Turkish Adaptation of Khalfa Hyperacusis Questionnaire

Khalfa Hiperakuzi Ölçeğinin Türkçeye Uyarlanması

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ABSTRACT

Objective: The aim of this study is to adapt Khalfa Hyperacusis Questionnaire (HQ) into Turkish for the use in the diagnosis and treatment of patients with hyperacusis.

Method: HQ and Beck Anxiety Inventory (BAI) were administered to a total of 529 participants (320 female, 209 male), aged 18 to 73 (mean age: 29.76±10.59) years who were randomly selected from the general population. For the evaluation of the data, confirmatory and exploratory factor analysis, correlation analysis, descriptive statistics, t-test, analysis of variance, and Sidak correction test were used.

Results: In the reliability analysis, the Cronbach’s alpha ($\alpha_C$) internal consistency coefficient was found to be 0.81. Factor analysis revealed three subdimensions (attentional, social, and emotional). The total variance of these three subdimensions were 63%, and the internal consistency of the subdimensions was also high ($\alpha_C >0.70$). Confirmatory factor analysis and structural equation modeling results indicated that three-factor solutions with 14 items met the criteria for the adequacy of fit among the Turkish patients. The mean score for hyperacusis was estimated as 15.69±6.63 points. There was a positive, weak, but significant association between hyperacusis and anxiety ($r=0.357$, $p=0.01$, $p<0.05$). The patients who were exposed to noise were found to have higher levels of hyperacusis, compared to those who were not ($t=6.78$, $p=0.01$, $p<0.05$). The patients who had decreased noise tolerance over time were found to be higher hyperacusis levels than those without ($t=4.83$, $p=0.01$, $p<0.05$).

Conclusion: Based on these measurements, 14 questions and three-factor solutions were found to be a valid and reliable tool.

Keywords: Hyperacusis, scale adaptation, auditory hyperesthesia, Khalfa Hyperacusis Questionnaire, Beck Anxiety Inventory

ÖZ

Amaç: Bu çalışmada hiperakuzi hastaların tanı ve tedavilerinde kullanılmak üzere Khalfa Hiperakusisi Ölçeği'nin Türkçeye uyarlanması amaçlandı.

Yöntem: Genel popülasyondan rastgele seçilmiş 18-73 yaş arası (M= 29.6, SD= 10.59) toplam 529 kişiye (320 kadın, 209 erkek) Türkçeye çevrilen Khalfa Hiperakusisi Ölçeği ve Beck Anksiyete Ölçeği uygulandı. Verilerin değerlendirilmesinde açıklamacı ve doğruluyucu faktör analizi, korelasyon analizi, tanımılcı istatistiksel yöntemler, t-testi, varyans analizi ve Sidak testi kullanıldı.

Bulgular: Yapılan güvenirlik analizinde Cronbach’ın alpha ($\alpha_C$) iç tutarlılık katsayısı 0.81 olarak tespit edildi. Faktör analizi sonucunda ise, üç adet alt boyut (dikkat, sosyal ve duygusal) tespit edildi. Faktör analizinin sonucunda ise, üç adet alt boyut (dikkat, sosyal ve duygusal) tespit edildi. Bu üç alt boyutun toplam varyansı %63 olarak bulundu ve alt boyutların iç tutarlılığı yüksek elde edildi ($\alpha_C >0.70$). Doğruluyucu faktör analizi ile yapılan uyum istatistiklerinin Türk hastalarından toplanan gerçek verilerle kabul edilebilen düzeyde uyumlulu olduğunu gösterdi. Hiperakusisi puanı ortalaması 15.69±6.63 olarak saplandı. Hiperakusisi ile anksiyete arasında pozitif yönde, düşük düzeyde güçlü ve anlamlı bir ilişki olduğu tespit edildi ($r=0.357$, $p=0.05$). Gürlütleme maruz kalan hastaların hiperakusisi düzeylerinin, gürlütleme mehr kalmayan hastalara kıyasla, daha yüksek olduğu tespit edildi ($t=6.78$, $p=0.05$). Zamanla gürlütleme olan tahammülerin azalma olan hastaların hiperakusisi düzeyleri, oynamalarla kıyasla, daha yüksek bulundu ($t=4.83$, $p<0.05$).

Sonuç: Yapılan ölçümler sonucunda 14 soru ve üç faktörü yapının geçerli ve güvenilir bir araç olduğunu sonucuna varıldı.

Anahtar kelimeler: Hiperakusisi, ölçek uyarlama, işitsel aşırı hassasiyet, Khalfa Hiperakusisi Ölçeği, Beck Anksiyete Ölçeği
INTRODUCTION

Hyperacusis has no single common definition. The situation has become difficult for patients, clinicians, and researchers due to its different definitions. According to the contemporary definition, hyperacusis in an individual with mostly normal hearing thresholds is intolerance to everyday sounds from the environment, which do not disturb other individuals1-3. Some authors that have focused on emotional status caused by hyperacusis have used the terms phonophobia (fear of sound)4 and misophonia (dislike of sound)5. Hyperacusis, phonophobia, and misophonia are subjective symptoms that resemble each other, and differentiation is difficult. In a review study, Tyler et al.6 examined different definitions and the contemporary approach, and to avoid the confusion in the diagnosis and treatment, they divided hyperacusis into four categories as loudness, annoyance, fear, and pain.

The scales used in the diagnosis and treatment of hyperacusis are of particular importance. The Hyperacusis Questionnaire (HQ)3, Multiple Activity Scale for Hyperacusis (MASH)7, and Questionnaire on Hypersensitivity to Sound (GÜF - Geräuschüberempfindlichkeit)8 are the most commonly used scales in the measurement of hyperacusis. MASH has been prepared in an interview format to be administered particularly to patients with tinnitus and this scale aims at measuring hyperacusis by asking patients their discomfort/distress in 15 different settings and activities (cinema, concert, work environment, driving, restaurant, etc.). GÜF was translated from German into English and validated by Bläsing et al.9, and this tool similarly measures subjective discomfort caused by sensitivity to sound. Khalfa et al.3 suggested that reactions to discomforting sound must be evaluated with regards to behavioral/adaptive, cognitive, and emotional aspects. The questions in HQ have been prepared in this context in anticipation of examining hyperacusis under these three subheadings. That would provide efficient evaluation in terms of diagnosis and treatment. The scale was administered to 201 individuals without applying any inclusion criteria, as the applicability of the scale on general population was investigated. The principal component analysis has produced three components (attention, social, and emotional dimensions). The total score in the scale is 42 points, and subjects scoring 28 points and above are considered to have hyperacusis.

In the present study, we aimed to adapt the hyperacusis scale developed by Khalfa et al.3 into Turkish language. We also evaluated the clinical usability of the Turkish version by assessing the validity and reliability of the scale to identify the subjects with and without hyperacusis based on their scores on this scale.

MATERIALS AND METHODS

Study population

In the present study, there were 529 participants (320 females and 209 males) recruited between January 2016 and August 2016. The ages of the participants ranged between 18 and 73 (mean: 29.76±10.59) years. The participants were recruited using two methods. Some (n=104) participants were recruited among Marmara University School of Medicine students and their friends and families. Ten of them were having hyperacusis complaints and seeking help. The other group consisting of 425 participants was recruited through Facebook and Twitter. Participants aged 18 years or over were included in the study and no other inclusion or exclusion criteria were applied, as the study investigated the applicability of the Turkish version of the scale on the general population.

In the original study of Khalfa et al.3, an average score of 14.97±6.79 was obtained on 201 participants on general population. In the present study, it was observed that the average score of 529 participants was 15.69±6.63. The power calculated over these average scores was found to be 0.99
and the effect size was 0.43. The study was found to have sufficient power.

The study was approved by the Marmara University Institute of Health Sciences Ethics Committee and conducted in accordance with the principles of the Declaration of Helsinki. A written informed consent was obtained from each participant.

**Data Collection Tools**

Two scales were used in the present study. The first scale is Khalfa Hyperacusis Questionnaire (HQ), which is the primary focus of the present study. The other scale is Beck Anxiety Inventory (BAI)\(^{10}\) that was used for the relationship between hyperacusis and anxiety. The Beck Anxiety Inventory was adapted to Turkish by Ulusoy et al.\(^{11}\). The Turkish adaptation of the scale has been found to have adequate reliability and validity. This inventory was completed by the participants providing consent for the study both in written and on the online form.

**Translation and Cultural Adaptation of the Questionnaire**

The questionnaire was translated from English to Turkish by four translators and two of them are native speakers of Turkish, bilingual in English. Translators have independently translated the original questionnaire into Turkish with the permission of the author. Afterward, we formed the pooled version that was then reviewed for the linguistic quality. The translated questions were initially applied to a group of fifteen participants; the eighth question’s examples are adapted culturally by removing “cocktail receptions” and adding “weddings” to maintain content integrity. This version was translated into English via a systematic forward-backward translation process and compared with the original questionnaire. The latest Turkish version of the questionnaire was administered to the participants (Appendix 1).

**Khalfa Hyperacusis Questionnaire**

The HQ is composed of two sections. The first section contains three questions inquiring previous noise exposure and general information about hearing. The second section contains 4-point Likert-type 14 questions. This section has attentional (questions 1-4), social (questions 5-10), and emotional (questions 11-14) dimensions. Only the second section of the questionnaire is scored (No= 0 points; Yes, a little= 1 point; Yes, quite a lot= 2 points; A lot= 3 points). The scores of the responses are summed. The maximum total score is 42 points. A score of ≥28 indicates hyperacusis.

**Beck Anxiety Inventory**

The BAI is composed of 21 items. This inventory is a Likert-type self-assessment tool. Each item is rated from 0 to 3 points (Not at all= 0 points; Mildly, but it didn’t bother me much= 1 point; Moderately - it wasn’t pleasant at times= 2 points; Severely - it bothered me a lot= 3 points). The anxiety level is measured based on the total score on this scale (0-7 points= minimal, 8-15 points= mild anxiety, 16-25 points= moderate anxiety, 26-63 points= severe anxiety).

**Statistical Analysis**

Statistical analysis was performed using the SPSS 22.0 software package and AMOS 23.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics included frequency, percentage, mean, and standard deviation. Exploratory factor analysis (EFA) was used to uncover the structure of the scale dimensions, and confirmatory factor analysis (CFA) was used to determine the factor structure. Cronbach’s alpha analysis was used to test internal consistency of subdimensions and reliability of the scales. One-Sample Kolmogorov-Smirnov (K-S) test was used to see whether the data was normally distributed. T-test was used to analyze the difference between measurements of two groups in the subdimensions. Analysis of variance (ANOVA) was used to compare three groups and Sidak test was used in paired comparisons (post-hoc). Correlation analysis was performed to test the relationship between subdimensions. A p value of less than 0.05 was considered statistically sig-
significant. Power and effect size calculations were determined with G*Power Version 3.1.7.

RESULTS

Results of Reliability and Validity Analyses

The HQ was found to be a considerably reliable tool based on the results of Cronbach’s alpha analysis that was performed to evaluate the reliability of 14 items of the scale (Cronbach’s alpha value of .81). As a result, no item was omitted from the scale. After controlling for the test reliability, factor analysis was performed to determine subdimensions.

Three subdimensions were identified according to the factor analysis. This includes attentional, social, and emotional subdimensions (Table 1). The Kaiser-Meyer-Olkin (KMO) coefficient was 0.81 in factorial analysis that calculated the adequacy of sampling. This coefficient indicates that 529 participants are adequate to reveal the construct of subdimensions (a KMO>0.70 is adequate for factor analysis). Furthermore, the acquired dimensions are structurally significant according to the Bartlett test evaluating the significance of factor structures ($X^2=4507.22$ $p=0.01$, $p<0.05$)

The three subdimensions are able to explain 63% of total variance contained in the data. When the subdimensions are evaluated individually, attentional dimension explains 26% of total variance, yielding an internal consistency of .75. Social dimension explains 20% of total variance, yielding an internal consistency of .77. Emotional dimension explains 17% of total variance, yielding an internal consistency of .73. The analysis showed that 14 expressions in the HQ have met the conditions for reliability and structural validity.

The analysis of the goodness of fit following factor analysis yielded a $X^2/df$ value of 3.899 and this value indicates a very good model fit. The Goodness of Fit Index (GFI) was 0.91, Adjusted Goodness of Fit Index (AGFI) was 0.882, Root Mean Square Residual (RMR) was 0.03, Root Mean Square Error of Approximation (RMSEA) was 0.068. The goodness of fit statistics calculated by the confirmatory factor analysis showed that the model was consistent at an acceptable level with the real-life data obtained from the Turkish participants. Based on these results, the results of confirmatory factor analysis were found to be valid in determining the structural validity of the scale.

Questionnaires

The mean hyperacusis score of the study participants was 15.69±6.63 points. There was a low but significantly positive (linear) correlation between the HQ and BAI ($r=0.37$, $p<0.01$). The relationship between the severity of anxiety and hyperacusis scores is shown in Table 2.
educational levels showed that participants with an educational level of high school or lower had lower hyperacusis scores compared with the participants with university or higher-level education (F = 2.63, p = 0.02, p < 0.05).

There was no significant relationship between hyperacusis scores of the participants and their ages (r = 0.09, p = 0.61, p > 0.05).

Participants with a history of noise exposure had higher hyperacusis scores than those without a history of exposure (t = 6.78, p < 0.05). Participants with decreasing tolerance to noise in time had higher hyperacusis scores than participants without any change in the tolerance to noise (t = 4.83, p < 0.05). Gender and history of hearing loss had no significant effect on the hyperacusis scores (Table 3).

Table 3. Relationship Between Khalfa Hyperacusis Questionnaire, Noise Exposure, Time-Tolerance Effect, Hearing Problem, Gender.

| Khalfa Hyperacusis Questionnaire | n   | X    | SD  | t    | p    |
|---------------------------------|-----|------|-----|------|------|
| Noise Exposure                  |     |      |     |      |      |
| Yes                             | 437 | 16.59| 6.40| 6.78 | 0.01 |
| No                              | 87  | 11.54| 6.11| 4.83 | 0.01 |
| Time Influence                  |     |      |     |      |      |
| Yes                             | 366 | 16.69| 6.46|      |      |
| No                              | 154 | 13.69| 6.48| 1.73 | 0.08 |
| Hearing Impairment              |     |      |     |      |      |
| Yes                             | 74  | 16.97| 7.09| -0.14| 0.88 |
| No                              | 450 | 15.54| 6.54|      |      |
| Gender                          |     |      |     |      |      |
| Male                            | 209 | 15.64| 6.59|      |      |
| Female                          | 320 | 15.72| 6.66|      |      |

n: Sample Size; X: Hyperacusis score mean; SD: Standard Deviation, t: t test, p: Significance.

**Khalfa Hyperacusis Questionnaire and the Complaint of Hyperacusis**

The HQ was administered to ten patients presenting to our clinic with complaints of hyperacusis. The scores ranged from a minimum of 15 points to a maximum of 34 points. The mean score was 25.1 points.

**Interpretation of the Scores**

Khalfa et al.\(^3\) suggested a 28-point criterion by adding two standard deviations to the mean of total scores, while 29-point criterion is suggested for the Turkish version of the HQ. In addition to this suggestion, two categories were created as “suspected hyperacusis” in participants with 15 to 28 points, and “complete hyperacusis” in participants with 29 points and higher based on our study on patients with hyperacusis and studies in the literature. The data obtained from the present study are presented in Table 4.

Table 4. Hyperacusis results.

| Hyperacusis group                                      | n   | %    |
|--------------------------------------------------------|-----|------|
| No hyperacusis (less than 15)                          | 233 | 44.0 |
| Suspected hyperacusis (15-28 points)                   | 279 | 52.7 |
| Complete hyperacusis (29 points or higher)             | 17  | 3.2  |

**DISCUSSION**

A gradual increase has been observed in the number of patients presenting to our clinic with hyperacusis within the last few years. This increase can be attributed to the urban noise exposure, increasing number of patients with tinnitus presenting to the clinics, and increasing accessibility to health care services. There is an increasing demand for tools to be used to measure sound sensitivity in a growing patient population. The HQ is widely used in this field and it was translated into many different languages. The aim of the present study was to bridge the gap for a validated, standardized, simple, and psychometrically strong scale for use in the Turkish language. This study, therefore, evaluated the psychometric characteristics of the HQ.

The Turkish version of the HQ showed satisfactory internal consistency (Cronbach’s alpha: .81) in the analysis. The authors did not feel the need to omit any item from the questionnaire. Following evaluation of reliability, factor analyses were performed to determine subdimensions and three dimensions were acquired. These were named as attentional, social, and emotional dimensions similar to that in the original scale. The three sub-
dimensions explained 63% of total variance contained in the data (Table 1). The goodness of fit statistics calculated following confirmatory factor analysis showed that the model was consistent at an acceptable level with the real-life data obtained from Turkish participants. According to these results, exploratory and confirmatory factor analyses showed that the structure was valid.

It is difficult to reach patient groups diagnosed with hyperacusis due to uncertainty in the definition of hyperacusis. Thus, it seems more reasonable to measure sensitivity to sound in general and interpret the results according to the distribution of total score by applying the measurement to the whole population. Normal distribution of total score indicates that the scale is sensitive in differentiating participants from the general population. The mean value and standard deviation reported in the study by Khalfa et al.\(^3\) (14.97±6.79) are considerably similar to the data obtained from the Turkish version of the scale (15.69±6.63). Therefore, 29-point criterion calculated according to the method proposed by Khalfa et al.\(^3\) can be suggested for use in the Turkish version of the questionnaire. The studies in the literature suggest that patients with a total score less than 28 points on the original scale might have different types of hyperacusis complaints and these patients must also be taken into consideration. In the study by Blomberg et al.\(^14\), when HQ was administered to the patients with Williams syndrome that were known to have high sensitivity to sound, only 13% of these patients met the 28-point criterion. In the study by Jüris et al.\(^15\), one-third of the patients suffering predominantly from hyperacusis achieved less than 28 points and the authors set the threshold to 24 points according to the results of descriptive statistics in their study. Fioretti et al.\(^16\) conducted a study on patients with tinnitus, and suggested that a score of 16 points must be determined as the criterion. In the study by Fackrell et al.\(^17\), there were only 19 patients with hyperacusis among 264 patients with tinnitus according to 28-point criterion. Meeus et al.\(^18\) reported that the majority of patients with tinnitus and hyperacusis achieved less than 28 points.

The Turkish version of the HQ was administered to 10 patients, who presented to our clinic complaining of hyperacusis and their scores ranged from 15 to 34 points with a mean score of 25.1 points. As the authors of the present study have shared the same concerns in the literature, classification as “suspected hyperacusis” and “complete hyperacusis” seemed reasonable considering the current analysis on patients with hyperacusis. The aim of the authors was to avoid underdiagnosing patients with hyperacusis and detect patients with various types of hyperacusis using the Turkish version of the HQ.

When hyperacusis is categorized as loudness, annoyance, fear, and pain; the scale to be administered should be able to analyze this classification. However, misophonia and phonophobia are not regarded as hyperacusis due to various definitions in the literature. The term hyperacusis is used only to refer to loudness hyperacusis. However, the lack of a relationship between uncomfortable loudness level (ULL) and hyperacusis in some studies does not justify this usage.\(^16,18\) The item “Do noise and certain sounds cause you stress and irritation?” in the HQ evaluates annoyance hyperacusis and the entity termed as misophonia. Baguley\(^19\) suggested that avoidance is the basic mechanism of hyperacusis. This causes a vicious cycle due to “homeostatic plasticity” and “gain control” mechanisms.\(^20,21\) The items “Do you even turn down an invitation or not go out due to the noise you would have to face?” and “When someone suggests doing something (going out to the cinema, to a concert, etc.), do you immediately think about the noise you are going to have to put up with?” are used to evaluate avoidance in the HQ.

The examination of the relationship between the items in the first section of the scale and total hyperacusis score provides information about the na-
tecture of hyperacusis. Although it is hard to speculate on the observation of increasing hyperacusis scores with increasing educational level of the participants, this can be attributed to the changes in perception of normality or the changes in the level of awareness with increasing educational level.

The relationship between anxiety and hyperacusis emphasized in the study by Blaesing and Kroener-Herwig was also observed in the present study. The participants with lower scores in the BAI achieved lower hyperacusis scores, whereas participants with higher scores in the BAI achieved higher hyperacusis scores (Table 2). These findings support the results of other studies in the literature and indicate the effects of hyperacusis on the mood state.

Exposure to noise is thought to be one of the most important factors associated with hyperacusis. There are studies in the literature highlighting exposure to noise coupled with increasing complaints of hyperacusis. Similar to the literature, the present study found higher hyperacusis scores in participants with a history of exposure to noise (Table 3).

Participants with a decrease in tolerance to noise in time had higher hyperacusis scores (t=3, p<0.05). This finding shows that sensitivity to sounds does not remain stable and may change in time. Additionally, findings of the study support the literature that there is lack of a relationship between hearing impairment and hyperacusis scores (Table 3).

There were only 10 patients with complaints of hyperacusis. With the increase in this number, it will be possible to have much information about the functionality of new diagnostic categories.

**CONCLUSION**

In conclusion, there is no established gold standard method in the measurement of hyperacusis. Detailed history taking is considerably important and the scales are appropriate tools in evaluating diversified characteristics of hyperacusis. The assessments in the present study showed that the scale containing 14 items and three-factor solutions is a valid and reliable tool for measuring hyperacusis.

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Appendix 1

Hiperaküzi Ölçeği

Adınız:  
Soyadınız:  
Cinsiyet: Erkek / Kadın  
Yaş:  
Meslek veya okudugunuz bölüm:  
Yaşadığınız yer:  
Telefon:  
Gürültüye maruz kalyor musunuz ya da kaldıınız mı?  
Birkaç sene öncesine göre gürültüye tahammülüüz daha mı az?  
Hiç işitme sorununuz oldu mu? Eğer olduysa, ne tür bir sorun {

| Aşağıdaki ankette size en uygun olan yanıt çarpi ile işaretleyiniz: | Hayır | Evet, biraz | Evet, oldukça | Evet, çok fazla |
|---------------------------------------------------------------|-------|-------------|---------------|----------------|
| 1. Gürültü algısını azaltmak için kulak tıkacı ya da kulaklık kullanıldığız oldu mu (normal yüksek sese maruz kaldığınız durumlardaki kulak koruyucusu kullanımınızı dikkate almayınız)? |       |             |               |                |
| 2. Günlük yaşamında, etrafınızda seslere kayıtsız kalmakta zorlanır mı즈ınız? |       |             |               |                |
| 3. Sesli veya gürültülü ortamlarda okumakta zorlanır mızınız? |       |             |               |                |
| 4. Gürültülü ortamlarda dikkatinizi toplamakta zorlanır mızınız? |       |             |               |                |
| 5. Gürültülü ortamlarda konuşmaları takip etmekte zorlanır mızınız? |       |             |               |                |
| 6. Tanıdığınız birinin size, gürültüye ya da belli seslere tahammül edemediğini söylediğiniz hiç oldu mu? |       |             |               |                |
| 7. Sokak gürültüsüne karşı özellikle hassas mızız da sizi rahatsız eder mi? |       |             |               |                |
| 8. Bazı sosyal durumlarda sesleri rahatsız edici bulur musunuz (düğünler, barlar, konserler, havai fişek gösterileri)? |       |             |               |                |
| 9. Birisi size bir şeyler yapmayı teklif ettiği (dışarı çıkmak, sinemaya ya da konsere gitmek vb.) ilk aklınıza gelen katlanmak zorunda kalacağınız gürültü mü olur? |       |             |               |                |
| 10. Karşılaştığınız gürültüden çekinerek, bir daveti geri çevirdiğiniz ya da dışarı çıkmaktan vazgeçtiğiniz olur mu? |       |             |               |                |
| 11. Sessiz olan bir ortamda karşılaştığınız gürültü ya da belli sesler, sizi nispeten sessiz olan bir ortamda minden daha mı çok rahatsız eder? |       |             |               |                |
| 12. Stres ve yorgunluktur, gürültüde dikkatinizi toplama yeteneğiniz azalır mı? |       |             |               |                |
| 13. Günün sonuna doğru gürültüde dikkatinizi toplamakta zorlanır mızınız? |       |             |               |                |
| 14. Gürültü ve bazı sesler size stres ve rahatsızlığa neden olur mu? |       |             |               |                |