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ORIGINAL ARTICLE

Validation of the Chinese version of the Halitosis Associated Life-quality Test (HALT) questionnaire

S-L He, J-H Wang, M-H Wang, Y-M Deng

Chongqing Research Center for Oral Diseases and Biomedical Science, Chongqing, China; Department of Preventive and Pediatric Dentistry, The Affiliated Hospital of Stomatology, Chongqing Medical University, Chongqing, China

OBJECTIVE: This study aimed to evaluate the reliability and validity of the Chinese version of the Halitosis Associated Life-quality Test (HALT) questionnaire.

METHODS: A total of 106 patients with oral malodour were recruited to complete the questionnaire after its translation and cross-cultural adaptation. The reliability of the Chinese version of the HALT was evaluated using internal consistency and test–retest methods. Both construct validity and discriminative validity were adopted to evaluate the validity of the HALT.

RESULTS: The Cronbach's alpha value (internal reliability) for the total HALT score was 0.95, and the intraclass correlation coefficient (ICC) value (test–retest reliability) was 0.89 (95% CI = 0.74–0.98). The construct validity was determined by exploratory factor analysis. Four factors were extracted, which accounted for 85.18% of the variance. All items had factor loadings above 0.40, ranging from 0.53 to 0.94. In addition, the Chinese version of the HALT was found to be valid for distinguishing patients with different degrees of oral malodour.

CONCLUSION: The results suggest that the Chinese version of the HALT has satisfactory psychometric properties and is applicable to patients with oral malodour in Chinese-speaking populations.

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Keywords: validation; halitosis; quality of life; questionnaire

Introduction

Oral malodour is a common complaint of patients and mainly originates from oral sources (tongue coating, periodontal disease, pharyngitis and tonsillitis) (Scully and Greenman, 2008). The estimated prevalence of this condition ranges from 20% to 34% (Liu *et al*, 2006; Bornstein *et al*, 2009). According to the American Dental Association, more than 50% of the adult population has suffered from oral malodour (American Dental Association, 2003). This oral disorder not only affects physical health of patients, but also causes a significant social or psychological handicap (Hine, 1957; Suzuki *et al*, 2008, Buunk-Werkhoven *et al*, 2012). Therefore, a comprehensive assessment of the impact of oral malodour on daily living and quality of life in patients is necessary. The oral health-related quality of life (OHRQoL) is precisely adapted to this need and has gained important implications for the clinical practice of dentistry and dental research in recent years (Sischo and Broder, 2011).

Various instruments have been used for more than 20 years for the assessment of OHRQoL among individuals. Commonly used instruments to assess OHRQoL among individuals include the Oral Health Impact Profile (Slade, 1997; Wong *et al*, 2002), the Oral Impacts on Daily Performance (Kida *et al*, 2006; Naito *et al*, 2007) and the Medical Outcomes Short-Form Health Survey Questionnaire (SF-36) (Anderson *et al*, 1996). These instruments are recognised to assess comprehensively the multi-dimensional impact of oral disorders (Montero *et al*, 2010). However, these generic oral health status measures are inappropriate to measure the burden of specific oral disorders (e.g. dental aesthetics (Wong *et al*, 2007), impairment of swallowing function (Dwivedi *et al*, 2010), early childhood caries (Lee *et al*, 2010)) on OHRQoL. These generic measures are too broad to assess accurately the links between specific oral conditions and OHRQoL (Locker and Allen, 2007). Moreover, the contents of the generic measures are less relevant to the experiences of patients with oral malodour. There is an inadequacy of valid instruments to assess the burden of oral malodour, although the OHRQoL of oral malodour has drawn significant attention in recent years (Buunk-Werkhoven *et al*, 2012).

Kizhner *et al* (Kizhner *et al*, 2011) recently proposed a Halitosis Associated Life-quality Test (HALT) questionnaire that evaluates the aspects of OHRQoL related to oral malodour to address this disorder. This

Correspondence: Song-lin He, MD, Department of Preventive and Pediatric Dentistry, The Affiliated Hospital of Stomatology, Chongqing Medical University, Chongqing, China. Tel: +86-023-89035800, Fax: +86-023-89035822, E-mail: songlinhecqmu@163.com
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condition-specific measure shows good psychometric properties, as proven by rigorous psychometric research, and could be used to evaluate the negative emotions specifically related to oral malodour. However, the HALT cannot be directly used in non-English-speaking countries. A rigorous psychometric test stage must be accomplished first before it could be used in other areas. Therefore, the purpose of the present study was to translate, cross-culturally adapt and test the reliability and validity of the HALT among Chinese-speaking patients with oral malodour.

Materials and methods

Patients

A list of patients previously recruited for a clinical trial of oral malodour treatment at the oral malodour clinic of West China College of Stomatology, Sichuan University, was used for recruitment. One hundred and thirty patients with oral malodour were contacted via telephone using a computer-generated randomised table. Among them, nine were eliminated based on exclusion criteria and 15 refused to participate in the present study. The organoleptic test (OLT) was adopted throughout the study by a single examiner (S.L.) who had been previously trained and calibrated (Roldan *et al*, 2005; Donaldson *et al*, 2007; Nalcaci and Sonmez, 2008). Twenty patients from the study were selected to determine the intra-examiner agreement. The S.L. reviewed the examinations on two separate occasions with an interval of 1 week. The Kappa value for intra-examiner agreement was 0.83 ($P < 0.001$).

On the test day, the patients abstained from wearing perfume or cologne. One hour before the assessment, patients were forbidden to drink tea, coffee and juice or use chewing gums, mouth rinses and smoke. The patients were asked to close their mouth for 1 min and exhale through the mouth with moderate force at a distance of approximately 10 cm from the nose of the investigator. The investigator scored oral malodour levels using the 0–5 organoleptic scale: 0 = no appreciable odour; 1 = barely noticeable odour; 2 = slight but noticeable odour; 3 = moderate odour; 4 = strong odour; 5 = extremely foul odour (Rosenberg *et al*, 1991). The following criteria were considered for patient inclusion into the study: (i) diagnosed with genuine halitosis (≥2 OLT score) according to the proposed classification of halitosis by the International Society for Breath Odor Research (Murata *et al*, 2002; Suzuki *et al*, 2008) and (ii) aged 18 years or older. Patients who could not accurately understand the contents of the questionnaire or those who were reluctant to sign the informed consent form were excluded from the present study.

For the sample size, the literature suggested 5–10 patients per item for the instrument analysis (Frank and Floyd, 1995; Hair *et al*, 1998). A minimum of 100 patients were required because the questionnaire contained 20 items. Finally, 106 patients were randomly selected to complete the Chinese version of the HALT. Additionally, the result of the Kaiser–Meyer–Olkin (KMO) was 0.73, which exceeded the recommended value of 0.60 to proceed with the exploratory factor analysis. The result also indicated the adequacy of the sample size. A detailed explanation was provided before the patients filled out the Chinese version of the HALT. The questionnaire was completed inside a waiting room. The patients could consult the research assistants at any time if they had any questions.

The test–retest reliability was evaluated by a computer-generated randomised table that randomly selected 30 of the 106 patients to make a return visit after 2 weeks. The present study was approved by the Ethics Committee of West China College of Stomatology, Sichuan University. All the patients signed an informed consent form.

The instrument

The HALT is a specific instrument for the comprehensive assessment of the physical, social and psychosocial negative impacts of oral malodour on adult males and females. This questionnaire is an English-language OHRQoL instrument, developed by the University Hospital of Columbia University in the USA (Kizhner *et al*, 2011). The HALT includes 20 items with the following four subscales: physical, emotional and functional limitations, and personal and social disabilities. A 5-point Likert scale ranging from 0 (no problem) to 5 (as bad as it could be) is used for each item. This instrument creates a scale score range of 0–100. Higher scores indicate greater impacts or more problems.

Translation process

The HALT was translated into the Chinese language using the forward–backward process proposed by (Del Greco *et al*, 1987). The process included the following major steps:

1. The HALT was first translated from English to Chinese by two independent translators. Both translators were not only fluent in English and Chinese but also have background knowledge of dentistry.
2. The two independent versions were translated back from Chinese to English by a professional English teacher and two dental specialists. These professionals had mastery of the English and Chinese languages and were not aware of the original questionnaire.
3. The translated and back-translated versions were compared and discussed by an expert panel. The expert panel consisted of two dental specialists with an extensive knowledge of the OHRQoL assessment. The panel was fluent in both English and Chinese languages. The panel mainly evaluated whether the Chinese version was translated well, through its accuracy (conceptual equivalence), clarity (understandable expressions) and popularity (avoidance of technical terms). A preliminary Chinese HALT version was then produced.
4. The preliminary Chinese HALT was pilot-tested on a convenience sample of 20 patients. New emerging problems were discussed after the test. The Chinese version of the HALT was considered final when no substantial differences could be found.

Table 1 Characteristics of Patients ($N = 106$)

Variable	*Number*	*%*
Age(y)		
18–40	52	49.1
41–60	48	45.3
≥60	6	0.06
Gender		
Male	60	56.6
Female	46	43.4
Organoleptic test score		
2	14	13.2
3	57	53.8
4	26	24.5
5	9	8.5

Statistical analysis

Reliability. Two types of reliability were adopted to assess the reliability of the HALT. Specifically, the internal consistency reliability was evaluated by calculating the Cronbach's alpha for the multi-item subscales. The test–retest reliability was determined by calculating the intraclass correlation coefficients (ICC) using data from 30 patients who filled out the HALT within the 2-week interval. A Cronbach's alpha of 0.70 or greater was considered statistically acceptable for comparisons between the groups. The ICC were designated as poor to fair agreement (<0.40), moderate agreement (0.41–0.60), good agreement (0.61–0.80) and excellent agreement (>0.80) (Bartko, 1966).

Validity. Validity was assessed in two ways: construct validity and discriminative validity. Construct validity for the HALT was determined by exploratory factor analysis. However, a Bartlett's test of sphericity coefficient and the KMO test were conducted first to determine if there were a sufficient number of significant correlations between the items to perform this analysis (Bartlett, 1950). Factor loadings >0.40 were considered significant in the present study. The discriminative validity was tested by comparing the mean scores differences in the degree of oral malodour being investigated. The degree of oral malodour was recorded in accordance with the 0–5 organoleptic scale. If the results of the Kruskal–Wallis test were significant, a Dunn's post hoc test was used to see which groups differed from each other. Statistical significance was set at $P < 0.05$. Statistical analyses were conducted by SPSS 20.0 (SPSS, Chicago, IL, USA).

Results

Sample characteristics

One hundred and six (106) patients were recruited from an oral malodour clinic in the present study. All the HALT questionnaires were completely filled out. The mean age of the sample was 36.8 ± 11.7 (18–67) years, and majority of the patients were men (56.6%). Among these patients, 49.1% were between 18 and 40 years old, 45.3% were between 40 and 60 years old and 0.06% were over 60 years old. A total of 14 patients (13.2%) were diagnosed with 2-° oral malodour; 57 (53.8%) displayed 3-° oral malodour; 26 (24.5%) exhibited 4-° oral malodour and 9 (8.5%) displayed 5-° oral malodour (Table 1).

Reliability

Table 2 shows the internal consistency for the multi-item scales. The Cronbach's alpha for the total score of the HALT was 0.95. The corrected item–total correlations for the HALT ranged from 0.32 (item 2) to 0.92 (item 19). All items met the recommended minimum of 0.20. Moreover, the test–retest reliability was calculated for 30 patients who took a retest after a 2-week interval. The mean scores of the first and second measurements were 50.4 ± 14.6 and 48.3 ± 14.1, respectively. The test–retest reliability was evaluated using the ICC. The obtained value for the ICC was 0.89 (95% CI = 0.74–0.98), which indicated an excellent agreement.

Validity

The construct validity was assessed through the factor analysis. The result of the KMO test was 0.73, and the Bartlett's test of sphericity was 3604.4 (df = 190, $P < 0.001$). The results of the factor analysis for the scales are presented in Table 3. All the items had factor loadings above 0.40, ranging from 0.53 to 0.94. The factor rotation was administered using the varimax method to extract four factors, which was consistent with the original English version, and accounted for 85.18% of the variance. Depending on the items, the first factor was labelled personal and social disabilities (items 14, 15, 16, 17, 18, 19 and 20), the second was emotional limitations (items 4, 5, 10, 11 and 12), the third was functional limitations (items 6, 7, 8, 9 and 13) and the fourth was physical limitations (items 1, 2 and 3). The per cent variances for the four factors were 27.32%, 25.99%, 17.93% and 13.94%, respectively. With respect to the discriminative validity, the Kruskal–Wallis test was conducted, followed by the Dunn's post hoc test for multiple comparisons. The scores of the HALT among the patients at different degrees of oral malodour are shown in Table 4. The calculated mean (s.d.) total scores of the HALT were 35.21 ± 11.73 for 2-° oral malodour, 47.16 ± 12.35 for 3-° oral malodour, 54.15 ± 12.77 for 4-° oral malodour and 66.22 ± 8.07 for 5-° oral malodour, respectively. There was a statistically significant difference in the median scores for the total scores of the HALT, categorised by the 0-to-5 organoleptic scale. The Dunn's post hoc test showed significant differences in HALT scores between all four groups for each group comparison ($P < 0.001$).

Discussion

Several studies (Wong *et al*, 2002; Allen, 2003; Akarslan and Erten, 2010; Larsson *et al*, 2010; Kizhner *et al*, 2011; Souza *et al*, 2011) that assess the OHRQoL have recently been reported. A popular way of collecting the related data for these studies is conducting surveys in the form of questionnaires. Foreign instruments must be adapted before they could be used in other cultures and different languages. Therefore, the purpose of the current study was to perform a cross-cultural adaptation of the original HALT and evaluate the reliability and

Table 2 Mean scores, corrected item–total correlations of the Chinese version of the Halitosis Associated Life-quality Test

Item	*Mean*	*SD*	*Corrected item–total correlation*	*Cronbach's alpha if item deleted*
1. Mainly mouth-breathing	1.94	1.11	0.47	0.95
2. Frequent tonsillar infections	1.02	0.85	0.32	0.95
3. Frequent sinus infections	0.78	0.96	0.43	0.95
4.Worrying about or self-conscious mouth breath	3.06	1.29	0.66	0.94
5. Miserable or tensed because of halitosis	3.12	1.21	0.70	0.94
6. Difficulty chewing or limiting certain food because of halitosis	2.32	0.98	0.72	0.94
7. Change of taste	1.60	0.94	0.78	0.94
8. Problems speaking (or mouth-covering) because of halitosis	2.40	0.89	0.51	0.94
9. Appearance affected because of halitosis	1.41	0.80	0.61	0.94
10. Depressed because of halitosis	3.14	1.21	0.68	0.94
11. Problems concentrating because of halitosis	3.21	1.14	0.73	0.94
12. Embarrassed because of halitosis	2.89	0.95	0.84	0.94
13. Spending time related to halitosis?	2.91	1.02	0.76	0.94
14. Talking from afar because of halitosis	3.04	1.07	0.82	0.94
15. Avoid going out because of halitosis	2.00	0.78	0.84	0.94
16. Communication problems because of halitosis	2.70	1.11	0.86	0.94
17. Mentioned about halitosis	2.40	0.93	0.72	0.94
18. Suffer financial loss because of halitosis	2.71	0.89	0.60	0.94
19. Suffer social/personal loss because of halitosis	3.09	0.71	0.92	0.94
20. Reduced life satisfaction because of halitosis	3.19	0.76	0.84	0.94

Table 3 Factor analysis results for the Chinese version of the Halitosis Associated Life-quality Test

Item	*Factor 1 (personal and social disabilities)*	*Factor 2 (emotional limitations)*	*Factor 3 (functional limitations)*	*Factor 4 (physical limitations)*
17	**0.89**	0.35	0.07	−0.01
16	**0.87**	0.34	0.25	0.18
19	**0.80**	0.43	0.24	0.29
15	**0.79**	0.45	0.12	0.23
14	**0.77**	0.22	0.44	0.17
18	**0.75**	−0.02	0.47	−0.04
20	**0.62**	0.58	0.09	0.37
5	0.16	**0.94**	0.18	0.08
11	0.25	**0.93**	0.09	0.11
4	0.24	**0.91**	0.19	−0.15
10	0.30	**0.89**	0.15	−0.13
12	0.32	**0.59**	0.53	0.26
8	0.060	0.10	**0.83**	0.22
13	0.35	0.46	**0.72**	−0.07
6	0.24	0.35	**0.66**	0.32
9	0.34	0.02	**0.66**	0.41
7	0.39	0.34	**0.53**	0.43
2	−0.09	0.01	0.32	**0.86**
3	0.52	−0.07	−0.05	**0.75**
1	0.19	−0.01	0.41	**0.72**
Eigenvalue	5.46	5.19	3.59	2.79
Percent variance (%)	27.32	25.99	17.93	13.94

validity of this Chinese version according to international studies (Sperber, 2004). The results in the present study show feasibility for the use of the Chinese version of the HALT for the measurement of the biopsychosocial impact of oral malodour.

Reliability

Cronbach's coefficient alpha was used to test reliability. The results exceeded 0.70 of the scale for internal consistency. The corrected item–total correlations were well above the recommended level of 0.2 (Kline, 1993). In addition, when items 1–3 were deleted, the Cronbach's alpha coefficient of HALT increased slightly. This results indicated that the items were irrelevant and should be deleted. This phenomenon may be caused by inappropriate questions, considering that oral malodour is less frequently associated with extra-oral causes (e.g. respiratory disorders of the sinuses, tonsils and nose) (Scully and Greenman, 2008). The results still demonstrate good internal consistency reliability for the HALT.

For the test–retest reliability, the patients did not receive treatment between the first and second completions of the HALT. The ICC values for the HALT exceeded 0.70, which demonstrated excellent agreement. This value was also greater than that reported in the English version. These findings indicate that the HALT is a reliable and stable instrument for assessing the OHRQoL of oral malodour.

Table 4 Discriminative validity for the Chinese version of the Halitosis Associated Life-quality Test

Level of organoleptic test	*No. of patients*	*Total scores of the Halitosis Associated Life-quality Test Mean ± SD*[a]	*H value*[b]
2	14	35.21 ± 11.73	30.89*
3	57	47.16 ± 12.35	
4	26	54.15 ± 12.77	
5	9	66.22 ± 8.07	

[a] The organoleptic test score differed significantly from each other by Dunn's post hoc test ($P < 0.001$).
[b] Kruskal–Wallis test.
*$P < 0.001$.

Validity

According to the results of the factor analysis, all the items had a factor loading >0.40, thus satisfying the criteria that predictive items have loadings. The results indicate

that all the items are strongly related to their factors. All 20 items of the questionnaire were grouped into the following four factors: personal/social disabilities (items 14, 15, 16, 17, 18, 19 and 20), emotional limitations (items 4, 5, 10, 11 and 12), functional limitations (items 6, 7, 8, 9 and 13) and physical limitations (items 1, 2 and 3). These factors reflect the four possible underlying dimensions of OHRQoL and explain the 85.18% of the variance. Item 13 [Spend time related to halitosis? (Such as additional gum chewing, extra brushing, etc.)] was loaded on the 'functional limitations' factor. This finding suggests that patients spend much time on oral malodour. Thus, they were relatively limited in function. To the best of our knowledge, the current study is the first to clarify the factor structure of the HALT. This clarification is not confirmed in the original version of the HALT or in other relevant studies. Therefore, comparisons with other studies are impossible.

A significant difference in the mean of the total scores of the HALT in terms of discriminative validity was found between patients with different levels of oral malodour. Lower scores were observed among patients with the highest degree of oral malodour (5°). Hence, the severity of oral malodour was associated with the decrease in OHRQoL.

Limitations and future research

Several limitations in the present study should be considered. First, the sample size of the present study was relatively small, particularly with respect to the factor analysis. Second, all the patients in the present study attended an oral malodour clinic. Thus, the results certainly cannot be extrapolated to the general population (Foster Page *et al*, 2005). Third, the Chinese version of the HALT may not be valid for all Chinese-speaking patients. Traditional Chinese is used in Hong Kong, Macao, Taiwan and other areas outside China. The instrument may need further translation and cross-cultural adaptation in these areas (Guillemin *et al*, 1993). Further research should focus on evaluating the psychometric properties of the HALT in a larger general population sample.

In conclusion, the present study is important because it is the first to introduce and evaluate the psychometric properties of the HALT in a non-English-speaking country (China). China has the largest population in the world, and more than 870 million people speak Mandarin Chinese, which confers that the Chinese version of the HALT has a wide clinical and research application. The current study confirms the reliability and validity of the Chinese version of the HALT. This version may be used appropriately to assess the OHRQoL of patients with oral malodour in Chinese-speaking populations.

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Author contributions

S-L He was involved in the study design, data collection and analysis, drafting and revising the manuscript. J-H Wang, M-H Wang and Y-M Deng were involved in manuscript editing.

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