

# The Tinnitus Handicap Inventory: A Study of Validity and Reliability

Songul Aksoy,<sup>1</sup> Yezdan Firat,<sup>3</sup> and Reha Alpar<sup>2</sup>

<sup>1</sup> Section of Audiology and Speech Pathology and <sup>2</sup> Department of Biostatistics, Hacettepe University Faculty of Medicine, Ankara, and <sup>3</sup> Department of Otorhinolaryngology, Inonu University Faculty of Medicine, Malatya, Turkey

**Abstract:** Our aim was to compose a Turkish version of the Tinnitus Handicap Inventory (THI). Each of two individuals independently translated and retranslated the English version of the THI, and it was adapted by an expert team. The Turkish version of the THI was completed by 110 tinnitus patients. We assessed the internal consistency and reliability of the Turkish version by Cronbach's alpha. We assessed test-retest reliability with a second investigation in 21 patients. We assessed construct validity by analyzing the patients according to their age and to tinnitus duration. Internal validity was tested by multi-item analysis, to assess item convergence and discriminant validity. We obtained high internal consistency and reliability with the Cronbach's alpha coefficient (0.88) and high intraclass correlation coefficient (ICC, 0.78–0.90). Test-retest correlation coefficient scores were highly significant. The Turkish version of the THI is a highly consistent and reliable measure that can be used in evaluating symptoms in tinnitus patients.

**Key Words:** inventory; reliability; tinnitus; translation-retranslation; validity

Recent interest has surfaced in symptom-specific handicap outcome measures for many audiological and otological diseases. That is, clinicians plan to quantify their patients' symptoms, administer their treatment, and get objective results about the patient's satisfaction. There are two important aspects of symptom-specific evaluation by a valid and reliable inventory [1–5]: First, this self-assessment tool assesses the severity of symptoms and provides objective data about the severity of the disease; second, this evaluation allows investigators to accurately assess and compare the pretreatment and posttreatment periods. Additionally, these evaluations quantify the effects of tinnitus on functional, emotional, and social life. Several outcome tools are available for the assessment of tinnitus complaints [6]. However, many of them lack reliability and validity data.

There is no valid and reliable tinnitus handicap inventory for Turkish people in their native language. Therefore, most clinicians use their own questionnaires, which lack reliability or validity (or both). The Tinnitus Handicap–Support Questionnaire [1,7], the Tinnitus Effect Questionnaire [8], and the Tinnitus Severity Questionnaire [9] are measurement tools in the English literature, but they have no (or low) internal consistency reliability and low test-retest reliability. The original Tinnitus Handicap Inventory (THI), developed by a working group commissioned by the British Association of Otolaryngologists, Head and Neck Surgeons, consists of 50 questions [10]. Newman et al. [2] developed its beta version with 25 questions, which is easy to administer and interpret and psychometrically robust. The THI, beta version, is the most standardized tinnitus handicap-measuring tool in the literature (Table 1). Table 2 displays the grading system for the beta THI. It demonstrates adequate reliability-validity and has good internal consistency, reliability, and convergent and construct validity.

The aim of this study was to translate the beta THI into Turkish and adapt it culturally. This study sought to analyze the validity and reliability of the Turkish version of the THI.

Reprint requests: Yezdan Firat, MD, Inonu Universitesi, Turgut Ozal Tip Merkezi, KBB Hastaliklari Anabilim Dalı 44280 Malatya, Turkey. Phone: 90 (422) 321 1183; Fax: 90 (422) 341 0128; E-mail: yfirat@inonu.edu.tr

**PATIENTS AND METHODS**

**Patients**

We administered the inventory to 110 consecutive out-patients (mean age, 47.2 years; standard deviation [SD], ± 14.4 years) having the tinnitus symptom for at least

3 months. All patients had been previously assessed by physical and otorhinolaryngological examination; complete audiological examination (air-bone measurements, speech tests, impedance audiometry values, middle-ear pressure, acoustic reflexes, and compliance); tinnitus intensity and frequency mapping; residual inhibition; and minimum masking level evaluations. We also included in the study patients having otological disease.

**Table 1.** Tinnitus Handicap Inventory, Beta Version

	Points		
	4	0	2
1. Because of your tinnitus is it difficult for you to concentrate?	Yes	No	Sometimes
2. Does the loudness of your tinnitus make it difficult for you to hear people?	Yes	No	Sometimes
3. Does your tinnitus make you angry?	Yes	No	Sometimes
4. Does your tinnitus make you confused?	Yes	No	Sometimes
5. Because of your tinnitus are you desperate?	Yes	No	Sometimes
6. Do you complain a great deal about your tinnitus?	Yes	No	Sometimes
7. Because of your tinnitus do you have trouble falling asleep at night?	Yes	No	Sometimes
8. Do you feel as though you cannot escape from your tinnitus?	Yes	No	Sometimes
9. Does your tinnitus interfere with your ability to enjoy social activities (such as going out to dinner, to the cinema)?	Yes	No	Sometimes
10. Because of your tinnitus do you feel frustrated?	Yes	No	Sometimes
11. Because of your tinnitus do you feel that you have a terrible disease?	Yes	No	Sometimes
12. Does your tinnitus make it difficult to enjoy life?	Yes	No	Sometimes
13. Does your tinnitus interfere with your job or household responsibilities?	Yes	No	Sometimes
14. Because of your tinnitus do you find that you are often irritable?	Yes	No	Sometimes
15. Because of your tinnitus is it difficult for you to read?	Yes	No	Sometimes
16. Does your tinnitus make you upset?	Yes	No	Sometimes
17. Do you feel that your tinnitus has placed stress on your relationships with members of your family and friends?	Yes	No	Sometimes
18. Do you find it difficult to focus your attention away from your tinnitus and on to other things?	Yes	No	Sometimes
19. Do you feel that you have no control over your tinnitus?	Yes	No	Sometimes
20. Because of your tinnitus do you often feel tired?	Yes	No	Sometimes
21. Because of your tinnitus do you feel depressed?	Yes	No	Sometimes
22. Does your tinnitus make you feel anxious?	Yes	No	Sometimes
23. Do you feel you can no longer cope with your tinnitus?	Yes	No	Sometimes
24. Does your tinnitus get worse when you are under stress?	Yes	No	Sometimes
25. Does your tinnitus make you feel insecure?	Yes	No	Sometimes
Total Score Per Column			
Total Score:			

**Translation-Retranslation**

Two bilingual translators performed the forward translation independently of one another. Both translators had medical backgrounds, and their mother tongue was Turkish. One translator was aware of the purpose of the study and the concepts involved in the instrument: to obtain a better idiomatic and conceptual—rather than literal—equivalence between the two versions of the inventory and to render the intended measurement more reliable. The other translator was unaware of the translation objective, and this was useful in eliciting unexpected meanings from the original tool. Two of the investigators performed a synthesis of the two translations. Two bilingual native Turkish speakers performed the back-translation. One of them was a medical doctor, and the other was a chiropractor; however, both were unaware of the content and original wording of the THI. An expert team composed of one of the investigators and a bilingually experienced translator reviewed the preliminary version of the THI. Testing was performed on a sample of randomly chosen patients for face validity. We subjected all patients to a structured interview after they answered the inventory. We asked them whether they had any difficulties in understanding the questions or had any comments regarding the content or layout of the inventory. According to the answers obtained from the interview and face validity test, we performed minor alterations, and our Turkish version of the THI was finalized.

**Table 2.** Grading System for the Tinnitus Handicap Inventory, Beta Version

Total Score	Classification	Grade
0–16	Slight (only heard in quiet environments)	1
18–36	Mild (easily masked by environmental sounds and easily forgotten with activities)	2
38–56	Moderate (noticed in presence of background noise, though daily activities can still be performed)	3
58–76	Severe (almost always heard, leads to disturbed sleep patterns and can interfere with daily activities)	4
78–100	Catastrophic (always heard, disturbed sleep patterns, difficulty with any activities)	5

## Validity-Reliability Analysis

We evaluated reliability using the test-retest method. Internal consistency reliability of the Turkish version of the THI was assessed using Cronbach's alpha. We made an inspection of the percentage of subjects responding "yes," "sometimes," or "no" to individual questions. We assessed internal consistency coefficients (ICCs) for all three subscales: emotional, catastrophic, and functional. An 8-item subscale explored the emotional consequences of tinnitus; a 5-item subscale explored the catastrophic effects; and the 12-item subscale explored the functional effects of tinnitus. Test-retest reliability was assessed with a second investigation in 21 patients. Three days after the first investigation, the inventory was answered again by randomly selected patients. We calculated Pearson correlation coefficients for total item score and score for three subscales and ICCs. Construct validity was assessed by separating the patients into three groups according to their age and to tinnitus duration. Internal validity was tested by multi-item analysis to assess item convergence and discriminant validity. We completed validity testing using analysis of variance (ANOVA); SPSS Version 10.5 was used for evaluating the data.

## RESULTS

We assessed 62 men (56.4%) and 48 women (43.6%) with ages ranging from 19 to 97 years. Patients had experienced their tinnitus for periods ranging from 3 months to 21 years (mean duration  $\pm$  SD,  $5.08 \pm 4.96$  years). Though most of the subjects localized their tinnitus bilaterally (48 patients; 43.6%), it was localized on the left side in 38 patients (34.5%) and on the right side in 24 patients (21.8%).

### Internal Consistency Reliability

The responses to the inventory are shown in Table 3. Endorsement rates for a "yes" response ranged from 10% to 71%; for a "sometimes" response, from 11% to 36%; and for a "no" response, from 10% to 70%. We assessed a high degree of ICCs for all subscales with a Cronbach's alpha of 0.886. This coefficient is 0.93 for the study of the original beta-version THI [11]. Because the items having high item-total correlation were considered more representative of the scale's content, all item-total statistics were reported and are shown in Table 4.

When an item is deleted, it is expected that the means and the variances are similar. As seen in Table 4, there were no great differences in these statistics. It is expected that item-total correlation should be greater than +0.25 for any item. All item-total correlations changed between 0.24 and 0.64 in our study. In the original beta

**Table 3.** Item-Endorsement Rates of the Turkish Version of the Tinnitus Handicap Inventory

Item	Percentage of Respondents Selecting Response		
	Yes	Sometimes	No
1	42	35	24
2	32	26	42
3	51	32	17
4	39	22	39
5	27	31	42
6	63	16	21
7	43	31	26
8	47	23	30
9	26	17	56
10	25	25	50
11	15	24	61
12	28	28	44
13	15	15	70
14	19	21	60
15	24	27	49
16	71	19	10
17	10	36	54
18	48	27	25
19	51	18	31
20	34	11	55
21	26	27	46
22	46	36	18
23	46	19	35
24	71	15	15
25	19	23	58

THI, these correlation coefficients were between 0.22 and 0.76 [11]. Item 2, which had the lowest item-total correlation (0.24), was similar in the beta THI, which also had the lowest item-total correlation (0.22). In the beta THI, this item was not rejected because of its high construct validity. Conversely, the number of items in which the item-total correlation is greater than 0.50 is 9, and the number of items in which the item-total correlation is greater than 0.40 is 19. It is also useful to calculate the efficient of multiple determination ( $R^2$ ) by using multiple linear regression to understand the importance of an item. In this approach, one of the items is taken to be a dependent variable whereas others are taken to be independent variables. In our study,  $R^2$  was between 0.31 and 0.66, and there was no item that had a very low value of  $R^2$ . When an item was deleted, Cronbach's alpha for that item did not change, except for items 2, 15, and 19. Therefore, it can be concluded that all items indicated high internal consistency (Cronbach's alpha scale, 0.886). We also calculated ICCs of the three subscales.

The alpha value was 0.75 for the emotional subscale. This coefficient is 0.87 for the original THI. Item-total correlations were between 0.37 and 0.60, and these rates were 0.56 and 0.82 for the beta THI. Item 21 had the greatest contribution—the emotional subscale—because

**Table 4.** Item-Total Statistics

Item	Total Mean When Item Is Deleted	Total Variance When Item Is Deleted	Item Total Correlation Coefficient	Coefficient of Multiple Determination (R <sup>2</sup> )	Cronbach's α When Item Is Deleted
1	46.45	409.74	0.47	0.56	0.88
2	47.02	422.07	0.24	0.47	0.89
3	46.15	406.95	0.54	0.53	0.88
4	46.82	410.37	0.40	0.41	0.88
5	47.11	401.51	0.58	0.53	0.88
6	45.98	407.38	0.49	0.46	0.88
7	46.49	413.89	0.38	0.36	0.88
8	46.47	401.17	0.55	0.66	0.88
9	47.42	406.78	0.47	0.50	0.88
10	47.31	406.56	0.49	0.42	0.88
11	47.73	407.30	0.54	0.48	0.88
12	47.13	405.62	0.50	0.46	0.88
13	47.93	414.16	0.43	0.44	0.88
14	47.64	408.23	0.49	0.47	0.88
15	47.33	418.96	0.31	0.34	0.89
16	45.60	419.66	0.38	0.38	0.88
17	47.69	416.60	0.43	0.31	0.88
18	46.35	409.68	0.45	0.47	0.88
19	46.42	420.92	0.25	0.52	0.89
20	47.25	391.77	0.64	0.62	0.88
21	47.22	399.42	0.60	0.55	0.88
22	46.27	409.72	0.49	0.49	0.88
23	46.58	401.42	0.52	0.62	0.88
24	45.69	418.88	0.35	0.38	0.88
25	47.60	406.59	0.52	0.48	0.88

of its highest item-total correlation score. Additionally, when an item was deleted, the alpha values changed between 0.69 (for item 21) and 0.74 (for item 6). The alpha value was 0.80 for the catastrophic subscale. This coefficient is 0.68 for the original THI. Item-total correlations were between 0.51 and 0.73 for this subscale, and these rates were 0.42 and 0.48 for the beta THI. The item contributing most to the catastrophic subscale was item 8. Otherwise, when an item was deleted, the alpha values changed between 0.71 (for item 8) and 0.79 (for item 11).

The alpha value was 0.78 for the functional subscale. This coefficient is 0.86 for the original THI. Item-total correlations were between 0.26 and 0.53 for this subscale, and these rates were 0.27 and 0.76 for the beta THI. The item contributing most to the functional subscale was item 1. When the item was deleted, the alpha values changed to between 0.75 and 0.78.

Description statistics for the total scales and three subscales are shown in Table 5. The correlations between total score and subscale scores are shown in Table 6.

**Test-Retest Reliability**

We assessed test-retest reliability with a second investigation in 21 randomly chosen patients. We gave these

**Table 5.** Descriptive Statistics for the Tinnitus Handicap Inventory Total Scales and Three Subscales

Statistics	Total	Emotional	Functional	Catastrophic
Mean SD	48.80	16.73	22.30	9.78
Min–Max	8–92	0–32	0–46	0–20

SD = standard deviation; min = minimum; max = maximum.

**Table 6.** Correlations Between Total Score and Subscale Scores (N = 110)

Subscale	Total	Functional	Emotional	Catastrophic
Functional	0.90	1.00	—	—
Emotional	0.91	0.74	1.00	—
Catastrophic	0.71	0.44	0.59	1.00
Total	1.00	—	—	—

patients the same inventory 3 days after the first investigation. Total scale scores, Pearson's correlation coefficients (*r*), and ICCs for three subscales are shown in Table 7. Test-retest correlation coefficients for the 25-item score were statistically significant. ICCs were rather high (0.78–0.90). These findings indicate that the Turkish version of the THI has good stability in the test-retest trial to assess the clinical change.

**Construct Validity**

We investigated the developmental differences according to construct validity. This was assessed by categorizing the patients into three groups according to their age and according to tinnitus duration. It is thought that tinnitus symptoms may increase with the aging process. The three groups of patients were divided according to their ages: 19–39 years, 40–59 years, and 60 years and

**Table 7.** Statistical Values of Test–Retest Reliability (N = 21)

Subscale	Mean	SD	R	ICC
Functional				
Before	23.24	13.06	0.84	0.90
After	20.48	13.35		
Emotional				
Before	19.14	6.34	0.77	0.80
After	15.81	7.92		
Catastrophic				
Before	10.86	6.37	0.66	0.78
After	9.05	6.50		
Total				
Before	53.24	22.79	0.83	0.88
After	45.33	25.65		

SD = standard deviation; ICC = intraclass correlation coefficient.

**Table 8.** Scale Statistics by Age Groups and Analysis of Variance Results

Subscale	19–39 Years (n = 34)		40–59 Years (n = 54)		60+ Years (n = 21)		F	p
	Mean	SD	Mean	SD	Mean	SD		
Functional	21.0	10.1	22.3	11.4	24.7	10.3	0.748	0.476
Emotional	15.1	7.4	16.7	6.4	19.0	9.1	1.938	0.149
Catastrophic	8.9	6.4	10.0	5.7	10.3	7.6	0.396	0.674
Total	45.0	20.5	48.9	19.9	54.0	24.6	1.196	0.307

SD = standard deviation.

older. We investigated the differences in the mean values for scale and subscales, though the F test results did not provide significant results. As patient age increases, mean values for scales also increase. Distribution of item-scale scores by age groups and ANOVA results are shown in Table 8.

We tested internal validity by multi-item analysis, to assess item convergent and discriminant validity. Validity testing was completed by ANOVA. As regards its construct validity (total correlations among correct domains: convergent  $r = 0.57$ – $0.90$ ; discriminating  $r = 0.19$ – $0.39$ ), the results were very good, as were the findings of the studies of validity.

## CONCLUSIONS

This study was designed to obtain the THI as a standard measuring instrument for patients and clinicians all over Turkey. The 25-item inventory can be used in neurotology clinics to evaluate the tinnitus symptom and its impact on knowledge and attitudes toward tinnitus. Patients with tinnitus generally live with their problem for long periods of time; thus, they want to know their symptom's quality or intensity. This preliminary version of the THI is able to detect the quality of the tinnitus symptom and its impact on patients' daily lives and psychosocial functioning, in addition to registering satisfaction with treatment.

The Turkish version of the THI proved to be a credible tool for tinnitus evaluation. After minor alterations

in translation and retranslation, scaling assumptions were met satisfactorily for the three multi-item subscales, and the first Turkish-language scale for evaluating tinnitus was developed. On the basis of our study results, we found the first Turkish version of the THI to be a measure that is acceptable, reliable, and valid for evaluating tinnitus in patients.

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