

Original Article

Reliability and Validity of the Tinnitus Handicap Inventory: A Clinical Study of Questionnaires

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BACKGROUND: The aim of this study is to observe the application of the Chinese version of Tinnitus Handicap Inventory-China in Tinnitus patients and verify its reliability and validity.

METHODS: About 1129 patients with tinnitus as the first complaint were selected as subjects. The patients were randomly divided into 2 groups: exploration group (n = 565), whose data were analyzed with reliability analysis method using Statistical Package for the Social Sciences software 19.0, validation group (n = 564), whose data were analyzed with validity analysis method using AMOS21.0.

RESULTS: (1) Reliability test: The Cronbach's α coefficients of the Tinnitus Handicap Inventory-China scale in both groups were 0.94, among which, the Cronbach's α coefficients of functional factor (F), emotion factor (E), and catastrophic factor (C) in group E were 0.87, 0.90, and 0.78, respectively. The half-reliability of the 2 components is 0.87. The correlation coefficient between items and the scale in group E and group V is 0.36-0.78 and 0.33-0.77, respectively. (2) Content validity: The Kaiser-Meyer-Olkin value of group E is 0.96, a total of 4 common factors were extracted, and the cumulative interpretation rate is 57.844%. The number of factors with load less than 0.4 on the 4 common factors is only 1 (F24), suggesting that this factor had little significance; the number of factors with load more than 0.4 on the 2 common factors is 8 (F1, E6, F9, C11, F15, E21, E22, and C23), suggesting that patients had different understandings of these 8 questions. (3) Structural validity: The root mean square error of approximation value of the AMOS structural model in group V is 0.065, and the root mean square residual value is 0.114, indicating low fitness; the NC value is 3.353, indicating good fitness of the scale, but it still needed to be simplified.

CONCLUSION: The Chinese version of Tinnitus Handicap Inventory-China has a high reliability when applied in China, but the content validity and structure validity are not high, and the clinical practicability needs to be improved.

KEYWORDS: Tinnitus, Tinnitus Handicap Inventory, reliability, questionnaire

INTRODUCTION

Tinnitus is defined as the sensation of hearing sound when no external sound is present; it can produce many symptoms of sleep disorders, difficulty hearing, an inability to concentrate, irritability anxiety, depression, and other adverse psychological reactions. If improperly treated, a patient with tinnitus can develop severe mental illness, sometimes with suicidal tendencies.¹ Tinnitus can be categorized as either objective or subjective; objective tinnitus (often originating in the middle ear) appears to come from inside the body via the conduction of sound to the ear, for example, from the musculature or from pulsing blood vessels. People with subjective tinnitus (of sensorineural origin) may be with hearing loss or have no detectable signs of disease and almost no detectable physical ailments. Objective tinnitus can be detected using a stethoscope or radiological technology, whereas subjective tinnitus can only be heard by the patient themselves.

Data from the National Center for Health Statistics in the U.S. Department of Health, Education, and Social Welfare (1968) indicates that 30% of the general population is affected by tinnitus, with 6% of those affected (1.8% of the general population) suffering disabling symptoms.² However, there are no current large-scale epidemiological investigations of tinnitus in China, although 10%

of people in China have experienced tinnitus and 5% have sought medical treatment. Additionally, the lives, sleep, work, and social activities of 2% of these individuals are adversely affected, and 0.5% of patients with tinnitus become disabled due to severe tinnitus.³

Because of its characteristics, it is difficult for doctors to diagnose the severity of subjective tinnitus according to objective indicators. In terms of its epidemiology, one-half of tinnitus patients will seek medical treatment, 2% will experience serious disruptions to their social lives, and 0.5% will even become disabled. Newman⁴ developed the Tinnitus Handicap Inventory (THI) self-rated scale in 1996; its purpose is to comprehensively determine the severity of tinnitus affecting patients by assessments of their daily behaviors. At present, the THI scale has been widely used in Korea,⁵ Persia,⁶ Brazil,⁷ Lithuania,⁸ Denmark,⁹ and elsewhere. Further, there are studies reporting the use of THI in China, including both Cantonese¹⁰ and Mandarin versions.¹¹ However, there are no current large-scale clinical studies of the applicability of the Chinese THI; thus, its reliability and validity require further verification. Therefore, this article aims to verify the application of the Chinese THI in China using a large clinical sample and observe whether there are situations in which the Chinese THI cannot be used as a result of its translation or due to cultural differences.¹²

METHODS

Ethical Review

The participants in this study had the right to withdraw from the study at any time. The subjects were informed about the purpose, nature, potential benefits, and risks of the study, and all provided written informed consent. This clinical trial originated from Shanghai Municipal Hospital, Shengkang Hospital Development Center (SHDC12014125), and was approved by the Ethics Committee of Yueyang Hospital, which is affiliated with the Shanghai University.

Subjects

The Chinese THI was administered to 1129 patients (between the ages of 14 and 88 years; average: 50.17 ± 14.606 years) who reported chronic tinnitus as their primary complaint or as their secondary complaint to hearing loss. These patients were seen in the Otolaryngology Department of Yueyang Hospital of Shanghai University for tinnitus between September 2015 and August 2017. The patients included 541 males (47.9%) and 588 females (52.1%). Of all patients, 285 patients (25.2%) received only primary education (at or below junior high school), 430 patients (38.1%) received secondary education (at or above junior high school), and 414 patients (36.7%) received higher education (at or above high school). Judging by the tinnitus frequency, 256 patients (22.7%) had low-frequency

tinnitus, 82 patients (7.7%) had medium-frequency tinnitus, and 791 patients (70.7%) had high-frequency tinnitus. All subjects were native Chinese speakers with good oral communication and the ability to understand and provide informed consent.

Study Design and Statistical Analysis

- (1) The patients were randomly divided into 2 groups without regard for gender, age, education level, or frequency of tinnitus. One group is the exploration group (group E, $n = 565$ cases), whose data were analyzed with the reliability analysis method using Statistical Package for the Social Sciences software 19.0 (IBM SPSS Corp.; Armonk, NY, USA). The other group is the validation group (group V, $n = 564$ cases), whose data were analyzed with the validity analysis method using AMOS21.0 (SPSS AMOS, which is a professional modeling software launched by IBM).
- (2) **Reliability analysis**
Statistical Package for the Social Sciences software 19.0 is used for the reliability analysis, and Cronbach's alpha coefficient is used to investigate the internal consistency of the scale. The cross-item consistency of the scale is tested using split-half reliability. The data are reliable when the Cronbach's alpha coefficient is >0.7 .
- (3) **Validity analysis**
Exploratory factor analysis (EFA) is used to test the content validity of the THI. Tinnitus Handicap Inventory structure validity is tested using confirmatory factor analysis (CFA). Principal component analysis (PCA) method is used to analyze the content validity when the Kaiser–Meyer–Olkin (KMO) >0.9 . The load matrix is rotated to be as close as possible to the simple structure, and the load amounts of the 25 questions on the 4 common factors (CFs) were obtained after the rotation of variance maximization using the Kaiser standardized orthogonal rotation method. The rotation converged after 7 iterations.

RESULTS

Tinnitus Handicap Inventory Data

Frequency distributions, means, standard deviations, and correlations of the Chinese THI data of 1129 patients (including the functional, emotional, and catastrophic subscales) are presented in Table 1.

Reliability Analysis: Reliability Detection

The Cronbach's coefficient of the group E is 0.94, which includes Cronbach's coefficients of 0.87, 0.90, and 0.78 for the functional, emotional, and catastrophic subscales, respectively. The correlation coefficient between items in group E and the scale is 0.36–0.78, whereas the correlation coefficient between items in group V and the scale is 0.33–0.77. The Cronbach's alpha coefficients of THI scale, group E, and group V are shown in Table 2.

Exploratory Factor Analysis: Content Validity

The KMO value of the group E is 0.96, confirming that this scale is eligible for an EFA, which is then conducted using the PCA method. After the rotation of maximum variance, 4 CFs with feature roots larger than 1 were extracted; the cumulative variance contribution rate is 57.84%, the explanatory variance (EV) of the first factor is 23.94%, and the EVs of the other 3 factors were 14.52%, 11.06%, and 8.32%, respectively (Table 3).

MAIN POINTS

- The Chinese version of Tinnitus Handicap Inventory-China (THI-CN) has a high reliability when applied in China.
- The factor F24 had little significance in THI-CN; and the patients had different understandings of 8 questions including F1, E6, F9, C11, F15, E21, E22, and C23.
- The content validity and structure validity of THI-CN are not high, and the clinical practicability needs to be improved.

Table 1. Frequency Distributions (%), Means, Standard Deviation (SDs), and Correlations of Chinese Tinnitus Handicap Inventory Ddata

Subscale	Items	Frequency of Answer "Yes"	Frequency of Answer "Sometimes"	Frequency of Answer "No"	Mean	Standard Deviation	Correlation
F	1. Because of your tinnitus, is it difficult for you to concentrate?	21.1	43.2	35.7	1.7	1.4	0.622
F	2. Does the loudness of your tinnitus make it difficult to hear people?	17.9	28.1	54.0	1.3	1.5	0.302
E	3. Does your tinnitus make you angry?	17.9	36.1	46.0	1.4	1.5	0.603
F	4. Does your tinnitus make you feel confused?	39.3	37.0	23.7	2.3	1.6	0.570
C	5. Because of your tinnitus, do you feel desperate?	19.3	23	57.7	1.2	1.6	0.624
E	6. Do you complain a great deal about your tinnitus?	35.6	37.9	26.5	2.2	1.6	0.664
F	7. Because of your tinnitus, do you have trouble falling asleep at night?	26.3	31.3	42.4	1.7	1.6	0.446
C	8. Do you feel as though you cannot escape your tinnitus?	46.4	26.5	27.1	2.4	1.7	0.586
F	9. Does your tinnitus interfere with your ability to enjoy social activities (dinner, movies)?	18.1	21.6	60.3	1.2	1.6	0.663
E	10. Because of your tinnitus, do you feel frustrated?	20.2	26.8	53.0	1.3	1.6	0.699
C	11. Because of your tinnitus, do you feel that you have a terrible disease?	40.0	26.0	34.0	1.9	1.7	0.590
F	12. Does your tinnitus make it difficult for you to enjoy life?	23.2	30.1	46.7	1.6	1.6	0.702
F	13. Does your tinnitus interfere with your job or household responsibilities?	19.6	33.3	47.1	1.5	1.5	0.740
F	14. Because of your tinnitus, do you find that you are often irritable?	18.4	31.5	50.1	1.4	1.5	0.608
F	15. Because of your tinnitus, is it difficult for you to read?	15.4	22.3	62.3	1.1	1.5	0.625
E	16. Does your tinnitus make you upset?	21.6	30.1	48.3	1.5	1.6	0.755
E	17. Do you feel that your tinnitus has placed stress on your relationship?	7.1	17.2	75.7	0.6	1.2	0.593
F	18. Do you find it difficult to focus your attention away from your tinnitus and on other things?	14.6	23.9	61.5	1.1	1.5	0.623
C	19. Do you feel that you have no control over your tinnitus?	47.8	30.0	22.2	2.4	1.7	0.420
F	20. Because of your tinnitus, do you feel tired?	25.9	31.0	43.1	1.7	1.6	0.657
E	21. Because of your tinnitus, do you feel depressed?	23.0	30.0	47.0	1.5	1.6	0.722
E	22. Does your tinnitus make you feel anxious?	26.9	36.3	36.8	1.8	1.6	0.740
C	23. Do you feel that you can no longer cope with your tinnitus?	23.9	28.5	47.6	1.5	1.6	0.675
F	24. Do you feel more ringing in your ears when you are stressed?	40.7	25.8	33.5	2.2	1.7	0.494
E	25. Does your tinnitus make you feel insecure?	19.6	18.6	61.8	1.2	1.6	0.655

F represents items included in the functional subscale; E represents items included in the emotional subscale; and C represents items included in the catastrophic subscale.

Table 2. Internal Consistency of the THI, Group E, and Group V.

Group Indicators	THI	Group E (n = 565)	Group V (n = 564)
THI	0.93	0.94	0.94
Functional subscale	0.86	0.87	0.87
Emotional subscale	0.87	0.90	0.90
Catastrophic subscale	0.68	0.78	0.76

Values are Cronbach's alpha coefficients.

Group E, exploration group; Group V: validation group.

The coefficients with load amounts less than 0.4 are deleted in Table 3. We see that the load of F24 on the four CFs is less than 0.4. The load capacities of questions F1, F4, E6, C11, F15, E21, E22, and C23 were all less than 0.5, whereas the load capacities of questions F1, E6, F9, C11, F15, E21, E22, and C23 were greater than 0.4 on 2 CFs at the same time in Table 4.

Confirmatory Factor Analysis: Structural Validity

Using the structural equation model, the relationship between latent variables and the corresponding relationship between latent variables and explicit variables were represented using a path diagram. The rectangle represents the explicit variable, the ellipse or circle represents the implicit variable (data carrier), the 1-way arrow represents the 1-way influence or causality, and the 2-way arrow represents the correlation coefficient in the path diagram. The larger the data, the greater the correlation, but the smaller the data after the rectangle explicit variable, the greater the correlation. Analysis of Moment Structure (AMOS) is used to draw the structural equation model for the THI scale, as shown in Figure 1.

Researchers primarily use fitness indicators, such as chi square values, significance and root mean square error of approximation (RMSEA) values, expected cross-validation index values, Standardized Root Mean square Residual (SRMR) values, and goodness of fit index (GFI) and comparative fit index (CFI) values as the bases for deciding whether a model achieves a specific degree of overall fitness for practical applications because of their sufficient explanatory value. To determine the suitability of the various fitness indices of the model, the fitness indices of the AMOS structural equation model¹² were compared to the parameters of the THI. These results are shown in Table 5.

Statistical Analysis

Frequency distribution, mean value, standard deviation (significant dependence on functional, emotional, or disaster subscales)

and question-total correlation (correlation between items and scales composed of other items) of each item of Tinnitus Handicap Inventory-China (THI-CN) are shown in Table 1. The range of question-total correlation coefficient for the THI-CN scale is 0.302-0.755.

Reliability Analysis

A scale is considered to have good reliability when Cronbach's alpha coefficient reaches 0.8-0.9. The THI scale showed good internal consistency from the reliability analyses of groups E and V. Cronbach's alpha coefficient for both groups is 0.94, which is nearly the same as the original THI scale's Cronbach's alpha coefficient (0.93). In the 3 subscales, group E and V had good internal consistency reliability of functional factors (Cronbach's alpha=0.87) and emotional factors (Cronbach's alpha=0.90). The Cronbach's alpha coefficient for the catastrophic factor is 0.78 and 0.76 in the group E and V, respectively, which were similar to those of the original THI scale as shown in Table 2. This low Cronbach's alpha coefficient may be related to the small number of questions used in the questionnaire. We found that the internal consistency is still significant after the THI scale is introduced in China.

The split-half reliability reflects the degree of internal consistency of the test items in terms of similar content or characteristics. To analyze split-half reliability, the test items were divided into 2 equal groups after the test. An odd-even grouping method is adopted and then the correlation between the 2 items is calculated. A higher correlation is indicative of higher reliability. The coefficients of the 2 groups were both 0.87, which suggest a high correlation between the scores of the 2 items, that is, a significant degree of internal consistency is achieved after the THI scale is introduced in China.

After analyzing the reliability of groups T and Y, the data of the 2 groups were found to be almost identical, confirming that when previous researchers divided the total samples into 2 groups for analysis and comparison, any errors that may have been caused by artificial groupings were almost completely excluded, providing support for the authenticity of the validity analysis.

Validity Analysis

Exploratory Factor Analysis

Exploratory factor analysis can be used to synthesize variables with complex relationships into key factors. In this study, PCA is used to analyze the THI scale. After rotation with maximized variance, 4 CFs with characteristic roots greater than 1 were extracted, which were

Table 3. Exploratory Factor Analysis of Group E

CF	Total Variance								
	Initial Eigenvalue			Extract the Sum of Squares and Load			Rotate the Sum of Squares and Load		
	Total	EV (%)	CVCR (%)	Total	EV (%)	CVCR (%)	Total	EV (%)	CVCR (%)
1	10.895	43.579	43.579	10.895	43.579	43.579	5.986	23.944	23.944
2	1.358	5.431	49.010	1.358	5.431	49.010	3.630	14.521	38.465
3	1.166	4.665	53.675	1.166	4.665	53.675	2.764	11.055	49.520
4	1.042	4.168	57.844	1.042	4.168	57.844	2.081	8.324	57.844

CF, common factor; CVCR, cumulative variance contribution rate; EV, explanatory variance.

Table 4. Rotation Component Matrix

Question	Common Factor			
	1	2	3	4
F1		0.483		0.518
F2				0.854
E3		0.633		
F4		0.493		
C5	0.655			
E6		0.455	0.483	
F7		0.721		
C8			0.690	
F9	0.574			0.572
E10	0.750			
C11	0.482		0.527	
F12	0.660			
F13	0.711			
E14		0.584		
F15	0.446	0.440		
E16	0.703			
E17	0.648			
F18	0.504			
C19			0.808	
F20		0.529		
E21	0.584	0.436		
E22	0.580	0.491		
C23	0.433		0.527	
F24				
E25	0.611			

inconsistent with the number of 3 CFs in the scale. The cumulative interpretation rate is 57.844%, as shown in Table 3.

There is a serious deviation from the classification of the original THI scale when the load amount is higher than 0.4 among the 4 CFs extracted, as shown in Table 4. None of the items in a CF were entirely functional, affective, or catastrophic. Therefore, it can be inferred that the use value of the THI scale is affected when it is introduced in China because of either translation or cultural issues.

The loads on the 4 CFs of question 24 (“Do you feel more ringing in your ears when you are stressed?”) were all less than 0.4. The loads on 2 CFs were greater than 0.4 for questions F1, E6, F9, C11, F15, E21, E22, and C23, suggesting that the choices of patients were ambiguous, and they did not know which CF to which they should be attributed. In other words, Chinese respondents have different understandings of the information they want to be asked in these 8 questions.

Confirmatory Factor Analysis

Confirmatory factor analysis is used to determine whether the relationship between a factor and its corresponding measurement term conforms to the theoretical relationship designed by researchers. This study evaluated the validity of the THI scale using the path graph and model parameters.

According to the path map, there is a good correlation between explicit and implicit variables, with only 3 items showing a weak correlation. The correlation coefficient between question 2F (“Do you think tinnitus is too loud to affect your hearing of others?”) and latent variable F is only 0.30, showing a weak correlation. The correlation coefficient between question 24F (“Do you feel more ringing in your ears when you are stressed?”) and latent variable F is 0.49, showing a weak correlation. The correlation coefficient between question 19C of the catastrophic factors (“Do you feel unable to control tinnitus?”) and latent variable C is 0.49, showing a weak correlation.

The latent variables of the functional, affective, and catastrophic factors are also highly correlated with each other, as their correlation coefficients are all greater than 0.90, indicating that these 3 factors are interrelated and reflective of the internal consistency mentioned above.

The model of the THI is then evaluated according to the fitness degree index of the structural model, and the data showed that it is significant ($P = .000$). The sample size used in this confirmatory factor analysis is 545. The increase of sample size may lead to the increase of chi square value and degree of freedom, which indicates that the model is rejected. In this paper, the chi square degree of freedom (NC) ratio is used for analysis, which is one of the indicators for the fitness of the model. The adaptation of the THI scale model is good ($NC = 3.363 > 3$), as reflected by the PCA. The RMSEA is an absolute index that does not require a reference model: the smaller the value is, the better the fit of the model. The RMSEA value of group V is 0.065, which indicates that the model can be further optimized.¹³ A model is considered acceptable with an RMR value below 0.05, but the RMR value of the group V is 0.114, which indicates that the degree of fitness of the THI scale is questionable. The purpose of the non-centrality parameter (NCP) value is to minimize the parameter value: the larger its value, the worse the degree of fitness of the model. When the NCP value is 0, the model has perfect fitness. The NCP value of group V is 640.088, which is far from 0. The CFI, GFI, and adjusted GFI of group V are all near the critical value, which indicates that the degree of fitness of the THI scale model is good.

There are many indices of the degree of fitness of a model, and many combinations of indices exist from which researchers can choose. It is not possible to judge whether a model has a good degree of fitness according to any single index; researchers instead should combine other indices and statistical theories to show the degree of fitness of a model.

DISCUSSION

The linguistic validation of the Chinese THI from the original THI consisted of 3 phases: (1) The scale was translated and tested by Qiulan Shi¹⁴ in 2007. After the full text was translated into English, 3 professionals who were proficient in English and familiar with the scale independently translated it into Chinese and then 1 English professional with no knowledge of the scale and 1 doctor translated it back into Chinese and compared both scales to ensure the Chinese version of the scale was equivalent to the original scale. (2) A cultural adjustment of the scale was then performed. As the original scale was established under a specific cultural background,¹³ it was discussed among tinnitus patients, otologists, nursing staff, and professionals

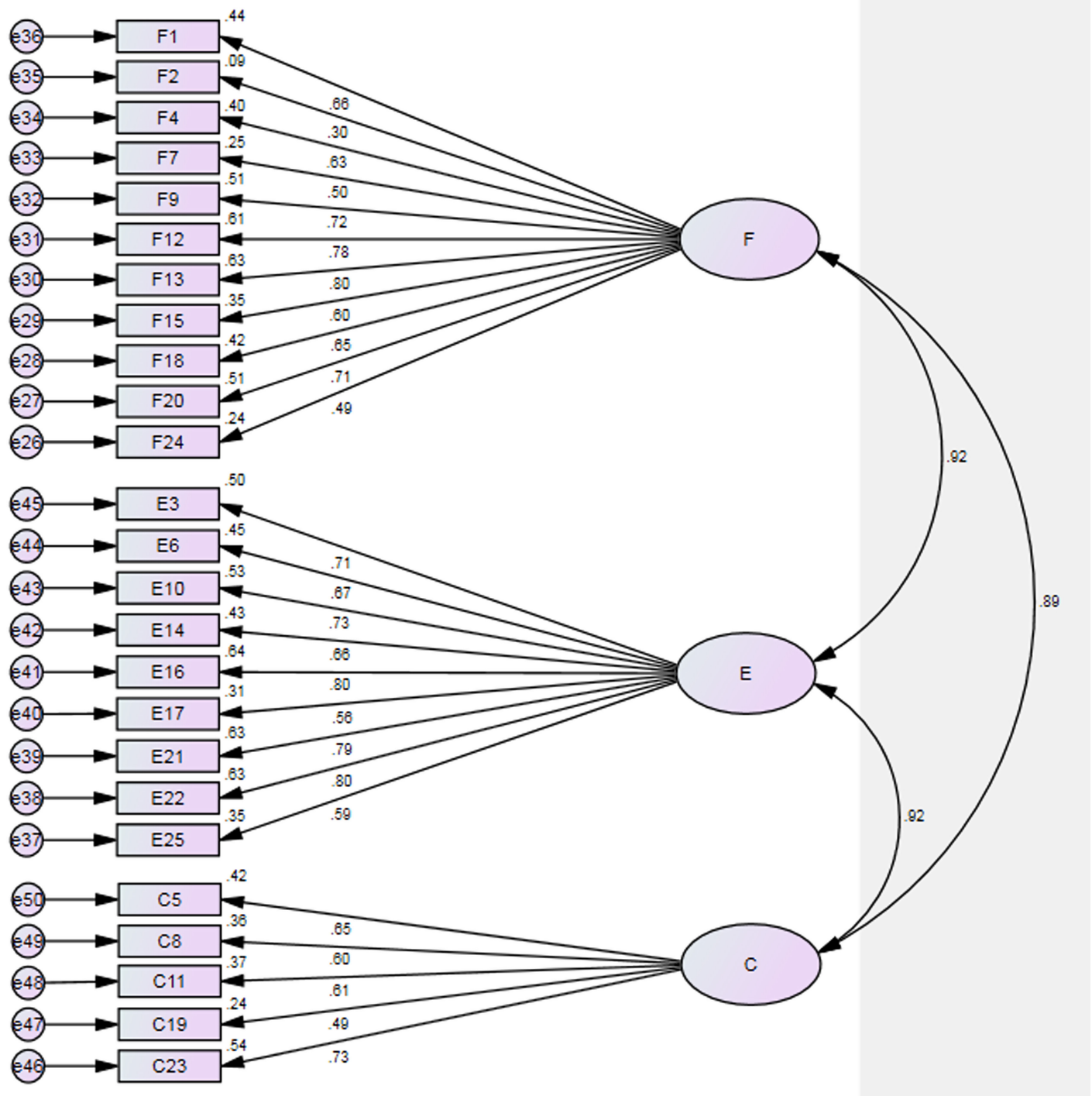


Figure 1. Three-dimensional structural equation model for the THI scale. The rectangle represents the explicit variable, the ellipse or circle represents the implicit variable (data carrier), the 1-way arrow represents the 1-way influence or causality, and the 2-way arrow represents the correlation coefficient in the path diagram. The larger the data, the greater the correlation, but the smaller the data after the rectangle explicit variable, the greater the correlation. F, Functional factor; E, Emotion factor; C, Catastrophic factor; THI, Tinnitus Handicap Inventory.

engaged in quality-of-life research, and the questions were determined to be readily understood by Chinese patients with different education levels. (3) The validation was then finalized, according to the reference method.⁴

Previous studies have reported that the THI performs comparably well in several countries and languages.^{7,9,15-21} The findings of our study suggest that the Chinese THI has good internal consistency

reliability for both the total scale (Cronbach's $\alpha=0.94$) and the 3 subscales-functional (Cronbach's $\alpha=0.87$), emotional (Cronbach's $\alpha=0.90$), and catastrophic (Cronbach's $\alpha=0.78-0.76$). The internal consistency reliability of the Chinese THI is similar to the validation of the scale in other languages. For example, Cronbach's α is 0.930 for the United States, Danish, German, Dutch, Lithuanian, and Hebrew THI scales; and it is 0.79-0.95 for the Korean THI, 0.72-0.94 for the Chinese THI (Cantonese), 0.91 for the

Table 5. Comparison of Standard Adaptation Parameters with THI Parameters

Indicator	Criterion or Threshold for Adaptation	THI Model Parameter Values
χ^2	$P > .05$ (not reaching significant levels)	0.000
GFI	>0.90	0.868
AGFI	>0.90	0.842
CFI	>0.90	0.906
NC	1 < NC < 3 (indicates that the model has a parsimony adaptation) NC > 5 (indicates that the model needs to be modified)	3.353
RMSEA	>0.05 (adaptation is good) >0.08 (adaptation is reasonable)	0.065
NCP	The less the better	640.088
EVCI	EVCI – TM < EVCI – IM < EVCI – SM	1.808 (EVCI – TM) > 1.155 (EVCI – SM)
RMR	<0.05	0.114

GFI, goodness of fit index; AGFI, adjusted GFI; CFI, comparative fit index; RMSEA, root mean square error of approximation; NCP, Non-centrality parameter; EVCI, expected cross-validation index; RMR, root mean square residual; TM, theoretical model; IM, independent model; SM, saturation model.

Italian THI, and 0.94 for the Portuguese THI (Lithuanian). Cronbach's alpha coefficients for the functional, emotional, and catastrophic subscales corresponded well with those of the original THI version. Our study found that the mean score of the question "Do you feel that your tinnitus problem has placed stress on your relationships with members of your family and friends?" (17E) is 0.6, which is the minimum of all items and consistent with previous Lithuanian research.⁸ Therefore, Tinnitus appears to have a little emotional impact on family and friends.

The THI is widely used in clinical practice and research as a 3-dimensional measure of tinnitus severity. Despite its extensive use, its factor structure remains unclear. Furthermore, the THI can be considered a reliable measure only if both Cronbach's alpha coefficient and classical test theory are used. Recently, Gos²² analyzed 1115 patients with tinnitus using the more modern and robust item response theory, finding that this bifactor model had the best fit (RMSEA = 0.055; CFI = 0.976; and SRMR = 0.040) and identifying 1 strong general factor and several weak specific factors. Further, Mokken scaling generated a reliable unidimensional scale (Loevinger's H = 0.463). To refine the THI, these authors proposed that 5 items have to be removed. Their findings support the use of the THI to evaluate tinnitus severity as a reliable, unidimensional scale. However, clinicians and researchers should rely only on its overall score, which reflects global tinnitus severity. Our study confirmed the utility of the 3-factor structure of the THI, which is consistent with an earlier German study of 373 patients with tinnitus.²³ On the bases of several combined criteria, we propose that certain THI items be removed to refine the scale, which is consistent with Elzbieta's study in which THI2, THI8, THI13, THI19, and THI24 were removed. Newman et al²⁴ proposed a shorter version of the THI, consisting of only 10 items, which were selected on the bases of just 3 criteria: a high item/total correlation, the representativeness of the 3 content domains, and face validity. We find that such criteria are insufficient and propose refining the THI

instrument by removing just those items with a low degree of fitness. We believe that short-form questionnaires are essential in busy clinical practices and extensive research protocols.

Additionally, Kennedy et al²⁵ noted that the THI, compared to other tinnitus-related questionnaires, contains a disproportionately large number of items related to the psychological/emotional aspects of tinnitus. The results of our study also suggest that tinnitus severity, as measured by the Chinese THI, captures mainly the emotional aspects of tinnitus, which have a high Cronbach's coefficient for the emotional subscale (0.90) in both the E and V groups as shown in Table 2.

It should be noted that the THI uses a 3-label nominal or category scale. Many psychophysicists would argue that this makes it inappropriate to average across scores and users. Stevens,²⁶ often referred to as the father of human psychophysics, summarized the different scales (nominal, ordinal, interval, and ratio) and noted their appropriate use and limitations. Numerical scales are appropriate for equal differences and equal ratios. This does not apply to ordinal scales. The sensitivity of the THI has been challenged.²⁷ Other considerations for tinnitus trials designs were proposed by professor Tyler.^{27,28} He created a questionnaire (developed on emotions, hearing, sleep, and concentration) focused on the primary activities impaired by tinnitus and therefore more sensitive to treatments and the questions and found that the tinnitus primary function questionnaire is valid, reliable, and sensitive and can be used to determine.²⁹ Many scales attempt to quantify the assessment of "quality of life". However, we believe that understanding the quality of life is complex, and many widely used questionnaires do not capture the broad range of factors that we believe are important. Many do not include questions about communicating. Professor Tyler also developed a preliminary questionnaire designed to measure "The Meaning of Life" from a broader perspective in 2020 year. Four factors were prominent in this initial sample, which called (1) friendship and positive outlook, (2) physical health, (3) hearing and mental health, and (4) satisfaction with life. Participants with tinnitus reported more trouble sleeping than participants with cochlear implants, whereas both groups had lower scores on hearing. Older patients reported more difficulty with remembering things but were more satisfied with their financial situation.³⁰ Therefore, based on the complexity and particularity of tinnitus disease, the evaluation of tinnitus is also complex, and the scale is widely used rather than limited.

CONCLUSIONS

The THI is widely used in countries around the world to examine the severity of tinnitus in affected patients. Applied studies in most countries have shown that this scale has good reliability and validity, and many studies have shown that the THI scale has certain applicability in China. However, our study found some discrepancies between the original THI and the Chinese THI. The results obtained by extracting CFs using the PCA were completely inconsistent with the dimensions of the scale itself, findings supported by research in other countries. But an analysis of the Chinese literature reveals that the total score of the THI scale is valuable. The THI scale has not been fully utilized, and the patient's assessments are time-consuming if the Chinese THI scale is widely used. Also, there is a deviation in the understanding of some items. How to make patients accurately understand the meaning of each item and make a correct evaluation during consultation is the key issue for the application of THI-CN

in China in the future. At present, our team is continuing to collect THI scores of tinnitus patients, with 952 new cases included now. We hope that further research results can supplement the deficiencies of this study.

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Informed Consent: Written informed consent was obtained from all participants who participated in this study.

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