ENT Updates

ORIGINAL ARTICLE

ENT UPDATES 11(3):165-173
DOI: 10.5152/entupdates.2021.21096

Validation of the Turkish Version of the Parents' Evaluation of the Aural/Oral Performance of Children (PEACH) Rating Scale

ABSTRACT

Background: The Parents' Evaluation of the Aural/Oral Performance of Children (PEACH) Rating Scale is a widely used instrument to evaluate adaptation, effectiveness of hearing aid and cochlear implant, and auditory rehabilitation outcomes in hearing-impaired children by parent observation in daily life listening situations. This study aimed to adapt the Parents' Evaluation of the Aural/Oral Performance of Children to Turkish children, analyze, and verify the validity and the reliability. We also looked for scores in various clinical conditions (age, sex, HA, CI experience, unilateral vs. bilateral users).

Methods: The study composed of 120 children with hearing loss (hearing aid users n = 57; cochlear implant users n = 63) between 3 and 12 (mean: 7.51±2.84) years of age. First, Parents' Evaluation of the Aural/Oral Performance of Children was adapted to Turkish children, and confirmatory factor analysis was used to evaluate the validity of the Turkish Parents' Evaluation of the Aural/Oral Performance of Children. Then, correlations of Turkish Parents' Evaluation of the Aural/Oral Performance of Children scores with age, hearing aid and cochlear implant experience, and group differences (male vs. female; hearing aid vs. cochlear implant users) were analyzed by using the proper statistical tests. Cronbach's alpha coefficient was used to confirm internal consistency, and the test-retest method was performed to evaluate the reliability of the measurement.

Results: Turkish Parents' Evaluation of the Aural/Oral Performance of Children has high internal consistency (Cronbach's alpha = 0.942) and test-retest reliability ($r = 0.949$, $P < .001$). Scores were increased in parallel to age, hearing aid, cochlear implant experience, and there was a significant difference in Turkish Parents' Evaluation of the Aural/Oral Performance of Children scores between unilateral and bilateral cochlear implant users.

Conclusion: The Turkish Parents' Evaluation of the Aural/Oral Performance of Children could be recommended as a convenient tool for children with hearing aid and cochlear implant to monitor functional, auditory, and communication skills.

Keywords: Aural rehabilitation, children, cochlear implants, hearing, hearing aids, surveys and questionnaires

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Cite this article as: Eroğlu K, Kamışli GİŞ, Altınyay Ş, Gökdoğan Ç, Bayramoğlu İ, Kemaloğlu YK. Validation of the Turkish version of the Parents' Evaluation of the Aural/Oral Performance of Children (PEACH) rating scale. *ENT Updates.* 2021;11(3):165-173.

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Received: *August 26, 2021*
Accepted: *October 5, 2021*

INTRODUCTION

Childhood hearing loss affects social, emotional, cognitive, speech-language, and academic skills. However, it is a (re)habitable disability with early diagnosis and intervention. It was observed that language-speech development was close to normal limits in the children who started using hearing aids (HA) and/or cochlear implants (CI) in the early period.[1-3]

An important issue during the diagnosis and rehabilitation process of these children is to follow up for achievements in their hearing skills and improvements in solving the problems related to hearing loss or obstructions in the process.[3] Although the effectiveness of the HAs and CIs can be evaluated by audiological tests, it is difficult to evaluate the life quality, changes in subjective complaints, and communication skills in complex situations by the audiological tests during early childhood because the children's language skills would not be fully developed and they would not be able to express themselves. For these

evaluations, the scales become necessary.[4-6] The functionality of auditory prostheses and auditory rehabilitation follow-ups can also be evaluated through the scales.[4,5,7]

There are various scales developed to evaluate the listening skills of children in daily life.[4,8-10] These scales differ according to their characteristics such as the age range they cover, whether the scale is aimed at the child, parent/caregiver, or teacher, and the areas it evaluates. The scales are prepared for the parent, teacher, or directly to the child according to the child's age and evaluation parameters.[4,7-10] One of these scales is the PEACH Rating Scale. The PEACH scale was first designed as "PEACH Dairy" in diary form. The number of questions and the contents of the questions in "PEACH Dairy" and "PEACH Rating Scale" are the same. However, the way of observation and scoring differs. A 1-week observation period is given to the parent for the "PEACH Dairy." During this time, the PEACH Diary is always next to the caregiver or parent and they note the observed situations regarding the questions in detail. At the end of the week, the clinician talks with the parent about scores and the situations that the parent noted in the PEACH Diary. Some difficulties encountered in the implementation of the PEACH Dairy resulted in the conversion of the scale to a more easily applicable form, the PEACH Rating Scale.[7,11]

The PEACH Rating Scale was developed by Ching and Hill in 2005 in Australia.[7] The scale evaluates children's daily listening skills, functional hearing performance, and amplification efficiency based on the observations of parents. The PEACH Rating Scale consists of 3 main parts and 13 questions. The first part is about the HA, the second part is about situations in quiet environments, and the third part contains questions describing noisy environments. The questions are answered with a Likert-type scoring system between 0 and 4. The original version of the scale has been translated into different languages such as Swedish,[12] Malaysian,[13] Tamil,[14] Brazilian Portuguese,[15] European Portuguese,[16] Persian,[17] Spanish,[18] and Chinese.[19] The studies revealed that PEACH was a convenient and applicable scale used to evaluate CI and HA outcomes, auditory education/auditory rehabilitation process, audiological needs, receptive and expressive language performance, and even psychosocial functions.[20-25]

In this study, we aimed to adapt the PEACH Rating Scale into the Turkish language and to investigate the validity and reliability of the Turkish version.

MAIN POINTS

- The Parents' Evaluation of the Aural/Oral Performance of Children Rating Scale gives information about hearing impaired children's listening skills, functional hearing performance and efficiency of HA and CI.
- Turkish Parents' Evaluation of the Aural/Oral Performance of Children Scale is a valid and reliable tool, presenting high internal consistency and test-retest reliability.
- Turkish Parents' Evaluation of the Aural/Oral Performance of Children is a useful scale that can be used safely in the evaluation and follow-up of children using HA and CI.

METHODS

This study was carried out at the audiology center of the Gazi University hospital. The written informed consent was obtained from all the participants of the study. The study design and the consent form were approved by the clinical research Ethics Committee of Gazi University under protocols 14574941-050.99-69050.

Translation and Cultural Adaptation of the PEACH Rating Scale

At this stage, the translation and the adaptation of the PEACH scale from English to Turkish were performed. Translation, review, and back translation steps were followed.[26] Firstly, 2 audiologists who frequently speak English, are a linguist, and a professional translator independently translated PEACH. Then 4 translations of the PEACH scale were synthesized by the 2 audiologists and 1 ENT physician. The original content of the scale has not been changed, but they made minor changes to the questions in terms of semantics, idioms, intelligibility, and cultural compatibility, and then consensus was maintained on all questions. The final translation (Turkish PEACH, Tr-PEACH) was translated back into English by another linguist. The linguist reviewed and compared the original PEACH scale and reverse translation. As a result of the comparison, the items in the original form and the translated form were found to be very close to each other in terms of structure and meaning. The 2 scales were found to be equivalent. After the translation and the adaptation stage, a pilot study was carried out on the parents of 40 hearing-impaired children who used CIs and/or HA users. During the pilot study, the parents were told to ask for phrases and sentences that they did not understand. It was determined that there was no problem in terms of intelligibility and applicability of the final Tr-PEACH Scale (Appendix 1). At the end of the translation and cultural adaptation steps, no item was removed or added to the Scale.

Participants

A total of 120 parents of children with HA and CI and aged between 3 and 12 years participated in the study. Children with chronic disease and additional disabilities were excluded because of the possibility that their aural and oral performance and communication skills may be affected by these health conditions independent of hearing loss.

The audiological evaluation was performed by using calibrated clinical audiometer (Interacoustic AC-40) with Telephonics TDH 49 headphones in a quiet soundproof room with industrial acoustic company standards. After otoscopic examination, 125-8000 Hz air (with TDH 49) and 500-4000 Hz bone-conducted (with Radioear B71 bone oscillator) pure tone audiometry were performed in all children. The children were tested with their HA and CI, and their devices were checked at the beginning of the testing.

Administering the Tr-PEACH

We followed the procedures of the original version to administrate the PEACH Rating Scale.[7] Turkish parents' evaluation of the aural/oral performance of children is comprised of 13 items and 3 main parts. The first part consists of 2 items about the hearing aid. The second part consists of 6 items about the situations in quiet environments, and the third part consists of 5 items

about the situations in noisy environments. The contents of the questions are as follows: hearing device use and response to loud sounds, hearing and communication in a quiet environment, hearing and communication in a noisy environment, telephone use, awareness, and the discrimination of environmental sounds.[13] The items are answered with a Likert-type scoring system between 0 and 4. It is expressed as 0=never, 1=rarely, 2=sometimes, 3=often, and 4=always. The first and second questions are not included in the calculation of the scale score. The sum of the item scores is converted into a percentage. The PEACH rating scale has 3 different types of scores. They are namely scored for quiet environments, noisy environments, and total score.

The parents rated the Tr-PEACH Scale in a silent room at the clinic. Before filling the Scale, the parents were informed about its content and how to apply it. Before answering the questions, the parents of the children using HA and CI are asked to fill out a pre-assessment checklist consisting of 3 questions, this part is necessary to proceed with the fill the scale. If the answer is yes for these 3 questions, the parent could start filling the scale questions.

Validity and Reliability Technique of the Tr-PEACH Rating Scale

An established technique for validity and reliability stages is used in this study.[27] Confirmatory factor analysis (CFA) was performed to analyze the validity of the Scale, and internal consistency reliability was analyzed via Cronbach's alpha coefficient. In addition to these, to evaluate the measurement reliability, the correlation between items and corrected item-total score correlation, effect on the scale score means, and the change of Cronbach's alpha value when the item is removed was found.

To analyze the reliability of the measurement result, the reliability coefficient was calculated using the test-retest method, and the stability of the Tr-PEACH over time was determined. Retest data were planned collected from all participants with 4 weeks intervals, and the consistency between the measurement results was examined using the correlation technique.

Statistical Analysis

The statistical analyses were performed using the IBM SPSS Version 23 (IBM SPSS Corp.; Armonk, NY, USA). The variables were investigated using histogram plots, probability plots, and Kolmogorov-Smirnov test to determine whether or not they are normally distributed. For the validity stage, confirmatory factor analysis was performed using LISREL 9.0 (Scientific Software International, Inc.; NC, USA).

RESULTS

A total of 120 children (M: 63, F: 57; mean age: 7.5±2.8) with hearing loss between the ages of 3-12 years were encountered in the study (Figure 1). Fifty-seven (M: 29, F: 28; mean age: 7.4±2.8) of them were HA users, while the number of the CI users was 63 (M: 34, F: 29; mean age: 7.5±2.8).

All children in the HA group had bilateral HAs, while in the CI group, 51 (81%) subjects were unilateral, and 12 (19%) were bilateral users. The mean age at first HA use was

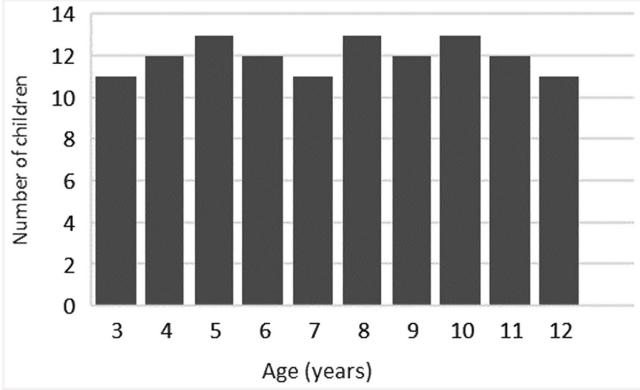

Figure 1. Age distribution of the children.

18.4±15.5 months, and the mean age at cochlear implantation was 24.1±18.0 months. Hearing aid and CI experiences were 67.4±29.0 and 63.7±32.6 months, respectively.

Construct Validity Results of the Tr-PEACH

The original PEACH scale has 2 sub-dimensional structures. The confirmatory factor analysis was used to evaluate the validity of this construct on the TR-PEACH scale. We evaluated the relationship between the factors determined by CFA, the relationship of variables with factors, the independence of factors from each other, and the adequacy of factors in explaining the model. The path diagram obtained with CFA is given in Figure 2.

The original PEACH Scale has 2 sub-dimensions, noise and quiet. After the translation and content validity of the TR-PEACH Scale, the validity of these 2 sub-dimensional distinctions in the TR-PEACH Scale was tested with CFA. The relationship between the factors determined by CFA, the relation of variables with factors, the independence of the factors, and the adequacy of the factors in explaining the model was examined. The results obtained with CFA and the path diagram are in Figure 2. As seen in Figure 2, each item of the sub-dimensions in the scales is meaningful and sufficient to explain the dimension.

The validity of the Scale was examined by controlling the goodness of fit indexes and CFA. The indexes and their values of coefficients are given in Table 1. Root mean square error of approximation (RMSA) and standardized root mean square residual (SRMR) indices were < 0.08, RMSEA were < 0.05, hypothesis values were 1.000, non-normed fit index (NNFI), comparative fit index (CFI), and incremental fit indices (IFI) indices were > 0.90, and GFI and AGFI were more than 0.95. Values express that its structure is in a perfect fit and good harmony. Thus, the validity of the Scale was once again demonstrated with these fit indices.

Reliability Results of the Tr-PEACH

Internal consistency between items was calculated with Cronbach's alpha coefficient, and item analysis was performed to evaluate item reliability. The reliability of the measurement result was tested with the test-retest method, correlation analysis was performed between the first measurement and the last measurement scores, and the validity coefficient was determined.

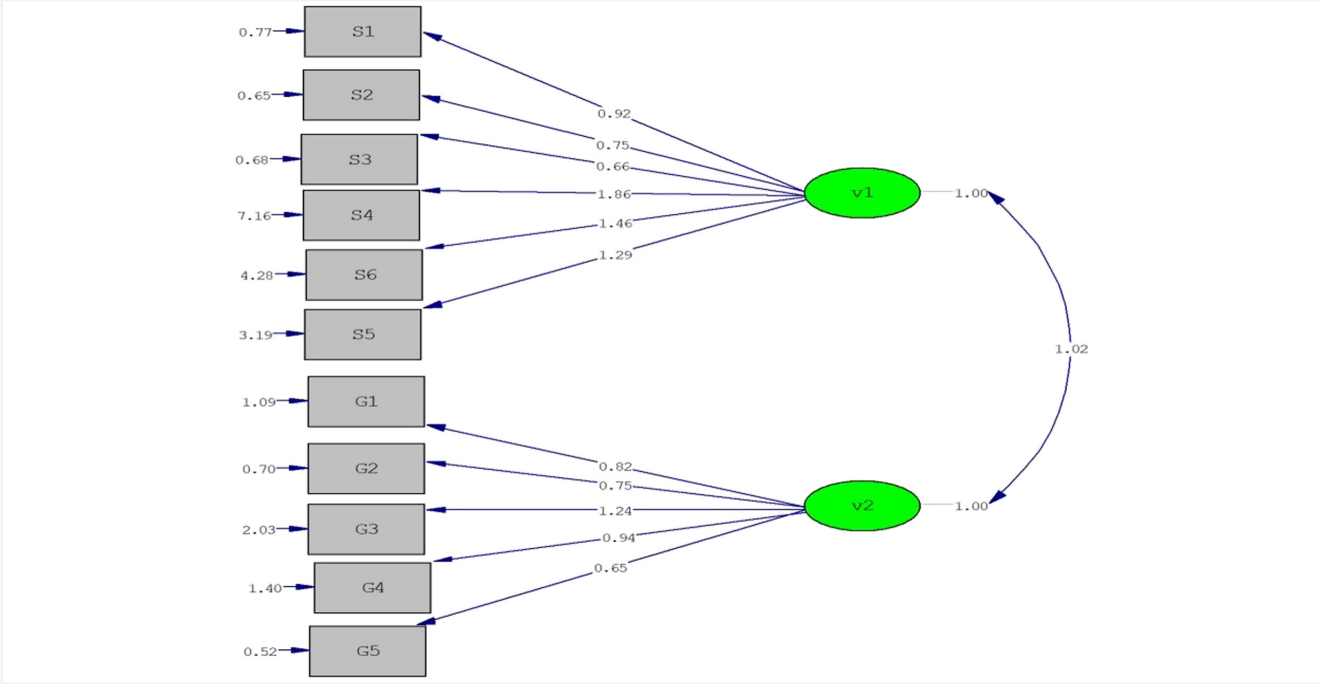

Figure 2. Path diagram or confirmatory factor analysis of Tr-PEACH.

Table 1. Goodness of Fit Coefficients Obtained as a Result of CFA

Indexes	RMSEA	GFI	AGFI	NNFI	CFI	IFI	SRMR
Coefficient	0	0.979	0.967	1.094	1.000	1.071	0.025

The validity analysis was applied to the TR-PEACH Scale, Cronbach's alpha values, additivity feature, and the equality of item averages were examined for the Tr-PEACH Scale and sub-dimensions (Table 2). Cronbach's alpha value was used to determine the internal consistency coefficient. It was 0.942 and that means TR-PEACH had a high internal consistency. Tukey's additivity test was performed to test whether the Scale was prepared as an additive scale type ($P < .05$), and the Hotelling T-test was used to test the equality of item averages ($P < .05$). These values show that TR-PEACH is a measurement tool with high internal consistency in the additivity property and unequal substances.

Item Reliability of Tr-PEACH

The item reliability was examined by item analysis, the items in the Scale were discussed, the correlations of the items were examined, and the consistency between the items was determined. As shown in Table 3, there is a high positive correlation between the items on the Scale.

The mean of the TR-PEACH Scale was 36.68±5.60, the variance was 31.428, and the Cronbach's alpha was 0.942. These values were used to compare the changes that occurred when the item was removed from the Scale.

As seen in Table 4, removing any item from the Scale did not increase the mean scale and Cronbach's alpha coefficient. When the corrected item-total score correlation in Table 3 was examined, the correlation coefficient was not below 0.30 in any item. These findings showed that the items in the Scale are interrelated and that no item should be removed. As a result, when the obtained Cronbach's alpha and correlation coefficients between items and item analyses were interpreted together, it was revealed that the Tr-Peach Scale had a high degree of reliability.

Table 2. Cronbach's Alpha Coefficient, Additivity, and the Difference Between Items for the TR-PEACH Scale and Sub-dimensions

		Cronbach's Alpha			
	Number of Items	Cronbach's Alpha	Based on Standardized Items	P^*	P^{**}
Tr-PEACH	11	0.942	0.947	<.001	<.001
Quiet	6	0.874	0.894	<.001	<.001
Noise	5	0.903	0.905	<.001	<.001

*Tukey's Additivity test *P*-value; **Hotelling *t*-test *P*-value. Tr-PEACH, Turkish parents' evaluation of the aural/oral performance of children.

Table 3. Correlation Coefficients Between Items of Tr-PEACH

Item	3	4	5	6	7	8	9	10	11	12
3										
4	0.666									
5	0.682	0.595								
6	0.616	0.703	0.616							
7	0.612	0.569	0.644	0.674						
8	0.534	0.662	0.546	0.561	0.537					
9	0.615	0.687	0.676	0.749	0.609	0.734				
10	0.528	0.567	0.645	0.649	0.604	0.534	0.735			
11	0.527	0.592	0.582	0.642	0.596	0.594	0.671	0.658		
12	0.514	0.649	0.588	0.602	0.507	0.630	0.717	0.658	0.569	
13	0.601	0.736	0.623	0.604	0.643	0.622	0.689	0.585	0.568	0.655

Table 4. Change of Cronbach's Alpha Value for Items in the Tr-PEACH

Item	Total Mean When Item Is Removed	Total Variance When Item Is Removed	Item Total Correlation Coefficient	Cronbach's When Item Is Removed
3	32.7917	28.721	0.716	0.940
4	32.9583	27.065	0.788	0.936
5	33.3667	25.915	0.755	0.936
6	33.7667	26.197	0.790	0.935
7	33.1500	26.515	0.727	0.937
8	33.1833	25.546	0.735	0.937
9	33.7583	24.302	0.862	0.931
10	33.5917	26.160	0.768	0.935
11	33.5333	25.646	0.739	0.937
12	33.7167	24.390	0.753	0.938
13	33.0167	26.924	0.778	0.936

The Test-retest Reliability

The test-retest method was used to evaluate the reliability of measurement results and stability of the Tr-PEACH over time. The 109 participants were reevaluated retest 3-4 weeks later than the first evaluation. The first test scores of the Tr-PEACH were as follows: total Score: 83.37±12.74 (min.: 27.27; max.: 100), quiet sub-dimension: 86.53±12.58 (min.: 29.17; max.: 100), noise sub-dimension: 79.58±13.59 (min.: 25.00; max.: 100.00. The retest scores of Tr-PEACH were found to be 81.65±12.58 (min.: 27.27; max.: 100), 84.94±12.69 (min.: 29.17; max.: 100), and 77.71±13.19 (min.: 25.00; max.: 100) for the total score and scores of the quiet and the noise sub-dimensions, respectively.

The correlation between the first and second test results was analyzed using Spearman's test. Spearman's rho and *P*-values were $r = 0.949$, $P < .001$ for total score, and $r = 0.945$; $P < .001$ for quiet sub-dimension, $r = 0.907$; $P < .001$ for noise sub-dimension. These findings have revealed that the Tr-PEACH Scale demonstrated high test-retest reliability, makes stable and consistent measurements depending on time, and the measurement sensitivity does not change radically over time. For the interpretation of the scale results, the raw scores of the TR-PEACH and subdimensions scores are converted into percentages.

Then, the data obtained from 120 children were analyzed regarding age, sex, and HA and CI. Statistically significant age differences were seen in the mean of both the total score of Tr-PEACH and its quiet and noise sub-dimensions ($P < .05$). Pearson correlation analysis presented significant positive correlations in total score of Tr-PEACH ($r = 0.567$; $P < .001$) and its quiet ($r = 0.533$; $P < .001$) and noise ($r = 0.548$; $P < .001$) sub-dimensions. All the pairwise correlations were significant at a medium level (Pearson correlation test).

In the mean of the total score and scores of the quiet and noise sub-dimensions, no sex differences were found (Student's *t*-test, $P > .05$). The mean of total score in males was 84.17±11.48, and the means of quiet and noise sub-dimensions were 87.43±10.98 and 80.26±12.80 in males, respectively, while mean values in females were 82.65±13.8, 78.97±14.34, and 85.71±13.91 for total score and quiet and noise sub-dimensions, respectively.

As seen in Table 5, all Tr-PEACH scores were significantly lower in unilateral CI users, while no difference was detected between the subjects using HAs and CIs.

Table 5. Comparison of the Total Score, Quiet and Noise Score with Bilateral CI, Unilateral CI, and HA Users

Score		Unilateral Cochlear Implant (n = 12)	Bilateral Cochlear Implant, (n = 51)	*P*	Hearing Aid, (n = 57)	Cochlear Implant (Total), (n = 63)	*P*
Quiet	Mean±SD	83.9±12.0	95.1±7.0	<.001	86.9±13.2	86.1±12.0	.529
	Min-Max	45.8-100.0	79.17-100.0		29.1-100.0	45.8-100.0	
Noise	Mean±SD	77.4±11.1	90.0±9.0	.001	79.3±15.3	79.8±11.8	.861
	Min-Max	45.0-90.0	75-100		25.0-100.0	45.0-100.0	
Total Score	Mean±SD	81.0±11.4	92.8±7.3	<.001	83.4±13.9	83.2±11.7	.733
	Min-Max	45.4-95.4	77.2-100.0		27.2-100.0	45.5-100.0	

The Spearman correlation test between duration of HA experience and the Tr-PEACH scores revealed significant strong positive correlations for all scores ($r = 0.648$, $P < .001$ for total score: $r = 0.650$; $P < .001$; for noise sub-dimension: $r = 0.699$, $P < .001$ for quiet sub-dimension). Furthermore, duration of CI experience also presented significant strong positive correlations with all scores ($r = 0.648$, $P < .001$ for total score, $r = 0.618$, $P < .001$ for quiet and $r = 0.630$, $P < .001$ for noise).

DISCUSSION

As it is well known, hearing is an active and dynamic sense in every aspect of life and hence hearing loss affects not only the language and communication but also academic and social skills of the hearing impaired children, compared to their hearing peers. Using HAs and CIs and efficient auditory training are essential tools for coping with the disadvantages of deafness.[20,28-31] Our data in this study clearly revealed that, as in accordance with the previous studies,[15-17,32] the PEACH Rating Scale could internationally evaluate the aural and verbal performance of the children with hearing loss in daily life situations after a proper validity and reliability work performed in each language. Thus, in this study, the Turkish version of the PEACH (Tr-PEACH) Rating Scale has been presented, and our data demonstrated that the Tr-PEACH Rating Scale could be used for not only detecting the difficulties caused by hearing loss in daily living activities but also following the rehabilitation processes of the children in a wide age range.

Previous studies indicate that PEACH Rating Scale helps to follow the rehabilitation processes of the children in a wide age range. It gives information about device performance in different aural situations, especially for children using CI and HA.[14,21-23] The widespread implementation of school-age, childhood, and newborn hearing screening programs provides early diagnosis of congenital and late-onset hearing losses, and the number of children using HA and CI is increasing.[32,33] Accordingly, the need for tests and scales also increases in pediatric audiology.

Therefore, this study aimed to make the Turkish validity and reliability of the PEACH Rating Scale be used in evaluating the listening skills of children with hearing loss. A total of 120 children, 63 boys, and 57 girls, aged 7.51±2.84 (min. = 3; max. = 12) participated in our study. The ages of the children showed a balanced distribution (Figure 1). While determining the age range, the studies in the literature related to the original version of the PEACH Scale were taken into consideration. During the development of the original scale, the age range was determined as infancy and childhood.[7] However, in the normalization study of the original version of the PEACH Scale, it has been shown that the scale scores for age are asymptomatic up to 30 months in healthy children and do not show an increase. After 30 months, it increases and reaches normal limits from the age of 3.[7] Considering these data, in this study, the lower age limit was determined as 3 years and the upper limit as 12 years.

Construct validity was examined in the PEACH Rating Scale Turkish version study. The original PEACH Scale has 2 subdimensions, quiet and noise.[7] In the Tr-PEACH Scale, the 2 subdimensions were checked with confirmatory factor analysis and fit indices, and it was seen that the data supported these factor structures. The PEACH Scale was previously translated into Malaysian, Portuguese, Persian, and the same 2-factor structure was obtained in these languages in the adaptation studies.[13,15,17]

The Cronbach's alpha coefficients of the Tr-PEACH Scale were 0.874 for the quiet sub-dimension, 0.903 for the noise subdimension, and 0.942 for the total scale. These coefficients indicate that the Tr-PEACH Scale and its sub-dimensions are highly reliable. In developing the original version of the Scale,[7] Cronbach's alpha coefficients were obtained 0.760 for the quiet sub-dimension, 0.790 for the noise sub-dimension, and 0.781 for the total scale. While Cronbach's alpha coefficient for children with normal hearing was 0.82 in the Persian version of PEACH, it was 0.93 in the Malay version. In the Chinese version, Cronbach's alpha coefficient was 0.98 in normal-hearing children, whereas it was 0.93 in the Spanish version.

The measurement results obtained from the Scale should be stable to be reliable. The test-retest method was used to evaluate the stability of the measurement results over time. In our study, the Tr-PEACH Scale was administered to the same participants twice with an interval of 4 weeks. The correlation of the 2 measurement scores was analyzed, and the correlation coefficients were determined. The reliability coefficient was $r = 0.945$, $P < .001$ for the quiet sub-dimension, $r = 0.907$, $P < .001$ for the noise sub-dimension, and $r = 0.949$, $P < .001$ for the total scale. These results indicate that the Tr-PEACH Scale is a reliable measurement tool that can yield consistent and stable results when administered at different times. In the original study of PEACH, the reliability coefficient was $r = 0.810$, $P < .001$ for the quiet subdimension, $r = 0.930$, $p < .001$ for the noise sub-dimension, and $r = 0.930$, $P < .001$ for the total scale.[32] In the Malay version, it was stated that there was a minimal difference between the first test and the retest results after 2 weeks. In the retest performed after 2 weeks in the Persian version, the correlation coefficient of the 2 measurements was $r = 0.99$. In the Chinese version, the Scale was administered after 3 weeks, and the correlation of the 2 total scores was $r = 0.96$.

The mean total score of the Tr-PEACH Scale obtained from all participants (children with HA and CI) in our study was 83.3%. In the original development study of the Scale,[7] the average score obtained from children with hearing loss was 62%. The researchers from the previous studies reported that the hearing-impaired group in their study consisted of late-diagnosed children.[7] In our study, children were mostly early diagnosed. Therefore, it is an expected result that there is a difference between the scores and that the scores are high in our sample consisting of children diagnosed early. Goh et al[21] administered the PEACH to the parents of children younger than 12 years of age, and the mean quiet score was 87.5%, and the noise score was 85%.[21] Naghibirad et al[17] report that the mean total score of the CI users was 73.18%, quiet 74.1%, and noise 72.0%. In our study, the total score and scores of the noise and quiet sub-dimensions were 83.2%, 79.8%, and 86.1% for CI users. As seen, the quiet score reported in the study of Naghibirad et al was close to our results.[17]

The current study indicates that the noise scores were lower than the quiet scores. It is known that children using HA and

CI perform better in one-on-one interactions and silent environments but have more difficulty in challenging listening conditions such as classroom, playground, and crowded places.[20,34] As expected, our findings demonstrate that hearing-impaired children have more difficulties with speech intelligibility in challenging listening environments, such as conversation in a group of people or a place with background noise. Thus, our findings are in agreement with the previous studies.[20,34]

The importance of early diagnosis of hearing loss, the selection of the appropriate device, and successful auditory rehabilitation are emphasized.[35,36] It has been shown that the use of HA and CI at an early age in children with hearing loss has a significant impact on many developmental areas such as listening abilities, speech intelligibility, learning abilities, and speech and language development.[29,37-39] Early amplification has an important role in speech perception, speech production, and spoken language.[40-42] Goh et al[21] studied children whose mean age of implantation was 39 months in their study, and the score of PEACH was 87.5% in quiet. They stated that the age of implantation was the most important predictor for oral communication. Kumar et al[14] evaluated the children aged between 3 and 6 years and found that children implanted before 2 years of age had higher PEACH scores than those implanted later.[14] In our study, the mean age of device use was 18 months for children with HA (the mean total score was 86.9% for the children with HA) and 24 months for children with CI (the mean total score was 86.1% for the children with CI), and there were significant positive correlations between implementation ages and all TR-PEACH scores. Furthermore, in our study, the lowest mean total score was 69.2% for 3 year olds, and the highest score was 92.04% for 11 year olds. These data support the data in the literature demonstrating the positive effect of early implementation and ongoing rehabilitation process in early rehabilitated children.[28,41,43] This data also supports the validity of Tr-PEACH to follow improvements of the children's daily listening skills, functional hearing performance, and amplification efficiency by age. The result obtained in our study is in line with the information in the literature.[28,36,38,41] Central nervous system plasticity is maximum in the early years of life. In children with hearing loss, restoration of hearing in the first 1-3 years is a critical period for language and speech development.[44] Auditory information reaches the auditory and linguistic areas of the brain with CI, and reorganization starts and develops in time. Therefore, the age of implantation and first HA use are very important parameters for developing successful spoken language and auditory skills.[45,46] This study also has shown that there are strong correlations between CI experience and mean Tr-PEACH scores. Hayes et al's study[43] about receptive vocabulary development has been determined that as the years of implant experience increase, the number of receptive vocabularies increases, but this progress reaches a plateau after 4 years of experience. It has been revealed that children with the highest vocabulary growth are those at the age of 1 year of implantation.[43]

The current study has proved that the differences between mean scores of children with HA and CI were not significant, and they demonstrated almost the same score (83.4% and 83.2%, respectively).

Regarding the unilateral and bilateral CI mean, Tr-PEACH scores were higher in bilaterally implanted children than unilaterally implanted children. These findings were consistent with the previous studies that prove the advantages of bilateral implantation. Children with bilateral CIs have better speech and language skills and spatial perception than children with unilateral CI.[1,2] Due to the advantages of binaural hearing, such as time and level differences between the ears in the horizontal plane, sound localization, the perception of sound in noisy environments, and speech perception are better than unilateral hearing.[47-49]

CONCLUSION

From the research carried out, it is possible to conclude that Tr-PEACH Scale is a valid and highly reliable tool with high internal consistency and test-retest reliability and consistent with previous studies. Hence, the Tr-PEACH Scale could be recommended as a convenient tool for children with HA and CI to monitor functional, auditory, and communication skills. Using the Tr-PEACH Scale, as a quantitative measurement tool of hearing device outcomes and auditory training, valuable information about auditory skills in complex daily life situations could be taken.

In recent years, mainly due to the Covid-19 pandemic, teleaudiology has become more popular, and the need and importance of the scales and screening tools such as the PEACH Rating Scale have increased in the assessment of hearing-impaired children.

Ethics Committee Approval: Ethics committee approval was received from the Ethics Committee of Gazi University under protocols 14574941-050.99-69050.

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

Peer Review: Externally peer-reviewed.

Author Contributions: Concept - İ.B., Ç.G., Y.K.; Design - İ.B., Ç.G., Y.K., Ş.A., K.E.; Supervision - İ. B., Ç.G., Y.K., Ş.A.; Resource - Y.K., Ş.A., K.E., G.İ.Ş.K., Ç.G., Ş.A.; Materials - K.E., Ş.A., Ç.G.; Data Collection and/or Processing - K.E., Ş. A., Ç.G.; Analysis and/or Interpretation - İ. B., Ç.G., Y.K., Ş.A., K.E., G.İ.Ş.K.; Literature Search - Y.K., Ş.A., K.E., G.İ.Ş.K.; Writing - Y.K., Ş.A., K.E., G.İ.Ş.K.; Critical Reviews - Y.K., Ş.A., K.E., G.İ.Ş.K.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

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APPENDIX 1

Ebeveynlerin Çocukların İşitsel / Sözel Performansını Değerlendirmesi (EÇİPED)

Teresa Ching & Mandy Hill tarafından geliştirilmiştir

EÇİPED nedir?

- EÇİPED, çocuğunuzun işitme cihazını ve/veya koklear implantını kullanırken nasıl duyduğunu ve diğer kişilerle nasıl iletişim kurduğunu kaydetmek için tasarlanmış bir formdur. Sizden çocuğunuzun günlük yaşamdaki dinleme davranışını gözlemlemenizi ve çeşitli işitme ve iletişim durumlarıyla bağlantılı olarak derecelendirmenizi rica ediyoruz.

EÇİPED bir test değildir. Normal düzeyde işiten bireylerin bile bazı durumlarda işitme zorluğu çektiğini unutmayınız. Çocukların dinleme becerileri, çocuklar büyüyüp geliştikçe ve dinleme pratiği yaptıkça gelişir.

EÇİPED'İ neden kullanmalısınız?

- EÇİPED çocuğunuzun işitme cihazının ve/veya koklear implantının etkililiğini değerlendirmek için kullanılır. EÇİPED puanlarınız çocuğunuzun günlük yaşam durumlarındaki fonksiyonel performansını betimlemek için kullanılacaktır. Sonuçlar, çocuğunuzun odyologları tarafından, çocuğunuzun yaşadığı belirli zorlukları gidermek için uygun odyolojik müdahaleyi belirlemede kullanılabilir. Zaman içinde belirli aralıklarda toplanan EÇİPED puanları, müdahale ile birlikte çocuğunuzdaki ilerlemeyi takip etmek için de kullanılabilir.

Nasıl uygulayacağım?

- Geçtiğimiz hafta içinde çocuğunuzun her soruyla ilgili davranışını düşünün.
- Çocuğunuzun tarif edilen davranışı gösterdiği zamanki tahmini yüzdeyi temel alarak, bir puan verin.

Sonra ne olacak?

- EÇİPED'i tamamladıktan sonra, bir araştırmacı puanlamalarınız üzerinden konuşmak için sizinle iletişime geçebilir. Araştırmacı çocuğunuzun yeterliklerini ve ihtiyaçlarını doğru anladıklarından emin olmak için size daha fazla soru sorabilir.

EÇİPED sonuçları çocuğunuzun ilerlemesini izlemek için kullanılacaktır. Bilgiler ayrıca müdahaleyi yönlendirmek için çocuğunuzun odyologuna da gönderilecektir.

Puanlama Öncesi Kontrol Listesi

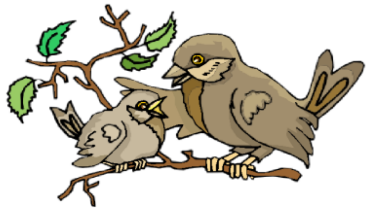
	Evet	Hayır
Çocuğunuz işitme cihazını ve/veya koklear implantını takıyor muydu?		
Çocuğunuz sağlıklı mıydı?		
Çocuğunuzun işitme cihazı ve/veya koklear implantı düzgün çalışıyor muydu?		

Eğer EÇİPED cihazlı performansı değerlendirmek için kullanılıyorsa, ancak yukarıdaki tüm soruların cevabı EVET olduğunda uygulanabilir.

Lütfen çocuğunuzun geçen haftaki dinleme davranışını düşünün ve uygun numarayı daire içine alın

	Soru	Hiç 0%	Nadiren 1 - 25%	Bazen 26 - 50%	Sık sık 51 - 75%	Her zaman 75-100%
1.	Çocuğunuz işitme cihazını ve/veya koklear implantını ne sıklıkla takar?	0	1	2	3	4
2.	Çocuğunuz ne sıklıkla yüksek sesten şikâyet eder ya da rahatsız olur?	4	3	2	1	0
3.	Seslendiğinizde, çocuğunuz **sessiz** ortamlarda adına tepki verir mi?	0	1	2	3	4
4.	İstenildiğinde, çocuğunuz **sessiz** ortamlarda basit komutları takip eder ya da basit bir görevi yapar mı?	0	1	2	3	4
5.	Seslendiğinizde, çocuğunuz yüzünüzü göremediği **gürültülü** ortamlarda adına tepki verir mi? (Örneğin, kafasını kaldırır, döner, sözel cevap verir)	0	1	2	3	4
6.	İstenildiğinde, **gürültülü** bir ortamda çocuğunuz basit yönergeleri takip eder ve basit bir görevi yapar mı?	0	1	2	3	4
7.	**Sessiz** bir yerde çocuğunuzla birlikte okuma yaparken, ne sıklıkla söylediklerinize dikkat eder? YA DA çocuğunuz hiç arka plan gürültüsü olmadan, TV veya CD'den şarkı/hikâye dinlerken ne sıklıkla söyleneni takip edebilir?	0	1	2	3	4
8.	Çocuğunuz, **sessiz** bir ortamda ne sıklıkla konuşmayı başlatır/konuşmaya katılır?	0	1	2	3	4
9.	Çocuğunuz, **gürültülü** bir ortamda ne sıklıkla konuşmayı başlatır/konuşmaya katılır?	0	1	2	3	4
10.	Çocuğunuz, arabada/otobüste/trende söylediklerinizi ne sıklıkla anlar?	0	1	2	3	4
11.	Çocuğunuz, kimin konuştuğunu görmeden insanların seslerini ne sıklıkla tanıyabilir?	0	1	2	3	4
12.	Çocuğunuz ne sıklıkla başarılı bir telefon görüşmesi yapar?	0	1	2	3	4
13.	Çoğunuz insan sesi haricindeki seslere ne sıklıkla tepki verir?	0	1	2	3	4

Lütfen yukarıdaki öğelerden herhangi biriyle ilgili yorum yapın:



Puanlama: Uzman tarafından tamamlanacaktır

		HAM PUAN %		PUAN %
SESSİZ	(Q's 3+4+7+8+11+12) **A**		(A/24) x 100	
GÜRÜLTÜLÜ	(Q's 5+6+9+10+13) **B**		(B/20) x 100	
TOPLAM	(A + B) **C**		(C/44) x 100	

2020 Journal Performance Data for: ENT Updates

Open Access since 2011

ISSN
2149-7109

EISSN
2149-6498

JCR ABBREVIATION
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ISO ABBREVIATION
ENT Updates

Journal Information

EDITION
Emerging Sources Citation Index (ESCI)

CATEGORY
OTORHINOLARYNGOLOGY - ESCI

LANGUAGES
English

REGION
TURKEY

1ST ELECTRONIC JCR YEAR
2020

Publisher Information

PUBLISHER
DERGIPARK AKAD

ADDRESS
MUSTAFA KEMAL MAHALLESI, DUMLUPINAR BULVARI, 2151 CADDE, NO 154 ODTU KARSISI, SANKAYA, ANKARA 06510, TURKEY

PUBLICATION FREQUENCY
3 issues/year