Cross-Culture Validation of the HIV/AIDS Stress Scale: The Development of a Revised Chinese Version

Lu Niu1‡, Yangyang Qiu1‡, Dan Luo1*, Xi Chen2, Min Wang3, Kenneth I. Pakenham4, Xixing Zhang5, Zhulin Huang5, Shuiyuan Xiao1

1 Department of Social Medicine and Health Management, School of Public Health, Central South University, Changsha, Hunan, China, 2 Hunan provincial Center for Disease Control and Prevention, Changsha, Hunan, China, 3 The First Hospital of Changsha, Changsha, Hunan, China, 4 School of Psychology, University of Queensland, Brisbane, Australia, 5 Changsha Center for Disease Control and Prevention, Changsha, Hunan, China

☯ These authors contributed equally to this work.
‡ The authors should be considered as co-first authors.
* luodan_csu_2011@126.com

Abstract

Background

Being HIV-infected is a stressful experience for many individuals. To assess HIV-related stress in the Chinese context, a measure with satisfied psychometric properties is yet underdeveloped. This study aimed to examine the psychometric characteristics of a simplified Chinese version of the HIV/AIDS Stress Scale (SS-HIV) among people living with HIV/AIDS in central China.

Method

A total of 667 people living with HIV (92% were male) were recruited from March 1st 2014 to August 31th 2015 by consecutive sampling. A standard questionnaire package containing the Chinese HIV/AIDS Stress Scale (CSS-HIV), the Chinese Patient Health Questionnaire-9 (PHQ-9), and the Chinese Generalized Anxiety Disorder Scale (GAD-7) were administered to all participants, and 38 of the participants were selected randomly to be re-tested in four weeks after the initial testing.

Results

Our data supported that a revised 17-item CSS-HIV had adequate psychometric properties. It consisted of 3 factors: emotional stress (6 items), social stress (6 items) and instrumental stress (5 items). The overall Cronbach’s α was 0.906, and the test-retest reliability coefficient was 0.832. The revised CSS-HIV was significantly correlated with the number of HIV-related symptoms, as well as scores on the PHQ-9 and GAD-7, indicating acceptable concurrent validity.

Conclusion

The 17-item Chinese version of the SS-HIV has potential research and clinical utility in identifying important stressors among the Chinese HIV-infected population and in understanding the effects of stress on adjustment to HIV.
Introduction

China’s HIV/AIDS prevention strategies and treatment measures have been implemented with notable effectiveness, but the number of people living with HIV as well as new infections per year continues to increase [1]. Nationally, as many as 497,000 HIV-infected people registered on the China Information System for Disease Control and Prevention by the end of October 2014 [2]; however, an expert panel estimated that the actual number was 780,000 by the end of 2011 [3]. Case reporting data shows that the number of newly diagnosed has increased each year from 20,450 in 2011 [4] to 45,145 in 2014 [5]. According to the 2014 China AIDS response progress report, among newly HIV-infected cases, sexual transmission, has become the primary mode of transmission, increasing from 33.1% in 2006 to 90.8% in 2013 [1]. Notably, the proportion of people infected through homosexual transmission has increased significantly from 2.5% in 2006 to 21.4% in 2013 [1].

Being infected with HIV is an extremely stressful experience for many individuals, which affects almost every aspect of a person’s life [6, 7]. A number of studies show that higher stress among people living with HIV is related to greater psychological morbidity, such as depression and anxiety [8]. Stress has also been documented to elevate risks of health-damaging behaviors, like smoking [9], alcohol use [10], and unsafe sex [11]. All of these factors eventually lead to lower quality of life and worse medical outcomes for people living with HIV [12]. AIDS is currently a manageable chronic infectious disease, and how to effectively and efficiently provide HIV care in medical facilities and communities is increasingly recognized as a crucial public health issue. Assessing stress experienced by people living with HIV is, therefore, an important first step in understanding adjustment to HIV and in assisting with psychosocial supports, such as stress management strategies.

With different operationalizations of the construct of stress, several established generic instruments or modified versions of these inventories (e.g., the Life Event Scale [13] and the Perceived Stress Scale [6, 14–16]) have been used to investigate stress among people living with HIV. These generic scales are not likely to be sensitive to stress within the HIV context, hence several HIV-specific life-event scales have been developed [6, 17–20]; however, there are no validation data for these scales. Amongst the HIV-specific stress measures for people living with HIV, the Perceived Stress Scale for People Living with HIV/AIDS [21] is the only validated Chinese stress scale. However, it consists of eight factors, some of which have conceptual overlap. For example, sexual relationship, social acceptance/rejection, and work related issues could all be categorized into social/psychological problems conceptually.

In 2002 Pakenham and Rinaldis developed a measure of stress specific to HIV/AIDS called the HIV/AIDS Stress Scale (SS-HIV) [22]. Pakenham and Rinaldis [22] used Lazarus and Folkman’s [23] conceptualization of stress and coping to guide the development of the SS-HIV. This conceptualization defines stress as “a relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being” [23]. According to this definition, one of the key elements of the stress process is a person’s appraisal of the stressfulness of an event. Hence, the SS-HIV gauges respondent’s subjective appraisal of the stressfulness of HIV/AIDS-specific stressors. Furthermore, Pakenham and Rinaldis [22] showed that the SS-HIV was related to appraisal processes and other theoretical constructs in Lazarus and Folkman’s conceptualization of stress and coping. The initial SS-HIV composed of 29 items was developed via qualitative interviews with 96 homosexual/bisexual HIV-positive men in Australia [22, 24]. Each item represents one category of HIV/AIDS related problems that people living with HIV experienced in the preceding month, and two example problems were provided for each item using the qualitative data gained from earlier research [22, 24]. By exploratory factor analysis, a 23-item SS-HIV with
three factors was generated; the three factors were social stress, instrumental stress and emo-
tional/existential stress [22]. The 23-item SS-HIV has shown good test-retest reliability, internal
consistency and concurrent validity in the gay/bisexual HIV-infected population [22]. In
this study, the SS-HIV was adopted to measure stress for Chinese people living with HIV.
Illness is experienced within a cultural and social context which, in turn, can shape how people
appraise aspects of their illness and how they cope with it [25]. Hence, the meaning of
items in a self-report scale that measures illness-related stress may vary from one cultural and
social context to another [26]. This is particularly likely in relation to HIV given the associated
cultural and social factors (e.g., sexual orientation, discrimination, stigma, and diagnosis con-
cealment) [27]. Cross-cultural research that examines the reliability and validity of illness-
related self-report scales is important to determine whether a remapping of the underlying
meanings of scale factors or items occurs when a measure is used in a different culture [28]. In
the present study we explore the extent to which the underlying meanings of factors and items
in the SS-HIV change from a Western to a Chinese cultural and social context.
In 2003 Lin et al. [27, 29] translated the SS-HIV into Chinese and applied it to HIV-positive
former plasma/blood donors in Henan province, China. Then in 2007, Gao et al [30] also used
this instrument among people living with HIV recruited from multiple settings in Guangzhou
without clearly stating the translation and validation process. Both studies reported acceptable
internal reliability coefficients for the Chinese versions of the SS-HIV (Cronbach’s α ranged
from 0.55 to 0.75) [29, 30], but the translations used in these Chinese versions vary. Addition-
ally, other psychometric characteristics of these Chinese versions of the SS-HIV, such as test-
retest reliability and validity, have not been examined. Hence, there is as yet no standardized
and validated Chinese version of the SS-HIV.
In this study, we aim to develop a culturally adapted and validated Chinese HIV-related
Stress Scale (CSS-HIV), which would help to elucidate stress processes involved in HIV diag-
nosis, management, and treatment among people living with HIV in China. We also aim to
explore the applicability of CSS-HIV among Chinese HIV-infected people, and shed light on
its psychometric properties.

Methods
Ethics Statement
Ethics approval was obtained through the Human Research Ethics Committee of Central
South University, and written informed consent has been obtained from all participants.

Participants and procedures
We used a cross-sectional design with consecutive sampling. Changsha City is the provincial
capital of Hunan province in China. By the end of 2014, Hunan Province had 23,515 cumu-
lated diagnosed HIV/AIDS cases, including 6,847 deceased cases, which represents the 7th
highest number of cases of HIV/AIDS among all provincial districts in China. Sexual contact
has become the primary mode of transmission in China, with 96% of new infections in Hunan
province in 2014 being infected by sexual contact [31].
During March 1st 2013 to August 31th 2014 a total of 667 people living with HIV who
attended the free voluntary counseling and testing clinic of Changsha CDC and the Changsha
Infectious Disease Hospital were recruited. Participants had to be aged ≥18 years old and living
in Changsha City, including 6 districts and 3 counties. The response rate was 95.3% (667/700).
All participants signed the informed consent form, and completed a questionnaire package.
Thirty-eight participants were selected randomly to complete the questionnaire again in four
weeks after the initial testing. The sampling procedure of this study has been described in detail elsewhere [32].

**Measurements**

**Demographics and HIV information.** Demographics such as gender, age, educational background, employment, and marriage status were collected by a purpose-built questionnaire. Medical and HIV related information was obtained from records in the HIV/AIDS registered management system, including mode of HIV-transmission, time since HIV-infection, CD4 count (/μl), and number of HIV-related symptoms as follows: persistent fevers for over 1 month; persistent diarrhea or watery stools for over 1 month; persistent cough for over 1 month; over 10% weight loss in the last 3 months; white patches in the mouth (thrush); recurrent herpes simplex; active tuberculosis; and others (indicated by participants).

**Chinese HIV/AIDS stress (CSS-HIV).** The 23-item SS-HIV is a measure of stress specific to HIV/AIDS [22]. It consists of three subscales: (1) social stress (10 items), which includes stressful social events such as isolation, stigma, difficulties on disclosure of HIV status and interpersonal relationships; (2) instrumental stress (6 items), which includes daily practical difficulties associated with HIV/AIDS related financial, transport, and treatment problems; and (3) emotional/existential stress (7 items) including HIV/AIDS related grief/bereavement, distressing emotions, concerns about death, and religious issues. Each item represents one problem category with two related examples. For instance, the item *Distressing emotions related to HIV/AIDS* also lists two examples, *you feel angry or fearful; you feel anxious or depressed* (see S1 Appendix). Respondents rate their perception of how distressing each problem item is on a 5-point Likert scale that ranges from 0 (not at all) to 4 (extremely), with higher scores indicating higher levels of stress.

Approved by the first author of the SS-HIV (Pakenham [22]), a panel of three bilingual public health professors, who were also trained in psychiatric or psychological fields, translated the original English version of the SS-HIV into simplified Chinese. Several meetings were held to review and discuss the difficulties encountered by individual translators during the translation process. The translator also had to seek clarification from the first author of the SS-HIV regarding the meaning of several items. Another meeting was facilitated by the panel in order to assess how well the translated version was understood. Their comments were recorded and the translation was modified. Then another bilingual medical researcher independently back-translated the finalized Chinese version into English. The panel compared the original English version with the back-translated Chinese version, and revised the suboptimal translated words/phrases to ensure consistency with Chinese culture. For example, Item 21 refers to *financial difficulties related to HIV/AIDS such as problems with superannuation payouts*. However, the social security system in China does not provide retirement protection plans for most unemployed people and, thus, the item was modified as follows, *problems with daily necessity payments* (in Chinese). The final Chinese version of SS-HIV was used in this study. Please see details of CSS-HIV in S1 Appendix.

**Chinese Patient Health Questionnaire-9 (PHQ-9).** Depression was measured by the PHQ-9, a 9-item screening instrument based on diagnostic criteria for major depression from the *Diagnostic and Statistical Manual of Mental Disorder, Fourth Edition* (DSM-IV) [33, 34]. Each item is rated on a 4-point scale ranging from 0 (none of the time) to 3 (almost every day). Cut-off scores of 5, 10 and 15 represent mild, moderate and severe levels of depression, respectively [33]. The PHQ-9 has shown good reliability and validity in various Chinese samples including HIV-infected individuals [35, 36].

**Chinese Generalized Anxiety Disorder Scale (GAD-7).** GAD-7 is a screening instrument for anxiety, which consists of 7 items that reflect the symptom criteria for general anxiety...
disorder from the DSM-IV [37, 38]. Respondents rate each item on a 4-point Likert scale regarding how often they have been bothered by an anxiety symptom in the last two weeks. Higher scores indicate higher levels of anxiety symptoms. A score over 5 was used to indicate a “mild-severe” level of anxiety, similar to levels of depression on the PHQ-9 [38]. The GAD-7 has been utilized in various Chinese samples including HIV-positive [35, 36], showing good reliability and validity.

Statistical analysis

Firstly, we conducted a confirmatory factor analysis (CFA) to examine the three-factor structures proposed by Pakenham and Rinaldis [22]. The following cutoff criteria for the goodness of fit indices were used: \( \chi^2/df < 3 \), Comparative Fit Index (CFI) > 0.90, Goodness of Fit Index (GFI) > 0.90, Tucker-Lewis Index (TLI) > 0.90, Root Mean Square Error of Approximation (RMSEA) < 0.05 [39]. The results from the CFA were not satisfied (see Table 1), so we conducted an exploratory factor analysis (EFA) to explore the underlying factor structure of the 23 items. The sample adequacy was assessed by the Kaiser-Meyer-Olkin (KMO) test and Bartlet’s test. Varimax rotation method was used in the EFA. When the model fit was inadequate, we identified problematic items. Items were retained if they met the following criteria: 1) correlation coefficients with the whole scale higher than 0.40; 2) factor loadings greater than 0.40 on only one factor [40]. After removal of problematic items, we conducted EFA and CFA again on the retained items. Table 1 shows model fit indices of the original and revised versions of the CSS-HIV. The model with the best model fit was retained.

### Results

### Participants’ characteristics

Of the 667 participants, 7.3% were female, and the mean age was 31.9 years with a range of 18 to 76 years (SD = 10.6). Most were single (62.7%), had attained tertiary education (46.3%), and had a stable job (56.2%). Most respondents (83.5%) were newly diagnosed (less than 1 month), and infected through sexual transmission (95.2%), in particular homosexual transmission.
Over one-third (36.7%) had HIV-related clinical symptoms, while 12.6% had a CD4 count lower than 200/μl.

Factor analyses
First, we conducted CFA on the original 23-item three-factor model, and poor levels of goodness of fit were found (Table 1). Then we conducted EFA with Varimax rotation on the 23 items. The KMO value was 0.950, and the Bartlett’s test of Sphericity was statistically significant ($\chi^2 = 7126.713, P = 0.000$), indicating the adequacy of proceeding with factor analysis. The EFA results indicated a three-factor model, but some items loaded on different factors rather than the original one. We conducted CFA on the revised 23-item three-factor model, which also showed a poor fit to the data with high $\chi^2/df$, CFI, GFI and TLI below 0.90, and RMSEA over 0.7.

Then we removed Item 10 (increased drug/alcohol use) which was correlated with the total score <0.4 ($r = 0.199, p = 0.000$), and 85.5% endorsed "not at all". EFA (with Varimax) and CFA were carried out on the retained 22 items, but the results still showed that the 22-item three-factor model was not ideal (Table 1).

Next, we removed 5 items (Items 6, 7, 12, 16, 22) with double loadings (>0.4) based on the EFA on 22 items, and conducted EFA (with Varimax) and CFA on the 17 items. The EFA yielded a three-factor solution that accounted for 56.274% of the variance, and the CFA goodness-of-fit measures supported the adequacy of this solution (CFI, GFI, TLI and IFI >0.90). Therefore, the 17-item three-factor structure was retained as the final model.

Based on the EFA results of the 17-item CSS-HIV, Factor 1 consisted of 6 items representing "social stress" (Items 4, 5, 11, 13, 14, 23) and accounted for 40.532% of the variance; Factor 2 consisted of 6 items representing "emotional stress" (Items 1, 2, 3, 8, 9, 15) and accounted for 8.687% of the variance; whereas Factor 3 consisted of 5 items representing "instrumental stress" (Items 17, 18, 19, 20, 21) and accounted for 7.054% of the variance. Eleven out of 17 items fell into the original SS-HIV factors, and item loadings ranged from 0.471 to 0.765 (Table 2).

Reliability
Cronbach’s $\alpha$ for the 17-item CSS-HIV was 0.906 for the whole scale. As displayed in Table 3, internal reliability coefficients of subscales ranged from 0.791 to 0.846; the inter-correlations among the three subscales were moderate, ranging from 0.567 to 0.656. The ICC was 0.908 for the whole scale and ranged between 0.766 and 0.829 for the subscales.

Concurrent validity
As shown in Table 4, people with more HIV-related symptoms were more likely to report higher CSS-HIV total and subscale scores. Although the correlations were weak, younger age was associated with greater social stress ($r = -0.104$); and people infected through heterosexual transition tended to have lower stress than those infected through homosexual and other modes, especially emotional stress ($r = 0.080$). Gender, education and CD4 counts were unrelated to the CSS-HIV total and factor scores.

In terms of depression and anxiety, the mean score of PHQ-9 was 78.09±6.63, and ranged from 0 to 27. 63.1% had depression symptoms ($\geq 5$) and 34.5% were classified in “moderate-severe” depression range ($\geq 10$). The mean GAD-7 score was 6.69±5.77, with a range from 0 to 21. The prevalence of anxiety was 58.6% ($\geq 5$), and 27.3% were classified with “moderate-severe” anxiety symptoms ($\geq 10$).
The Spearman correlation analysis indicated that the total stress score, as well as the three subscales, were significantly and positively correlated with both depression and anxiety. The correlations were moderate, ranging from 0.510 to 0.711.

**Discussion**

This study presents the psychometric characteristics of a Chinese version of the HIV/AIDS Stress Scale (SS-HIV) in a representative sample of people living with HIV in central China. The results suggested that the 17-item CSS-HIV with three factors has adequate internal reliability, test-retest reliability and concurrent validity.

Item 10 which referred to substance abuse related to HIV/AIDS was removed. We found that most of the participants (86.7%) reported no increased drug/alcohol intake related to

| Sub-scales and item description | Mean (SD) | Factor 1 | Factor 2 | Factor 3 |
|--------------------------------|-----------|----------|----------|----------|
| **Social stress**              |           |          |          |          |
| 04. Confidentiality/privacy concerns related to HIV/AIDS | 10.94(6.01) | 0.765    |          |          |
| 14. Difficulties in telling others of your HIV/AIDS status | 2.46(1.43) | 0.708    |          |          |
| 13. Overly attentive to bodily functions or changes | 1.91(1.45) | 0.695    |          |          |
| 11. Discrimination/stigma concerns related to HIV/AIDS | 1.71(1.30) | 0.668    |          |          |
| 23. Reducing risk of infection | 1.74(1.46) | 0.668    |          |          |
| 05. Sexual difficulties related to HIV/AIDS | 1.88(1.38) | 0.640    |          |          |
| **Emotional stress**           |           |          |          |          |
| 02. Relationship difficulties related to HIV/AIDS | 1.23(1.27) | 0.471    |          |          |
| 01. Distressing emotions related to HIV/AIDS | 6.12(5.07) | 0.741    |          |          |
| 09. Suicidal thoughts/attempts related to HIV/AIDS | 1.49(1.14) | 0.677    |          |          |
| 15. Boredom related to HIV/AIDS | 1.49(1.14) | 0.677    |          |          |
| 08. Isolation related to HIV/AIDS | 1.30(1.26) | 0.626    |          |          |
| 03. Grief/bereavement related to HIV/AIDS | 1.35(1.34) | 0.626    |          |          |
| **Instrumental stress**        |           |          |          |          |
| 18. Difficulty with health care system | 1.23(1.27) | 0.741    |          |          |
| 19. Difficulty with treatment related to HIV/AIDS | 4.60(4.28) | 0.746    |          |          |
| 21. Financial difficulties related to HIV/AIDS | 0.88(1.17) | 0.746    |          |          |
| 20. Transport difficulties related to HIV/AIDS | 1.05(1.23) | 0.720    |          |          |
| 17. Employment difficulties related to HIV/AIDS | 0.75(1.02) | 0.741    |          |          |
| The total score of CSS-HIV     | 4.60(4.28) | 0.746    |          |          |
| Eigenvalue                     | 21.65(13.22)| 6.891    | 1.477    | 1.199    |
| Proportion of explained variance (%) | 40.532 | 8.687    | 7.054    |

doi:10.1371/journal.pone.0152990.t002

The Spearman correlation analysis indicated that the total stress score, as well as the three subscales, were significantly and positively correlated with both depression and anxiety. The correlations were moderate, ranging from 0.510 to 0.711.

**Table 3. The interclass correlations, internal reliability and test-retest reliability of 17-item CSS-HIV factors.**

| Factors | Factors | Cronbach’s α | ICC   |
|---------|---------|--------------|-------|
|         | Social stress | Emotional stress | Instrumental stress |       |
| Social stress | - | - | - | 0.818 | 0.766|
| Emotional stress | 0.656* | - | - | 0.846 | 0.823|
| Instrumental stress | 0.567* | 0.635* | - | 0.791 | 0.829|

Note: Internal reliability and test-retest reliability was assessed using the criterion of Cronbach’s alpha ≥0.70 and the intra-class correlation coefficient (ICC) ≥0.70.

* p <0.05

doi:10.1371/journal.pone.0152990.t003
HIV/AIDS, although some prior research has shown that life stress is associated with increased substance use in people living with HIV [10, 42]. Meade’s study also found that substance abuse was the least commonly endorsed item among the 23 items [27]. It may indicate a cultural discrepancy in how Western and Chinese individuals react to stressful events. Additionally, other problematic items tended to be related to the original emotional/existential stress dimension including: concerns about death related to HIV/AIDS, difficulties in coming to terms with HIV/AIDS status, difficulty dealing with HIV-related symptoms or illness, and religious/existential difficulties related to HIV/AIDS. The fact that these items did not load unambiguously on the original emotional/existential stress dimension may reflect cultural differences in perceptions of these stressor and marked progress in the treatment and management of HIV/AIDS over the past 10 years. Regarding the latter, these stressors (particularly the existential stressors) are less likely to be prominent in the context of current relatively effective medical treatments, which have changed HIV/AIDS from being a life threatening illness to a chronic health condition.

Findings from the present study confirm the three-dimensional structure of HIV/AIDS related stress: social, emotional, and instrumental stress. In the 17-item three-factor structure of CSS-HIV, the majority of items loaded onto these original three factors. However, cultural differences in how some of the HIV/AIDS stressors in the CSS-HIV are experienced emerged. There were six items that loaded onto other factors rather than the original one, and the changes were mostly between social stress and emotional stress. According to Lazarus and Folkman’s (1984) conceptualization of stress and coping [23], the extent to which an event is perceived as stressful in large part depends on the person’s appraisal of the event with respect to its potential for harm, controllability and mastery. These appraisals are in turn shaped by cultural and social contexts [43]. There is considerable conceptual overlap between social stress and emotional stress as demonstrated by the moderately high correlation between these two factors in the present study ($r = 0.656$). Different cultural contexts may alter the poignancy of the emotional or social elements of stressors represented in the items that changed between the social and emotional stress factors.

Take the item **Suicidal thoughts/attempts related to HIV/AIDS** as example. This item originally loaded on the social stress factor, but in the present study it loaded on the emotional stress factor. There are various motivations for suicide. For instance, the interpersonal theory of suicide suggests that perceived burdensomeness and social alienation are the key elements that arouse one’s desire for death [44]. In Shneidman’s model of suicide [45], a desire to end...
unendurable psychological pain/psychache is considered to be the core feature of suicide. In China, intrapersonal motivations (e.g. feeling depressed, hopelessness, and a desire to escape of pain,) were endorsed more frequently than the interpersonal factors among people living with HIV who reported suicide ideation/attempts [46–48]. These findings are consistent with the suicide thoughts/attempts item loading on the emotional stress factor in the present study.

The reliability findings supported that the 17-item CSS-HIV and its three subscales have good internal consistency (Cronbach’s α 0.791–0.906), which were similar to findings of the original 23-item scale (0.76–0.85), but better than the 23-item Chinese versions developed by Lin et al. (0.55–0.73) [29] and Gao et al. (0.55–0.75) [30]. The ICCs of the whole scale and subscales ranged from 0.766 to 0.908, which indicates that the 17-item CSS-HIV has acceptable test-retest reliability over the short-term (4 weeks).

Consistent with Pakenham and Rinaldis’ study [22], this study also showed that problems related to social stress were most troublesome, and people with more HIV-related symptoms were likely to have higher stress (social, instrumental and emotional/existential stress). Previous studies conducted by Lin et al [29] and Gao et al [30], have shown that the SS-HIV has concurrent validity with a number of other measures including Beck Depression Inventory (BDI) [29], Center for Epidemiological Studies Depression Scale (CES-D) [30] and Self-rating Anxiety Scale (SAS) [29, 30] among Chinese HIV-infected people. In the current study, HIV-related stress was also found to be significantly and moderately positively correlated with depression and anxiety (r = 0.661 for PHQ-9 and 0.678 for GAD-7; p < 0.001) and, thus, the construct validity of this 17-item scale was supported, and demonstrates the expected link between HIV/AIDS related stress and depression and anxiety.

The main limitation of this study is the sample characteristics. Most of the participants were male and more than half of them were infected via homosexual transmission. HIV-infected sub-populations, such as injecting drug users (IDU), female sex workers and pregnant women may have different stressful experiences due to HIV-infection. For example, Item 10 refers to increased drug/alcohol intake, which might be a prominent stressor for HIV-infected IDUs, was the least stressful event in our sample where only 1.2% were IDUs. Another limitation is the lack of representation of people with longer time of infection and advanced courses of AIDS, and this may have produced a bias towards lower levels of stress. Future research on the CSS-HIV should be conducted with other Chinese HIV-infected groups, and continue to evaluate its psychometric properties.

In conclusion, results from the present study show that the 17-item CSS-HIV is a psychometrically sound instrument for measuring HIV/AIDS-related stress among people living with HIV in China. The CSS-HIV shows potential in identifying people living with HIV who may be at risk for mental health problems. The CSS-HIV is also useful in identifying important stressors among HIV-infected Chinese, which will help to inform the development of targeted stress management programs. Having a common scale that assesses HIV-related stress will also assist research that explores comparisons in HIV across countries.

Supporting Information

S1 Appendix. The English and Chinese versions of SS-HIV.
(PDF)

Acknowledgments

We would like to express our gratitude to all participants and staffs of Changsha Center for Disease Control and Prevention, Changsha Hospital for Infectious Disease Hospital, and those
from School of Public Health, Central South University, for their kindest contributions and assistance to this study.

Author Contributions
Conceived and designed the experiments: DL SYX XC. Performed the experiments: MW XXZ ZLH DL YYQ LN. Analyzed the data: LN YYQ DL. Contributed reagents/materials/analysis tools: DL KIP. Wrote the paper: LN YYQ DL KIP.

References
1. National Health and Family Planning Commission of the People’s Republic of China. 2014 China AIDS response progress report. 25 June 2014. Available: http://www.unaids.org.cn/cn/index/Document_view.asp?id=860. Accessed 1 July 2015.
2. China News. The total number of alive people living with HIV in China is 497,000. 1 Dec 2014. Available: http://www.chinanews.com/gn/2014/12-01/6832958.shtml. Accessed 4 August 2015.
3. The former Ministry of Health of the Republic of China. 2012 China AIDS response progress report. 31 March 2012. Available: http://www.unaids.org.cn/en/dataanalysis/knowyourresponse/countryprogressreports/2012countries/cc_CN_Narrative_Report[1].pdf. Accessed 15 September 2014.
4. Chinese Center for Disease Control and Prevention. 2012 National report on notifiable infectious disease. 15 March 2013. Available: http://www.nhfpc.gov.cn/jkj/s3578/201304/b540269c6e5141e6bb2d00ca539bb9f7.shtml. Accessed 16 April 2015.
5. Chinese Center for Disease Control and Prevention. 2014 National report on notifiable infectious disease. 16 Feb 2015. Available: http://www.nhfpc.gov.cn/jkj/s3578/201502/847c04a13a0ac43e84f173909be0c0b.shtml. Accessed 16 April 2015.
6. Thompson SC, Nanni C, Levine A. The stressors and stress of being HIV-positive. Aids Care. 1996; 8 (1): 5–14. PMID:8664369
7. Ndlovu U, Ion A, Carvalhal A. “My children and my home”: the most recent and challenging stressors of HIV-positive women. Archives of Womens Mental Health. 2010; 13(3): 215–222.
8. Su X, Lau JT, Mak WW, Chen L, Choi KC, Song J, et al. Perceived discrimination, social support, and perceived stress among people living with HIV/AIDS in China. Aids Care. 2013;25(2): 239–48. doi:10.1080/09540121.2012.701713 PMID: 22835331
9. Marshall MM, Kirk GD, Caporaso NE, Mccormack MC, Merlo CA, Hague JC, et al. Tobacco use and nicotine dependence among HIV-infected and uninfected injection drug users. Addictive Behaviors. 2010; 36(1): 61–67.
10. Reif S, Muzavero M, Raper J, Thielman N, Leserman J, Whetten K, et al. Highly stressed: stressful and traumatic experiences among individuals with HIV/AIDS in the Deep South. Aids Care. 2011; 23(2): 152–162. doi: 10.1080/09540121.2010.498872 PMID: 21259127
11. Kelly BC, Bimbi DS, Lzienicki H, Parsons JT, Stress and Coping Among HIV-Positive Barebackers. Aids and Behavior. 2009; 13(4): 792–797. doi: 10.1007/s10461-009-9586-2 PMID: 19533321
12. Leserman J, Whetten K, Lowe K, Stangl D, Swartz MS, Thielman NM, How Trauma, Recent Stressful Events, and PTSD Affect Functional Health Status and Health Utilization in HIV-Infected Patients in the South. Psychosomatic Medicine. 2005; 67(3): 500–507. PMID: 15911916
13. Byrnes DM, Antony MH, Goodkin K, Elfantis-Potter J, Asthana D, Simon T, et al. Stressful events, pessimism, natural killer cell cytotoxicity, and cytotoxic/suppressor T cells in HIV+ black women at risk for cervical cancer. Psychosomatic Medicine. 1998; 60: 714–722 PMID: 9847030
14. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. J Health Soc Behav. 1983; 24(4): 385–96. PMID: 6668417
15. Koopman C, Gore-Felton C, Marouf F, Butler LD, Field N, Gill M, et al. Relationships of perceived stress to coping, attachment and social support among HIV-positive persons. AIDS Care. 2000; 12(5): 663–672. PMID: 11218551
16. Eller LS, Mahal G. Psychological factors in Nepali former commercial sex workers with HIV. Journal of Nursing Scholarship 2003; 35(1): 53–60. PMID: 12701527
17. Roberts JE, Ciesla JA, Direnfeld DM, Hewitt RG. Emotional distress among HIV-positive individuals: the roles of acute negative life events and psychological diatheses. Personality and Individual Differences. 2001; 30(2): 241–257.
18. Kessler RC, Foster C, Joseph J, Ostrow D, Wortman C, Phair J, et al. Stressful life events and symptom onset in HIV infection. Am J Psychiatry. 1991; 148(6): 733–738. PMID: 1674646
19. Nott KH, Vedhara K. The measurement and significance of stressful life events in a cohort of homosexual HIV positive men. AIDS Care. 1995; 7(1): 55–70. PMID: 7748911
20. Crystal S, Kersting RC. Stress, social support, and distress in a statewide population of persons with AIDS in New Jersey. Social Work in Health Care. 1998; 28(1): 41–60. PMID: 9711685
21. Su X, Lau JT, Mak WW, Chen L, Feng T, Chen X, et al. Development of the perceived stress scale for people living with HIV/AIDS in China. AIDS Patient Care and STDS. 2008; 22(12): 989–98. doi: 10.1089/apc.2008.0095 PMID: 19072105
22. Pakenham KI, Rinaldis M. Development of the HIV/AIDS stress scale. Psychology and Health. 2002; 17(2): 203–219.
23. Lazarus RS, Folkman S. Stress, Appraisal, and Coping. New York: Springer Pub Co.; 1984.
24. Pakenham KI, Dadds MR, Terry DJ. Adaptive demands along the HIV disease continuum. Social Science and Medicine. 1996; 42(2): 245–256. PMID: 8928033
25. Pakenham KI. Making sense of Multiple Sclerosis. Rehabilitation Psychology. 2007; 52(4): 380–389.
26. Tseng WS. Clinicians Guide to Cultural Psychiatry, San Diego, California: Academic Press; 2003.
27. Meade CS, Wang J, Lin X, Wu H, Popper PJ. Stress and coping in HIV-positive former plasma/blood donors in China: a test of cognitive appraisal theory. AIDS Behav. 2010; 14(2): 328–38. doi: 10.1007/s10461-008-9494-x PMID: 19127424
28. Lee EH, Chung BY, Suh CH, Jung JY. Korean versions of the perceived stress scale (PSS-14, 10 and 4): psychometric evaluation in patients with chronic disease. Scandinavian Journal of Caring Sciences. 2014; 29(1): 183–192. doi: 10.1111/scs.12131 PMID: 24660854
29. Lin XY, Wang JP, Chen HY, Su WL, Peng B. Emotional status and related factors among HIV-positive paid blood donors. Chinese Journal of Applied Psychology. 2004; 10(4): 49–53.
30. Gao LL. Effects of psychosocial factors on emotional disorders and risk behaviors in HIV positive persons. M.Sc. Thesis, Sun Yat-sen University. 2008. Available: http://d.wanfangdata.com.cn/Thesis/Y1294886.
31. Yi ZY, Wu H, Chen B. Hunan Province currently has 23,515 cumulated registered HIV/AIDS cases. The Red Net. 1 Dec 2014. Available: http://health.rednet.cn/c/2014/12/01/3537373.htm. Accessed 11 September 2015.
32. Qiu YY. Cross-cultural debugging and application research of HIV/AIDS Stress Scale. M.Sc. Thesis, Central South University, 2015.
33. Spitzer RL, Kroenke K, Williams JB. Validation and utility of a self-report version of PRIME-MD: the PHQ primary care study. Primary Care Evaluation of Mental Disorders. Patient Health Questionnaire. JAMA. 1999; 282(18): 1737–1744. PMID: 10568646
34. Bian CD, He XY, Qian J, Wu WY, Li CB. The reliability and validity of a modified patient health questionnaire for screening depressive syndrome in general hospital outpatients. Journal of Tongji University (Medical Science). 2009; 30 (5): 136–140.
35. Liu Y, Gong HY, Yang GL, Yan J. Perceived stigma, mental health and unsafe sexual behaviors of people living with HIV/AIDS. J Cent South Univ (Med Sci). 2014; 39(7): 658–663.
36. Qiu YY, Luo D, Cheng R, Xiao Y, Chen X, Huang ZL, et al. Emotional problems and related factors in patients with HIV/AIDS. J Cent South Univ (Med Sci). 2014; 39(8): 835–841.
37. Spitzer RL, Kroenke K, Williams JB, Lowe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. Arch Intern Med. 2006; 166(10): 1092–1097. PMID: 16717171
38. He XY, Li CB, Qian J, Cui HS, Wu WY. Reliability and validity of a generalized anxiety disorder scale in general hospital outpatients. Shanghai Archives of Psychiatry. 2010; 22(4): 200–203.
39. Zhang YB. Structural equation modeling. In: Sun ZQ, editor. Medical Statistics (Third Edition). Beijing: People's Medical Publishing House, 2010.
40. Hou JT, Wen ZL, Cheng ZJ. Structural equation modeling and its applications. Beijing: Education Science Publishing House, 2004.
41. Ho AH, Potash JS, Fong TC, Ho VF, Chen EY, Lau RH, et al. Psychometric properties of a Chinese version of the Stigma Scale: examining the complex experience of stigma and its relationship with self-esteem and depression among people living with mental illness in Hong Kong. Comprehensive Psychiatry. 2015; 56:198–205. doi: 10.1016/j.comppsych.2014.09.016 PMID: 25284279
42. Myers HF, Sumner LA, Ullman JB, Loeb TB, Carmona JV, Wyatt GE. Trauma and Psychosocial Predictors of Substance Abuse in Women Impacted by HIV/AIDS. Journal of Behavioral Health Services & Research. 2009; 36(2): 233–246. doi: 10.1007/s11414-008-9134-2 PMID: 18636332
43. Pakenham KI. Benefit finding and sense making in chronic illness. In: Folkman S. (Ed.). Oxford Handbook on Stress, Coping, and Health. NY: Oxford University Press, 2011; pp.242–268.

44. Joiner TE, Van Orden KA, Witte TK, Selby EA, Ribeiro JD, Lewis R, et al. Main Predictions of the Interpersonal–Psychological Theory of Suicidal Behavior: Empirical Tests in Two Samples of Young Adults. J Abnorm Psychol. 2009; 118(3): 634–46. doi: 10.1037/a0016500 PMID: 19685959

45. McNaught A, Spicer J. Theoretical perspectives on suicide in gay men with AIDS. Soc Sci Med. 200; 51(1): 65–72. PMID: 10817469

46. Wu HY, Sun YH, Zhang XJ, Zhang ZL, Cao HY. Study on the social psychology influencing factors of suicidal ideation in people living with AIDS. Chin J Dis Control Prev. 2007; 11(4): 342–345.

47. Qu WY, Tian JH, Xu K, Wang KR. The study of the cause of suicide among people living with HIV/AIDS and crisis intervention. China J AIDS/STD. 2005; 11(2):91–93.

48. Wu YL, Yang HY, Wang J, Yao H, Zhao X, Chen J, et al. Prevalence of suicidal ideation and associated factors among HIV-positive MSM in Anhui, China. International Journal of STD & AIDS. 2015; 26(7): 496–503.