

## Research Article

# Psychometric Evaluation of the Persian Version of the Tinnitus Cognitions Questionnaire

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**Citation:** Sadeghijam M, Rahimi Pour S, Hasanpour Z, Hamraz I. Psychometric Evaluation of the Persian Version of the Tinnitus Cognitions Questionnaire. *Aud Vestib Res.* 2025;34(1):?-?.

### Article info:

Received: 17 Feb 2024

Revised: 13 Mar 2024

Accepted: 05 May 2024

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**Short running title:** Psychometric Evaluation of the Persian...

### Highlights:

- P-TCQ is an appropriate tool for cognitive evaluation of tinnitus patients
- CBT is an evidenced-based tinnitus management approach
- The TCQ can be used along with the THI to evaluate tinnitus patients

### ABSTRACT

**Background and Aim:** Cognitive Behavioral Therapy (CBT) is the only evidence-based and method for tinnitus management. To assess a patient's progress during and after CBT, an assessment tool such as a questionnaire is needed. Since there is no validated tool available in Iran for this purpose, this study aims to investigate the psychometric properties of the Persian version of the Tinnitus Cognition Questionnaire (P-TCQ).

**Methods:** The TCQ was first translated to Persian based on the international quality of life assessment protocol. participants were 102 tinnitus patients and 7 audiologists. After translation and data collection, psychometric properties (content validity, face validity, construct validity, criterion validity, reliability) of the P-TCQ were evaluated.

**Results:** The Content Validity Ratio (CVR) and Item-Content Validity Index (I-CVI) values were higher than the minimum acceptable values (0.74 and 0.79, respectively). Item-level Face Validity Index (I-FVI) and average of Scale-level Face Validity Indexes (S-FVI) were in a range of 0.8-0.96 and 0.88-0.90, respectively, all of which were higher than the acceptable value of 0.7. Furthermore, fit indices had higher than the acceptable values and showed the good fit of the confirmatory factor analysis model. There was a positive correlations between the TCQ total scores and the tinnitus handicap inventory ( $r=0.60$ ) and hospital anxiety and depression scale ( $r=0.61$ ),

indicating acceptable criterion validity. Furthermore, Cronbach's alpha coefficient and the intraclass correlation coefficient showed that the TCQ has acceptable reliability.

**Conclusion:** The P-TCQ is a valid and reliable questionnaire to evaluate the cognitive aspects of tinnitus in the Iranian samples.

**Keywords:** Tinnitus; cognition; tinnitus cognitions questionnaire; cognitive behavioral therapy; tinnitus handicap inventory

## Introduction

Individuals with tinnitus report hearing a buzzing, ringing, or other sounds in the absence of external sound source. These sounds are either heard in the head or ears. According to studies, the global prevalence of tinnitus ranged from 4% to 37% [1, 2]. Although there are different theories about tinnitus, a single theory or mechanism could not explain the mechanism of tinnitus, because it is a heterogeneous disorder and various factors can be involved. Tinnitus can cause a wide range of problems and is usually associated with hearing loss, hyperacusis, anxiety, depression, and sleep disorders. People suffering from tinnitus have reported that their daily lives are severely disturbed by tinnitus [3, 4]. Unfortunately, there is no cure for tinnitus but there are methods by which specialists can improve the affected people's quality of life. These approaches include medical treatment, sound therapy, use of hearing aids, tinnitus retraining therapy, mindfulness-based stress reduction therapy, acceptance and commitment therapy, and Cognitive Behavioral Therapy (CBT). Among these approaches, CBT is an evidence-based practice and has a strong research background supporting its effectiveness for tinnitus [3, 5-9]. Many different questionnaires are used for tinnitus evaluation. Questionnaires are among the most effective and easy-to-use tools for clinicians. We need questionnaires to assess patients' progress before, during, and after intervention. As CBT focuses on the cognitive aspects of tinnitus, we need a questionnaire with the same purpose. One of these questionnaires is the Tinnitus Cognitions Questionnaire (TCQ) [10]. There are about 110 million Persian speakers worldwide, including Iranians, Tajiks, and Afghans [11, 12]. Since there is no Persian version of TCQ available, this study aimed to translate and validate the Persian version of TCQ for the Iranian samples.

## Methods

This is a cross-sectional study with a psychometrics approach that was conducted in 2021–2023 at Iran University of Medical Sciences. Written informed consent was obtained from participants before the study. All of the participants filled out the consent form. The stages of this research included: translation, validity evaluation (content validity, face validity, construct validity, and criterion validity), and reliability evaluation. For the evaluation of content validity, the opinions of 7 audiologists who were expert in the tinnitus management were used. Face validity was determined according to the opinions of 7 audiologists and 26 tinnitus patients. For construct validity and criterion validity evaluations, the Persian versions of the Tinnitus Handicap Inventory (THI), the Hospital Anxiety and Depression Scale (HADS), and the P-TCQ were completed by 102 patients from four centers in Tehran, Iran (Milad Hospital, Firoozgar Hospital, Mollasadra Hearing Center, and the audiology clinic of the School of the Rehabilitation Sciences). We also examined each patient's audiogram and immittance test results (including tympanometry and acoustic reflexes), followed by tinnitus tests and obtaining Pitch Matching (PM), Loudness Matching (LM), Minimum Masking Level (MML), and Residual Inhibition (RI). For assessing reliability, 46 tinnitus patients completed the TCQ with a 2-week interval. The demographic information of participants are presented in Table 1. Their mean hearing thresholds at frequencies of 250, 500, 1000, 2000, 4000, and 8000 Hz at the right and left ears are shown in Figure 1.

## Translation

The TCQ, originally developed by Peter H. Wilson and Jane L. Henry, is a measure to assess a person's cognition associated with tinnitus. In addition, this questionnaire is an important tool for the evaluation of efficiency and outcome in tinnitus cognitive management. It has 26 items measuring negative and positive cognitions (each with 13 items). Each item is rated on a 5-point Likert scale as: never, rarely, occasionally, frequently, and very frequently. The negative items are scored 0–4, while positive items have reversed scoring (4–0). The total score ranges 0–104, with higher scores representing more tendency to engage in negative cognitions in response to tinnitus and low engagement in positive cognitions [13, 14].

The translation of the TCQ from English to Persian was done based on the international quality of life assessment protocol and the language translation and cultural adaptation of guidelines [15, 16]. Despite our efforts to contact

the authors, we could not reach them. Before beginning the translation process, all translators were provided with the necessary information about the study objectives, the target group, and the content of the questionnaire. For forward translation, two translators (translators 1 and 2) who were fluent in English, separately translated the items to Persian. The translated version was given to other two bilingual translators (translators 3 and 4). They reviewed the translation quality in terms of three factors: clarity (easy to understand), use of common language, and similarity to the main version. They rated on a 5-point Likert scale for each item. For backward translation, the Persian version was given to other bilingual translators (translators 5 and 6) for translation into English. In a session between the researchers and translators 5 and 6 for comparing the main version with the translated version in terms of conceptual and lexical similarities, the final Persian version of the TCQ was obtained.

### **Content validity**

For the evaluation of content validity, as mentioned before, 7 audiologists scored the necessity of each item based on a three-point scale (necessary, useful but not necessary, not necessary) as well as the relevance of each question based on a four-point scale (completely relevant, relevant but needs revision, somewhat relevant, irrelevant). The Content Validity Ratio (CVR) and Item-Content Validity Index (I-CVI) were then evaluated. The CVR was obtained according to Lawshe's method and using the following formula for each item:  $CVR = (n_e - N/2) / (N/2)$ , where  $n_e$  is the number of experts marked an item as "essential", and  $N$  is the total number of experts.

### **Face validity**

For the evaluation of face validity, as mentioned before, 33 participants (7 audiologists and 26 tinnitus patients) rated the items based on two criteria: fluency (clarity and comprehensibility) and adaptability to the Iranian culture on a six-point Likert scale: very low (1 point), low (2 points), moderate (3 points), high (4 points), very high (5 points) and excellent (6 points). Generally, the scores 4, 5, and 6 were considered suitable. The Item-level Face Validity Index (I-FVI), item impact score, and the average of Scale-level Face Validity Index (S-FVI) were used for the evaluation of the face validity. The I-FVI was calculated as:  $I-FVI = (\text{agreed item}) / (\text{number of raters})$ . the average of S-FVI was calculated as:  $S-FVI(Ave) = (\text{sum of I-FVI scores}) / (\text{number of items})$ . Also, the item impact score was calculated as:  $\text{frequency} (\%) \times \text{importance}$ .

### **Construct validity and criterion validity**

To evaluate the construct validity, we assessed the internal correlation between two subscales and items of TCQ using the Confirmatory Factor Analysis (CFA). In this regard, Comparative Fit Index (CFI), Tucker-Lewis's coefficient Index (TLI), Item Fit Index (IFI), and Root Mean Square Error of Approximation (RMSEA) were reported. For criterion validity evaluation, we assessed the relationship between the scores of the Persian TCQ and the Persian THI. Since there is a direct relation between the handicap caused by tinnitus and the patient's cognitive problems, the THI can be a good tool for this comparison. The THI has three subscales of emotional, functional, and catastrophic. Emotional and catastrophic subscales are caused by the cognition associated with tinnitus. Therefore, to evaluate the criterion validity, these two subscales of THI were used.

### **Reliability**

To evaluate the reliability of the Persian TCQ results, as mentioned before, tinnitus patients completed the TCQ with a 2-week interval. Cronbach's alpha coefficient and the Intraclass Correlation Coefficient (ICC) were used to assess the internal consistency and test-retest reliability, respectively.

### **Statistical analysis**

In this study, SPSS v.17 was used for statistical analysis.  $p \leq 0.05$  was considered statistically significant. For evaluating the relationship between the test and retest scores of each item and the relationship between the score of subscales and the total score of TCQ, we used Pearson's correlation test and Spearman's correlation test, respectively. The CFA were performed in AMOS v.24 software.

## **Results**

### **Validity assesment**

The minimum acceptable values for CVR and I-CVI are 0.74 and 0.79, respectively. In our study, both CVR and I-CVI values were higher than these acceptable values. Therefore, all items of the Persian TCQ were acceptable in terms of necessity and relevance. The I-FVI values for fluency and cultural adaptation were in a range of 0.8–0.96, and the S-FVI values for cultural adaptation and fluency were 0.88 and 0.90, respectively. The FVI value is acceptable if it is higher than 0.7. The item impact scores of all items were acceptable, since they were more than 1.5.

For construct validity, the correlation coefficients were in a range of 0.45–0.84. Also, the result of Spearman's correlation test for the relationship between negative and positive cognitions (two subscales of TCQ) was 0.40. The highest correlation value in the positive cognition subscale was for the items 16, 19, 20, and 23 ( $r=0.84$ ,  $0.81$ ,  $0.77$ , and  $0.76$ , respectively) and the highest correlation in the negative cognition subscale was for the items 4 and 7 ( $r=0.81$ , and  $0.84$ , respectively). Finally, fit indexes of the first-order CFA model (Figure 2) had acceptable values and showed the good fit of the model to the data (CFI=0.96, RMSEA=0.05, IFI=0.96, TLI=0.95,  $\chi^2/df=1.25$ ).

Table 2 shows the results of the correlation test between the THI score and the scores of TCQ subscales. As can be seen, THI had a high positive correlation with negative cognitions ( $r=0.61$ ). Furthermore, there was a high positive correlation between the negative cognitions and the emotional subscale of the THI ( $r=0.60$ ). Total scores of THI and TCQ also positively correlated to each other ( $r=0.60$ ). Moreover, the results showed a high positive correlation between the scores of TCQ and HADS ( $r=0.61$ ).

### **Reliability assesment**

The mean, standard deviation, Cronbach's alpha coefficient, and ICC for items, total score, and subscale scores of TCQ are shown in Table 3. The Persian TCQ had acceptable internal consistency ( $\alpha=0.93$  for the overall score and two subscales). The ICC ranged from 0.70 to 0.92 indicating stability over time. The item-total correlations was from 0.32 (item 1) to 0.72 (item 12).

### **Discussion**

Tinnitus is a common problem with a high prevalence around the world. This disorder can cause emotional and cognitive problems and the CBT is an efficient approach to remediate it. It is necessary to use a standard tool to assess cognitive problems in Iranian people with tinnitus. Thus, the main goal of this study was to provide Iranian audiologists with a standard tool to evaluate the cognitive aspects of tinnitus and assessing patients' progress after tinnitus interventions. In this regard, we evaluated the psychometric properties of the Persian version of the TCQ with the participation of 102 tinnitus patients and 7 audiologists. The results showed that the Persian TCQ had acceptable reliability and validity, and it can be used as a standard tool by Iranian audiologists for cognitive evaluation of tinnitus patients.

In this study, we assessed different types of validity including content validity, face validity, construct validity, and criterion validity. For assessing the content validity, we asked 7 audiologists to rate each TCQ items. Based on their opinions, all items ( $n=26$ ) had acceptable necessity and relevance. This is consistent with the results of other studies conducted on 200 tinnitus patients in Australia [13], 342 tinnitus patients in the UK [17], and 75 tinnitus sufferers in Japan [18]. These studies showed that TCQ can accurately assess cognitive problems in tinnitus patients. To evaluate the face validity, we asked 26 tinnitus patients to rate the items, and then we assessed I-FVI and the item impact scores. Based on the results, both I-FVI and impact scores were in the acceptable range. Consistent with other versions of TCQ, such as the Japanese version [18], the Persian version is clear and compehensible and has adaptability to the Iranian culture. Thus, we can use it for the Iranian population. Moreover, the results of construct validity using factor analysis revealed that the subscales of positive and negative cognitions are independent and have an inverse relationship with each other. To evaluate the criterion validity, we assessed the relationship of the TCQ score with the scores of THI (to show that TCQ can accurately assess the cognition problems of tinnitus patients) and HADS. The results yielded a high positive correlation. The presence of correlation between TCQ and HADS scores indicate that higher cognitive problems in tinnitus patients can increase their depression and anxiety [19-22]. Finally, high internal consistency and acceptable test-retest reliability showed that the Persian TCQ is a reliable tool for assessing cognitive problems in tinnitus patients.

### **Conclusion**

The Persian version of TCQ has acceptable validity and reliability. Therefore, it can be used by Iranian audiologists to evaluate their tinnitus patients after CBT. Moreover, we recommend that audiologists can use THI and HADS to select tinnitus management approaches since there is a high positive correlation between their scores and the TCQ score; high tinnitus handicap and hospital anxiety and depression are associated with more cognitive problems in tinnitus patients.

## Ethical Considerations

### Compliance with ethical guidelines

This study was approved by the Ethics Committee of Iran University of Medical Sciences with Ethical Code IR.IUMS.REC.1401.707.

### Funding

There was no funding source available for this study.

### Authors' contributions

MS: Conceptualization, study design, project administration, data acquisition, interpretation of the results, and manuscript drafting; SRP: Study design, supervision, data acquisition, interpretation of the results, and manuscript drafting; ZH: Data acquisition; IH: Statistical analysis, methodology, and software.

### Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

### Acknowledgments

The authors would like to thank Ms. Raha Nekoutabar, Ms. Anis Hosseini, Mr. Mahdi Farrebagha, Ms. Niloufar Abbasi, Ms. Nastaran Abbasi, and all who have contributed to this study. No funding was received for this study.

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Accepted Manuscript

Table 1. Demographic information of participants

Characteristics	Mean(SD)
Age (year)	53.93(14.10)
Pitch matching of tinnitus (Hz)	4172.06(2808.56)
Loudness matching of tinnitus (dB SL)	8.53(7.75)
Minimum masking level (dB HL)	56.48(21.21)
Tinnitus type	67% noise/33% tone
Tinnitus location	33% right ear/41.5% left ear/25.5% head
Gender	36.3% female/63.7% male

Table 2. Spearman correlation between the tinnitus cognitions questionnaire with the tinnitus handicap inventory and hospital anxiety and depression scale

Items	THI	Emotional	Functional	Catastrophic	HADS	Anxiety	Depression	TCQ	Positive TCQ	Negative TCQ
THI	1									
Emotional	0.93**	1								
Functional	0.93**	0.79**	1							
Catastrophic	0.78**	0.69**	0.60**	1						
HADS	0.58**	0.60**	0.50**	0.50**	1					
Anxiety	0.56**	0.59**	0.50**	0.47**	0.92**	1				
Depression	0.50**	0.51**	0.42**	0.44**	0.92**	0.69**	1			
TCQ	0.62**	0.60**	0.52**	0.59**	0.61**	0.55**	0.58**	1		
Positive TCQ	0.43**	0.41**	0.33**	0.38**	0.51**	0.41**	0.52**	0.82**	1	
Negative TCQ	0.61**	0.60**	0.52**	0.59**	0.53**	0.51**	0.46**	0.86**	0.44**	1

THI; tinnitus handicap inventory, HADS; hospital anxiety and depression scale, TCQ; tinnitus cognitions questionnaire

\*\* Significance level less than 0.001

Table 3. Test-retest and Cronbach's alpha coefficient of the tinnitus cognitions questionnaire

Domains	Items	Mean(SD)	Item total correlation	Pearson correlation (test-retest)	Cronbach Alpha
Negative thoughts	1	3.30(1.12)	0.32	0.78**	0.93
	2	1.86(1.57)	0.60	0.84**	
	3	1.43(1.60)	0.54	0.84**	
	4	1.84(1.51)	0.71	0.83**	
	5	2.24(1.51)	0.42	0.71**	
	6	2.82(1.39)	0.49	0.92**	
	7	1.77(1.55)	0.65	0.70**	
	8	2.11(1.49)	0.57	0.82**	
	9	1.30(1.53)	0.72	0.91**	
	10	1.80(1.61)	0.58	0.91**	
	11	2.01(1.58)	0.41	0.83**	
	12	1.06(1.41)	0.74	0.70**	
	13	0.89(1.41)	0.64	0.78**	
Positive thoughts	14	1.87(1.45)	0.56	0.81**	0.93
	15	1.56(1.54)	0.63	0.73**	
	16	1.01(1.27)	0.56	0.72**	
	17	1.08(1.49)	0.35	0.72**	
	18	0.63(1.05)	0.50	0.80**	
	19	1.11(1.28)	0.57	0.91**	
	20	1.53(1.45)	0.56	0.88**	
	21	1.44(1.37)	0.38	0.72**	
	22	1.41(1.40)	0.62	0.77**	
	23	1.07(1.19)	0.66	0.72**	
	24	1.18(1.24)	0.52	0.85**	
	25	1.57(1.43)	0.57	0.84**	
	26	1.21(1.29)	0.57	0.77**	

\*\* Significance level less than 0.001



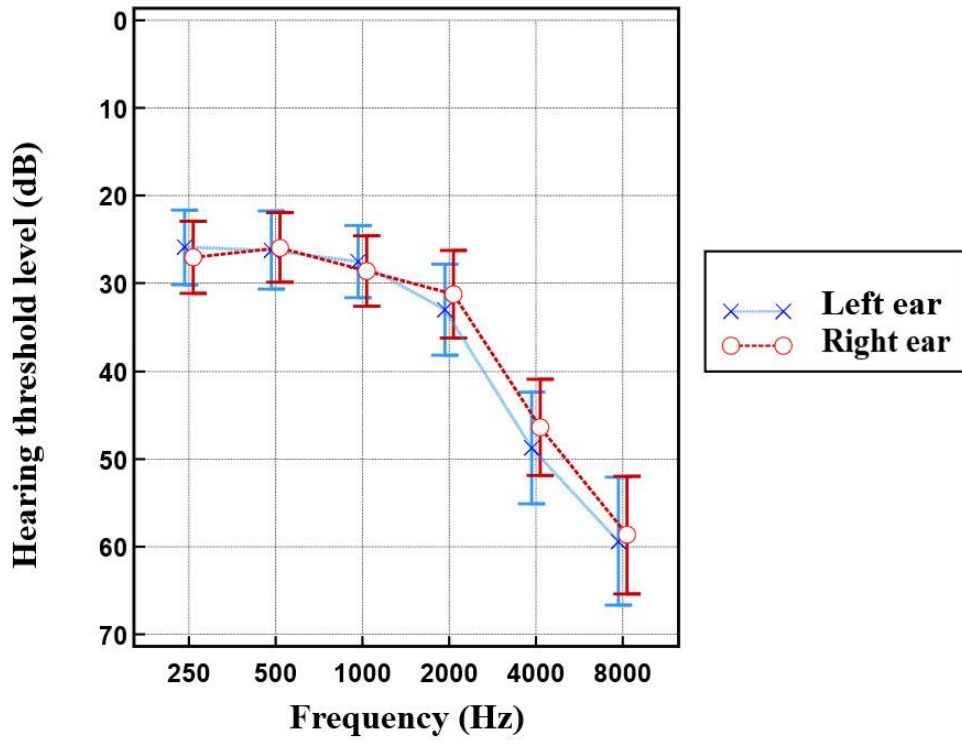


Figure 1. Mean hearing thresholds and standard deviations across audiometric frequencies at right and left ear

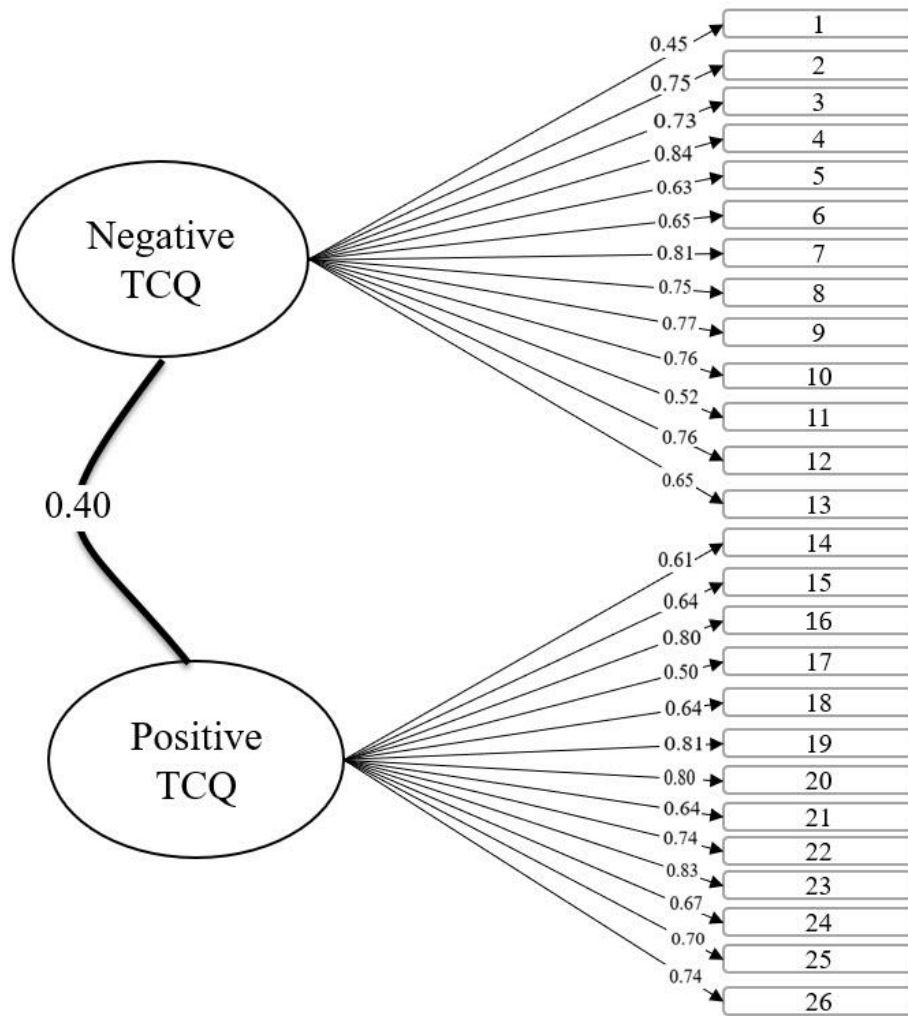


Figure 2. First-order original 2 factor structure derived by confirmatory factor analysis. TCQ; tinnitus cognitions questionnaire