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The Turkish Short Version of the Speech, Spatial, and Qualities of Hearing Scale (SSQ) for Clinical Use: Determining Reliability and Validity for People with and without Hearing Loss on the Basis of SSQ12-A, SSQ12-B, SSQ12-C

ABSTRACT

Objective: This study was aimed at analyzing the validity and reliability of a Turkish shortened version of Speech, Spatial and Qualities of Hearing (SSQ) scale for adults using hearing aids and/or cochlear implants. The analysis was based on three forms of the SSQ, namely, SSQ12-A, SSQ12-B, and SSQ12-C.

Methods: A total of two hundred and fifty-eight individuals with moderate or moderate-to-severe (n=98), severe or very severe hearing loss (n=71) and normal hearing (n=89) from four centers participated in our study. SSQ12-A was administered to individuals who were suffering from hearing loss, and with normal hearing but were not previously fitted with a hearing aid. SSQ12-B was distributed to individuals who had been using a hearing aid for at least 6 months, and SSQ12-C was administered to individuals who had been using cochlear implants for at least 6 months. SSQ12-A was then re-administered to 27 individuals with hearing loss for the reliability of the questionnaire.

Results: The internal consistency and reliability of all the three questionnaires were high (Cronbach's $\alpha=0.96$, $\alpha=0.96$, and $\alpha=0.84$, respectively). Individuals with moderate hearing loss derived higher scores than did the individuals with severe or very severe hearing in SSQ12-A and SSQ12-B. No statistically significant difference was found between the scores ($p > 0.05$) of the respondents in the first and second rounds of SSQ12-A administration.

Conclusions: The Turkish shortened version of the SSQ is a valid and reliable questionnaire for assessing hearing function. The three forms of the SSQ12 are useful for evaluatinghearing impairment and in organizing rehabilitation programs.

Keywords: Speech, Spatial hearing, Hearing loss, Reliability and validity

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INTRODUCTION

Hearing loss is the most common health problem which affects the auditory function of more than 360 million people worldwide.[1] Although the causes of hearing loss differ and its effects on daily life vary by region, the disorder is associated with the loss of sound perception. .[2] For hearing loss assessment, certain terminologies such as "hearing functioning", "handicap", and "disability" are used. Handicap and disability are evaluated subjectively along with the effects of hearing loss, whereas hearing function is evaluated purely through sound threshold measurement.[2,3] In most clinics, only audiometry tests are used, but hearing handicap and disability scales are also required to adequately define and diagnose the disorder.[4,5] are numerous questionnaires and scales have been designed to evaluate hearing loss on the basis of different aspects (listening in the presence of noise, and spatial aspects of listening) and to direct auditory rehabilitation processes.[5,6] An example is the Speech, Spatial and Qualities of Hearing Scale (SSQ) which was developed to evaluate hearing under experimental conditions and with respect to behavioral aspects.[5] The scale has been usedused to assess changes in performance over time in adults with cochlear implants and the succeeding performance of bilateral cochlear implant applications.[7,8] It has also been adopted to compare non-users and users of hearing aids in terms of benefits

and determine the effectiveness of bilateral hearing aids. The SSQ, which consists of 49 items, is intented to evaluate different aspects of speech and spatial hearing and hearing ability in daily life.[5] Certain versions are designed to measure the benefits of t interventions or to compare different interventions. . For fast and routine evaluations, short versions such as SSQ5, SSQ12, and SSQ15 were developed.[9,10] In extensive clinical studies, similar results are derived using SSQ12 and SSQ49, but shorter versions of the latter are used more frequently.[10] According to Noble et al.,[9] the average performance of the SSQ49 scale, which is sensitive to different hearing situations, is close to that of the SSQ12 scale. In our study, the validity and reliability of a Turkish version of SSQ12 for individuals with hearing aids and/or cochlear implants were examined, and the long-term benefits of amplification interventions were compared. The analysis was grounded on the basis of SSQ12-A, SSQ12-B, and SSQ12-C.

METHODS

This study was approved by the Ethics Committee of Ankara Yıldırım Beyazıt University University and was carried out in accordance with the Helsinki Declaration , Informed consent was obtained from all the participants before the initiation of the research. Before commencement, as well, permission to translate the English SSQ and SSQ12 scales into Turkish was acquired. The sample consisted of 258 individualswhose native language is Turkish and who were monitored in four centers. The participants were divided into three groups according to the extent of hearing loss. The first group consisted of 89 individuals (42 males, 47 females) with normal hearing and aged 18 to 40 years (mean age 27.2 ± 4.2 years). The second group comprised 98 individuals (43 males, 55 females) with moderate or moderate-to-severe hearing loss and aged 18 to 80 years (mean age 51.04 ± 16.89 years). To the third group belonged 71 individuals (33 males, 38 females) with severe or very severe post-lingual hearing loss and aged 18 to 40 years (mean age 28.59 ± 13.53 years). For all participants, air conduction tests on both ears were conducted at octave frequencies of 125-8000 Hz; bone conduction threshold measurements at octave frequencies of 500-4000 Hz were carried out in a sound-treated booth, and the pure-tone average (500, 1000, 2000, and 4000 Hz) was calculated. The three SSQ versions were administrated to the participants in accordance with their statuses and and the features of the scales. Participants with indications of amplification were tested using SSQ12-A (258 individuals) before amplification. Those who had been using a hearing aid for at least 6 months were administered SSQ12-B (169 individuals), and participants who had been using cochlear implants after at least 6 months were given SSQ12-C (71 individuals). The mean duration of amplification use was 3.67 ± 3.16 years in the hearing aid group, whereas the mean duration of cochlear implant use was 5.47 ± 4.2 years in the cochlear implant groups.

Turkish Version of SSQ12

The SSQ (Gatehouse & Noble, 2004) is a self-report questionnaire consisting of 49 items designed to measure auditory impairment in different listening situations. The SSQ49 scale consists of 10 pragmatic subscales (speech in quiet, speech in noise, speech in speech contexts, multiple speech stream listening, localization, distance and movement, segregation, identification of sound, quality and naturalness, and listening effort). These 49 questions consist of general hearing skills such as speech perception, spatial hearing and listening effort[5.] The SSQ12 questionnaire is the shorter version of the questionnaire derived from the SSQ49 and consists of three subscales (hearing, speech and quality) similar to the SSQ49 questionnaire. Questions (1 - 5) of the SSQ12 are related to speech (hearing items), the next three questions (6 - 8) are related to spatial hearing (spatial hearing items) and the last four questions (9 - 12) are related to hearing quality (qualities of hearing items). . . The SSQ can be successful in revealing the effects on the hearing process in different listening situations as well as situations in which different hearing aid fitting strategies are used. Therefore, different versions of the SSQ questionnaire have been developed to determine the benefits provided by hearing aids[11] Although it has the same questions as the original SSQ, the SSQB scale is used to assess how participants' experiences with hearing aids compare to their experiences before using hearing aids. The evaluation method used in the SSQ- B scale is a visual analog scale used to compare results with the initial listening situation. The SSQ12-A form is the questionnaire in which the individual is evaluated without the hearing aid, the SSQ12-B form evaluates both before and after hearing aids are used, and the SSQ12-C is the questionnaire evaluates the first device used by the individual and the use of another device or cochlear implant.[9] According to the scoring scheme for each item in the original SSQ and SSQ-A scale (from 0 to 10), the left side of the visual scale ("0") indicates inability or the absence of a skill, while the right side of the scale indicates competence. Therefore, participants are evaluated by giving each item a score out of 10. The SSQ-B and SSQ-C were developed to investigate the characteristics of hearing and listening skills before and after using a hearing aid. In the SSQ-B scale, the right side of the zero is marked if it is better with the hearing aid in the situations indicated in each question, and the left side of the zero if it is worse with the hearing aid; "0" means nothing changes with the hearing aid, "+5" means much better in the indicated state, and "-5" means much worse in the indicated state[5] In one study, the responses obtained from all versions of the SSQ in individuals who do not wear a hearing aid were found to be very similar. The resulting differences were concluded to be due to the difference in hearing loss. No differences were observed in terms of rating between the SSQ A and SSQB utility scales[11]

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 23.0 (IBM SPSS Corp.; Armonk, NY, USA). The Kolmogorow–Smirnov test was used to evaluate the data normality assumptions, anddescriptive statistical analyses were evaluated by taking the mean scores of each SSQ12 version. Before performing factor analysis, Kaiser–Meyer–Olkin (KMO) and Bartlett's test of sphericity (BTS) measurements were performed to evaluate whether the sample size was sufficient. KMO values which were greater than 0.70 were considered good, and the scores which were greater than 0.90 were considered perfect. For the factor analysis of SSQ (-A, B, and C), Cronbach's alpha and item–total correlation were measured through an evaluation ofinternal consistency. The factor quantity was also evaluated and eigenvalues and scree plot curves were used to determine the factors showing high correlation in SSQ12-A, B, and C test items. Those with an eigenvalue greater than 1 were included in the evaluation.[12] The nonparametric Wilcoxon test was used to compare dependent variables,

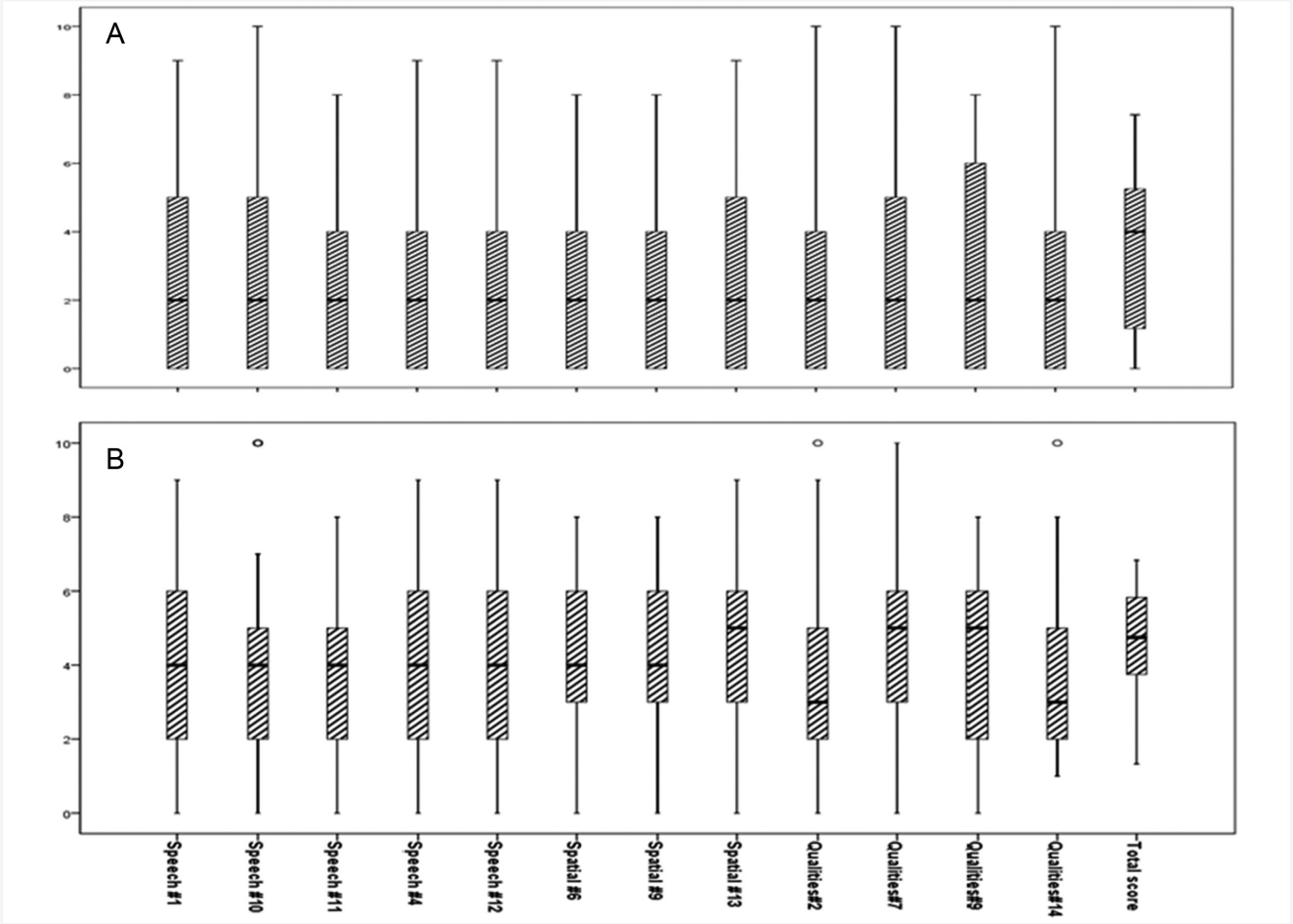

Figure 1.a,b. Box plots of the score for each item in Speech, Spatial and Qualities of Hearing scale (SSQ12) from hearing aids and cochlear implants (A), as well as the score for each item in SSQ12 from 98 hearing aids (B). The box represents the middle 50% of the data. The lower and upper outer lines that encase the box represent the 25th and 75th percentiles. Solid horizontal lines indicate the median.

and a chi-square test was used to analyze the categorical changes. An independent *t*-test was used to compare the data of individuals using hearing aids and cochlear implants, and for statistical comparison between genders. The significance level was accepted as 0.05 (5%).

RESULTS

Turkish Version of Speech, Spatial, and Qualities of Hearing Scale Form A (SSQ12-A)

The SSQ12-A mean score was found to be 7.2 ±1.1 in individuals with normal hearing. For individuals with normal hearing (N = 89), the KMO score was found to be 0.80, and the BTS result was $\chi 2 = 1491$, df = 78, p = 0.001. According to these results, the data that had been obtained for the SSQ12-A of individuals with normal hearing are suitable for factor analysis. For the SSQ12-A questionnaire given to individuals with normal hearing, three eigenvalues greater than 1 were found; the first factor was 45.6% of the total variance (eigenvalue = 5.9), the second factor was 10.3% of the total variance (eigenvalue = 1.3) and the third factor constitutes 9.4% (eigenvalue = 1.2) of the total variance. For SSQ12-A, the first factor consists of five questions that relate to localization and sound quality (4 - 6, 10, 11), the second factor consists of five questions that related to speech and spatial perception (1 - 3, 7, 8), and the third factor consists of two questions (9,12) that related to the quality of speech and segregation. While the mean value of SSQ12-A which had been applied before hearing aid use was 2.90 ± 2.40 in all individuals (169 individuals), the mean value was found to be 4.39 ± 1.58 in individuals with moderate-to-severe hearing loss (98 individuals), and 0.26 ± 0.58 in individuals with severe-and-very severe hearing loss (71 individuals) (Table 1). Item and total scores of SSQ12-A are illustrated in the box plot (Figure 1). For all individuals ($N = 169$), the KMO score was found to be 0.93, and the result for BTS was $\chi^2 = 4138$, $df = 66$, $P = .001$. According to these results, the data which had been obtained for SSQ12-A are suitable for factor analysis. The internal consistency coefficient was found to be 98.6 (correlation between questions 67 - 95) for the SSQ12-A questionnaire for individuals with hearing loss, in which questionnaire reliability was tested with Cronbach's alpha and item–total correlation coefficients. The Cronbach's alpha values of the three subscales of the SSQ12-A was calculated, and all values were found to be above the clinical usability level (0.7 critical value) (Speech, 0.89; Spatial, 0.78; and Qualities, 0.75).

Table 1. Mean SSQ12 A and B Scores and Standard Deviations for Moderate to Moderate-to-Severe (*n* = 98) and Severe to Very Severe Hearing Loss

	SSQ12A			SSQ12B		
Items	**MHL**	**SHL**	***P***	**MHL**	**SHL**	***P***
Q1	4.06 (2.01)	0.16 (0.41)	.001*	3.11 (1.78)	0.88 (0.32)	.001*
Q2	3.97(2.19)	0.23 (0.57)	.001*	2.90 (1.70)	0.94 (0.41)	.001*
Q3	3.81(1.94)	0.23 (0.57)	.001*	2.84 (1.83)	1 (0.34)	.001*
Q4	3.86 (2.09)	0.32 (0.77)	.001*	3.09 (1.56)	1.27 (0.75)	.001*
Q5	4.07 (2.05)	0.26(0.63)	.001*	2.98 (1.87)	1.05 (0.53)	.001*
Q6	4.05 (1.97)	0.29 (0.68)	.001*	1.98 (2.11)	1.11 (0.47)	.99
Q7	4.05 (1.90)	0.25 (0.52)	.001*	2.43 (1.97)	1.22 (0.42)	.001*
Q8	4.71 (2.28)	0.28 (0.63)	.001*	2.40 (2.06)	1.11 (0.32)	.001*
Q9	3.51 (2.05)	0.26 (0.63)	.001*	3.24 (1.85)	1.16 (0.38)	.001*
Q10	4.81 (2.63)	0.23 (0.57)	.001*	2.54 (1.94)	1.27 (0.32)	.001*
Q11	4.5 (2.41)	0.29 (0.68)	.001*	2.74 (2.08)	1.36 (0.72)	.001*
Q12	3.86 (1.95)	0.26 (0.63)	.001*	2.86 (2.02)	1.32 (0.80)	.001*
Overall scores	4.1 (1.77)	0.26 (0.58)	.001*	2.76 (1.60)	1.34 (0.61)	.001*

SSQ, Speech, Spatial and Qualities of Hearing scale; MHL, moderate or moderate to severe hearing loss; SHL, severe to very severe hearing loss.

These high α values indicate that the internal consistency coefficient reliability of the questionnaire is adequate. Scree plots and the eigenvalues values were analyzed to determine the factor quantity. Since the answers n given by individuals with severe hearing loss to each item in the questionnaire were close to zero value, the factor quantity of individuals with moderate and severe hearing loss were examined in two aspects. First, in SSQ12-A, two of the 12 questions of each questionnaire had been given to individuals with moderate and moderate-to-severe hearing loss of different types had eigenvalues which are greater than 1; , the first factor constituties 71.3% of the total variance (eigenvalue = 8.56), the second factor constitutes 15.7% (eigenvalue = 1.88) of the total variance. For SSQ12-A, the first factor consists of 10 questions (1-8, 10, 11) that related to speech and spatial perception such as speaking in the presence of noise and localization; and the second factor consists of 2 questions (9, 12) that related to speech quality such as segregation and listening effort (Table 2). Second, in the SSQ12-A given to all individuals with severe or very severe hearing loss, one eigenvalue greater than 1 was found, which constituties 67.5% of the total variance (eigenvalue = 8.1).

For reliability purposes, the questionnaire was reapplied and evaluated after an average of 3 months in 27 individuals with moderate and moderate-to-severe hearing loss. No significant differences were observed between the first overall mean (mean = 5.2, SD = 0.85) and the second overall mean (mean = 5.33, SD = 1.42) ($P > .05$) of the SSQ12A questionnaire. PPNo statistically significant difference was found among the individuals participating in our study in terms of gender difference ($P < 0.05$).

Turkish Version of Speech, Spatial and Qualities of Hearing Scale Form B (SSQ12-B)

SSQ12-B score average was 2.16 ± 1.46 in all individuals (169 individuals), 2.76 ± 1.6 in participants with medium and moderate-to-severe hearing loss (98 individuals), and 1.34 ± 0.61 in participants

Table 2. Factor Structure of SSQ12A in Individuals with Moderate to Moderate-Severe Hearing Loss

Scale Sub-Dimensions	Items	Factor Loading of the Items	Eigenvalues of the Factors	Variances Explained by the Factors
Factor 1	Q 1	0.868	8.59	71.6
	Q 2	0.915		
	Q 3	0.916		
	Q 4	0.912		
	Q 5	0.928		
	Q 6	0.928		
	Q 7	0.927		
	Q 8	0.933		
	Q 10	0.914		
	Q 11	0.780		
Factor 2	Q 9	0.777	1.41	11.8
	Q 12	0.770		

Kaiser–Meyer–Olkin Measure Of Sampling Adequacy (KMO) = 0.90.
Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization.

Table 3. Factor Structure of SSQ12b in Individuals with Moderate to Moderate-Severe Hearing Loss

Scale Sub-Dimensions	Items	Factor Loadings of the Items	Eigenvalues of the Factors	Variances Explained by the Factors
Factor 1	Q 1	0.913	8.56	71.3
	Q 2	0.858		
	Q 3	0.872		
	Q 4	0.868		
	Q 5	0.860		
	Q 9	0.761		
Factor 2	Q 6	0.949	1.88	15.7
	Q 7	0.886		
	Q 8	0.907		
	Q 10	0.905		
	Q 11	0.876		
	Q 12	0.679		

Kaiser–Meyer–Olkin Measure Of Sampling Adequacy (KMO) = 0.86.
Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization.

with severe and very-severe hearing loss (71 individuals) (Table 1). Item and total scores of SSQ12-B individuals are illustrated in the box plot (Figure 1). The KMO score for SSQ12-B was 0.86 and BTS result was $\chi^2 = 1908.2$, $df = 66$, $P = .001$ in individuals with moderate and moderate-to-severe hearing loss; KMO score was 0.86, and the BTS result was $\chi^2 = 847.73$, $df = 66$, and $P = .001$ in individuals with severe hearing loss. For all individuals, the KMO score was 0.92, and the BTS result was $\chi^2 = 3240.4$, $df = 66$, $P = .001$. The internal consistency coefficient of the SSQ12-B questionnaire, in which the questionnaire reliability was evaluated with Cronbach's alpha, was found to be 0.96 in individuals with hearing loss (item correlation 0.66-0.87), 0.95 in individuals with severe hearing loss (item correlation 63-88), and 0.96 in all individuals with hearing aids (item correlation 69-90). The Cronbach's alpha value of the three subscales of the SSQ12-B questionnaire was calculated, and all values were found to be above the critical level of 0.7 (speech, 0.86; spatial, 0.76; and qualities, 0.81). The SSQ12-B factor analysis of hearing aid users is illustrated in Table 3. In each questionnaire of 12 questions given to individuals with moderate and moderate-to-severe hearing loss, two eigenvalues greater than 1 were found for SSQ12-B; the first factor constituted 71.4% of the total variance (eigenvalue = 8.56), the second factor constituted 15.7% (eigenvalue = 1.88) of the total variance. For SSQ12-B, the first factor was derived from the 6 questions (1-5, 9) related to speech, quality and hearing, while the second factor was derived from two questions (6, 7, 8, 10, 11, and 12) that related to spatial hearing. For individuals with severe hearing loss who use hearing aids, one eigenvalue value greater than 1 was found among the 12 questions of the SSQ12-B; the factor constituted 67.5% (eigenvalue = 8.10) of the total variance. For individuals with severe hearing loss, 12 questions (1-12) related to speech, spatial ,and quality (Factor 1) were found for SSQ12-B. For SSQ12-B, 2 eigenvalues greater than 1 were found; the first factor constituted 74.8% of the total variance (eigenvalue = 8.98), and the second factor constituted 13.5% of the total variance (eigenvalue = 1.62). For SSQ12-B, factor 1 was derived from six questions (1-5, 9) that related to the quality of speech and hearing, Factor 2 was derived from two questions that related to spatial hearing (6, 7, 8, 10, 11); question 12 was found to be similar for both groups. In our study, a significant

Table 4. Factor Structure of SSQ12C in Individuals with Severe to Very Severe Hearing Loss

Scale Sub-Dimensions	Items	Factor Loadings of the Items	Eigenvalues of the Factors	Variances Explained by the Factors
Factor 1	Q 3	0.741	4.59	38.3
	Q 4	0.886		
	Q 5	0.680		
	Q 8	0.558		
Factor 2	Q 7	0.582	1.46	12.1
	Q 10	0.583		
	Q 11	0.827		
	Q 12	0.703		
Factor 3	Q 6	0.829	1.32	11
	Q 9	0.903		
Factor 4	Q 1	0.864	1.1	9.17
	Q 2	0.788		

Kaiser–Meyer–Olkin Measure of Sampling Adequacy (KMO) = 0.73.
Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization.

difference was observed between the SSQ12-B general score averages of individuals with moderate and moderate-to-severe hearing loss and the averages of the general scores of individuals using hearing aids.

Turkish Version of Speech, Spatial and Qualities of Hearing Scale Form C (SSQ12-C)

The mean SSQ12-C score of individuals (71 individuals) who had received cochlear implantation after using hearing aids was found to be 4.57 ± 0.32. The KMO value was 0.73 in individuals with cochlear implants, and the BTS result was $\chi^2 = 355.16$, $df = 66$, $P = .001$. The internal consistency coefficient was found to be 0.84 (50-83) in cochlear implant users for SSQ12-C, in which the questionnaire reliability was evaluated with Cronbach's alpha. The factor analysis of cochlear implant users is respectively illustrated in Table 4. A rotated component matrix was utilized for the components in individuals with cochlear implants. In individuals with cochlear implants, among 12 questions in each questionnaire, 4 eigenvalue values greater than 1 were found for SSQ12-C; the first factor constituted 38.3% of the total variance (eigenvalue = 4.59), the second factor constituted 12.1% of the total variance (eigenvalue = 1.46), the third factor constituted 11% (eigenvalue = 1.32) of the total variance, and the fourth factor constituted 9.17% (eigenvalue = 1.1) of the total variance. In individuals with cochlear implants given the SSQ12- C four questions (3-5, 8) related to speech in the presence of noise and spatial hearing; four questions (7, 10-12) related to speech and speech quality (Factor 2), two questions related to segregation (Factor 3); and two questions (1, 2) related to the quality and naturalness (Factor 4).

DISCUSSION

In our study, the benefit of using hearing aids and/or cochlear implants in individuals with moderate, moderate-to-severe, severe, and very-severe hearing loss was evaluated through the use of theA, B, and C forms of the Turkish SSQ12 questionnaire, and psychometric properties of amplification use were determined in 258 individuals.

Studies have shown that the SSQ49 score is lower in individuals with hearing loss, in comparison with individuals with normal hearing, and the short form SSQ12 is sensitive to the limitations that are experienced by individuals with hearing loss in their daily hearing stuation.[13] nother study, demonstrated that the SSQ12, unlike the other versions (SSQ5 and SSQ15), presents a strong relationship between hearing loss and mean scale scores, and each change of 0.75 in the SSQ score may be associated with 10 dB loss in the audiogram.[14] Individuals with moderate and moderate-to-severe hearing loss have higher SSQ12-A total scores than individuals with severe and very-severe hearing loss. The fact that individuals with severe and very-severe hearing loss have lower self-reported disability than individuals with moderate and moderate-to-severe hearing loss is consistent with other studies, and indicates that this questionnaire may be affected by the extent of hearing loss.[13,14] The first part of our study is compares the SSQ12-A to the original version of SSQ12, although Akeroyd et al[15] in the original version and Ou et al[16] in the short version (SSQ12) found 3 factors: two factors for individuals with moderate and moderate-to-severe hearing loss and one factor for all individuals with severe hearing loss was found.[3,14,16 17] It is thought that this incompatibility may have been caused by hearing loss, age and questionnaire difference. It is speculated that while the SSQ12-A is not useful in evaluating the hearing performance of individuals with severe hearing loss, it could be useful in evaluating the hearing performance of people with moderate and moderate-to-severe hearing loss. The fact that Noble et al[9] found three factors in the short version of the SSQ12 and the original version of SSQ49, and four factors were found in the SSQ49 version designed by Kılıç[18] was not compatible with our study. This difference was speculated to be due to the variation in hearing loss in the studies, the difference between languages, or the possibility that results from the answers with hearing aid might have been given. In our study, the internal consistency level was found to be perfect in evaluating the hearing performance of all individuals, however, it is recommended that all degrees of hearing loss be evaluated separately and that mild hearing loss be included, since it constitutes 87.2% of the total variance.

In our study, the SSQ12-B scores of individuals with moderate and moderate-to-severe hearing loss who usedhearing aids were found to be higher than the average scores of individuals with severe hearing loss usedhearing aids. In the factor analysis of SSQ12-B, two factors were found: the first factor is related to the quality of speech in the presence of noise, speech in silence, and hearing; the second factor is related to spatial perception. Regardless of the extent of hearing loss in all individuals using hearing aids, the mean SSQ12-B scores were found to be similar and consistent with the study by Ou et al.[16] It is speculated that individuals with hearing aids can be evaluated with SSQ12-B regardless of the extent of loss. In their study, Miranda et al.[13] point out that SSQ12 is sufficiently sensitive to reveal the difficulties which are experienced by individuals with hearing loss in daily listening enviroments.[13,18] In the study carried out by Ou et al.[16] in the short version of SSQ12 for individuals with hearing loss using hearing aids, factor 1 was indicated to be related to speech intelligibility and quality, which included items 1-5, 11, and 12; factor 2 was reported to be related with spatial perception which included items 6, 7, and 8; and factor 3 was reported to be related to items 9 and 10. In our study, for individuals with moderate and moderate-to-severe hearing loss, factor 1 is related to speech intelligibility and spatial perception while factor 2 is related to quality.[16]

The finding that individuals with severe and very-severe hearing loss have a lower mean SSQ12-B score than the average SSQ12-C score showed that these individuals benefit more from cochlear implants than hearing aids. In our study, the number of factors was determined as four in SSQ12-C, two in SSQ12-A, and two in SSQ12-B. In SSQ12-C, the first factor was found to be related to speech and spatial hearing in the presence of noise (items 3 #, 4 #, 5 #, 6 #, 7 # and 8 #), the second factor was found to be related to speech and speech quality, the third factor was found to be related to segregation, and the fourth factor was associated with the speech quality and naturalness.

CONCLUSION

As a result of our study, it was speculated that there may be differencesthe quantity of factors and the contexts to which these factors are related with respect to different languages and

cultures This situation must be taken into consideration when the scale is utilized for evaluation purposes. There is no study in the literature that compares three different forms of SSQ12 within the same study group. Our study has the feature of being the pioneer in this respect, and it has been concluded that all three forms of the SSQ12 scale are useful as a valid and reliable method in the context of evaluation of the amplification performance for individuals with moderate to very severe extents of hearing loss, and could provide important information in the follow-up procedures of the rehabilitation processes.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of Ankara Yıldırım Beyazıt University, (Approval No: 2020/54).

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

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REFERENCES

1. World Health Organisation. 1.1 billion people at risk of hearing loss, 2015. Available at http://www.who.int/mediacentre/news/releases/2015/ear-care/en/. Accessed on 9 August 2020.
2. Granberg S, Swanepoel de W, Englund U, Möller C, Danermark B. The ICF core sets for hearing loss project: international expert survey on functioning and disability of adults with hearing loss using the international classification of functioning, disability, and health (ICF). *Int J Audiol*. 2014;53(8):497-506. [CrossRef]
3. Ou H, Kim E. Which short version of the speech, spatial, and qualities of hearing scale to choose: SSQ5 or SSQ12. *J Otorhinolaryngol Disord Treat*. 2017;60(6):279-294.
4. Ahlstrom JB, Horwitz AR, Dubno JR. Spatial benefit of bilateral hearing aids. *Ear Hear*. 2009;30(2):203-218. [CrossRef]
5. Gatehouse S, Noble W. The speech, spatial and qualities of hearing scale (SSQ). *Int J Audiol*. 2004;43(2):85-99. [CrossRef]
6. Tyler RS, Perreau AE, Ji H. Validation of the spatial hearing questionnaire. *Ear Hear*. 2009;30(4):466-474. [CrossRef]
7. Hua H, Johansson B, Jönsson R, Magnusson L. Cochlear implant combined with a linear frequency transposing hearing aid. *J Am Acad Audiol*. 2012;23(9):722-732. [CrossRef]
8. Olsen SØ, Hernvig LH, Nielsen LH. Self-reported hearing performance among subjects with unilateral sensorineural hearing loss. *Audiol Med*. 2012;10(2):83-92. [CrossRef]
9. Noble W, Jensen NS, Naylor G, Bhullar N, Akeroyd MA. A short form of the speech, spatial and qualities of hearing scale suitable for clinical use: the SSQ12. *Int J Audiol*. 2013;52(6):409-412. [CrossRef]
10. Kießling J, Grugel L, Meister H, *et al.* SSQ ins Deutsche und deren evaluation. *Z Audiol*. 2011;50(1):6-16.
11. Jensen N, Akeroyd M, Noble W, Naylor G, editors. The Speech, Spatial and Qualities of Hearing scale (SSQ) as a benefit measure. NCRAR conference on The Ear-Brain System: Approaches to the Study and Treatment of Hearing Loss; 2009.
12. Kaiser HF. The application of electronic computers to factor analysis. *Educ Psychol Meas*. 1960;20(1):141-151. [CrossRef]
13. Miranda-Gonsalez ECd, Almeida Kd. Hearing disability measured by the speech, spatial and qualities of HEARing scale (SSQ): pilot study of a short version in Brazilian Portuguese. *Audiol Commun Res*. 2017;22. [CrossRef]
14. Singh G, Pichora-Fuller K. M. Older adults' performance on the speech, spatial, and qualities of hearing scale (SSQ): test-retest reliability and a comparison of interview and self-administration methods. *Int J Audiol*. 2010;49(10):733-740.
15. Akeroyd MA, Guy FH, Harrison DL, Suller SL. A factor analysis of the SSQ (speech, spatial, and qualities of hearing scale). *Int J Audiol*. 2014;53(2):101-114. [CrossRef]
16. Ou H, Perreau A, Tyler RS. Development of a shortened version of the spatial HEARing questionnaire (SHQ-S) for screening spatial-hearing ability. *Am J Audiol*. 2017;26(3):293-300. [CrossRef]
17. Cañete OM, Marfull D, Torrente MC, Purdy SC. The Spanish 12-item version of the speech, spatial and qualities of hearing scale (sp-SSQ12): adaptation, reliability, and discriminant validity for people with and without hearing loss. *Disabil Rehabil*. 2020;42:1-8.
18. Kılıç N. Speech, spatial and quality of hearing scale (SSQ) for Turkish language and evaluation of adults with normal hearing and sensorineural hearing loss by SSQ [in Turkish] Gazi University Institute of Health Sciences. Normalization and Adaptation of MSc Thesis; 2017.