measures. *MPR-online.* 2003;8(2):23–74.
35. Fan J, Upadhye S, Worster A. Understanding receiver operating characteristic (ROC) curves. *Can J Emerg Med.* 2006;8(1):19–20. doi:10.1016/j.patrec.2005.10.010
36. Hall DL, Luberto CM, Markowitz A, et al. Health uncertainty among healthcare workers during the COVID-19 pandemic. *J Hosp Adm.* 2021;10:2. doi:10.5430/jha.v10n2p45
37. Wu D, Yang T, Hall DL, Jiao G, Huang L, Jiao C. COVID-19 uncertainty and sleep: the roles of perceived stress and intolerance of uncertainty during the early stage of the COVID-19 outbreak. *BMC Psychiatry.* 2021;21(1):1–11. doi:10.1186/s12888-021-03310-2
38. Miller MB. Coefficient alpha: a basic introduction from the perspectives of classical test theory and structural equation modeling. *Struct Equ Modeling.* 1995;2(3):255–273. doi:10.1080/10705519509540013
39. Yang T, Barnett R, Fan Y, Li L. The effect of urban green space on uncertainty stress and life stress: a nationwide study of university students in China. *Health Place.* 2019;59:102199. doi:10.1016/j.healthplace.2019.102199
40. Raykov T. Scale reliability, Cronbach's coefficient alpha, and violations of essential tau-equivalence with fixed congeneric components. *Multivar Behav Res.* 1997;32(4):329–353. doi:10.1207/s15327906mbr3204_2

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