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RESEARCH ARTICLE

Parent's and teacher's evaluation of aural oral performance of children with hearing aids

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Abstract

Background and Aim: Parents' evaluation of aural/oral performance of children (PEACH) and teachers' evaluation of aural/oral performance of children (TEACH) questionnaires are used to assess the behaviors of hearing-impaired children in real-life situations. This study aims to compare the scores of PEACH and TEACH in children with severe-to-profound sensorineural hearing loss (SNHL) using hearing aids.

Methods: This is a double-blind two-period crossover study on 21 children aged 9-72 months with severe-to-profound SNHL using hearing aids. There were two 6-week periods of fitting Phonak Naida Venture SP hearing aids using the fifth version of the Desired Sensation Level (DSL v5) and the National Acoustics Laboratories' nonlinear fitting procedure (NAL-NL2) prescriptions. At the end of each trial, the PEACH and TEACH questioners were completed through an interview with the parents and teachers, respectively.

Results: There was a strong correlation between the PEACH and TEACH in total and subscale scores. There was no significant difference between the results of DSL v5 and the NAL-NL2 prescriptions for the total score and subscale scores of PEACH and TEACH.

Conclusion: The PEACH score has a strong correlation with the TEACH score. These questionnaires are useful tools for indirectly assessment of hearing-impaired children's communication skills. The DSL v5 and the NAL-NL2 prescriptions make no significant difference in the performance of children with severe-to-profound SNHL.

Keywords: Aural oral performance; questionnaire; children; parents; hearing loss; functional performance

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Introduction

Hearing impairment in children negatively affects their speech development, academic performance, and communication compared to healthy peers. Sensorineural hearing loss (SNHL) is the most common type of hearing loss in neonates [1]. To prevent communication and speech problems, children with hearing loss should use hearing aids or cochlear implant [2]. The Desired Sensation Level (DSL) procedure [3] and the National Acoustic Laboratories (NAL) procedure [4] have widely been used for fitting hearing aids. The NAL prescription aims to maximize predicted speech intelligibility while the DSL

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prescription aims to normalize loudness at different frequencies [5]. Overall, the DSL prescription causes more gain than the NAL prescription [6]. Young Children with hearing loss cannot express verbal information about amplification; hence, parents and educators can provide useful information about the effect of amplification in real conditions [7]. Questionnaires are valid and reliable tools for evaluating hearing aid function and auditory performance of children in real-life situations [8]. So far, several questionnaires have been designed for this purpose including Auditory Behavior in Everyday Life, Early Listening Function, Infant Toddler Meaningful Auditory Integration Scale, Meaningful Auditory Integration Scale, Parents' evaluation of aural/oral performance of children (PEACH) and Teacher's evaluation of aural/oral performance of Children (TEACH) [9]. The PEACH and TEACH are two questionnaires designed in 2007 to record the parents' and teachers' observations of children's aural/oral performance when using hearing aid or cochlear implant in real-life situations [10]. These two questionnaires contain information about the device usage and loudness discomfort, functional performance in quiet and noisy environments, and response to environmental sounds [7]. The PEACH questionnaire contain 13 items, 6 related to child's response in quiet situation (respond to name, following verbal instructions, listening to a story read aloud, participating in a conversation, using telephone, and recognizing familiar voices) and 5 related to child's response in noisy situation (respond to name, following verbal instructions, participating in a conversation, understanding speech in a vehicle, and recognizing environmental sounds). The first and second questions are related to device usage and loudness discomfort. The TEACH questionnaire contain all items mentioned in the PEACH questionnaire except the two items related to the use of telephone and conversations in a vehicle [11]. The PEACH questionnaire has good internal consistency and high test-retest reliability and can be used for both genders and different age groups and degrees of hearing loss [10]. There is a strong correlation between obligatory cortical auditory evoked potentials and the PEACH score in hearing-impaired children [12]. Change in frequency responses affects the PEACH and TEACH scores [11]. There are localized Persian versions of PEACH prepared by Naghibirad et al. [13] and TEACH prepared by Fatahi et al. [14] with acceptable validity and reliability. This study aimed to compare the scores of PEACH and TEACH in children with severe-to-profound SNHL using hearing aids.

Methods

This is a double-blind, cross-over study on 21 children (7 girls and 14 boys) aged 9-72 months (Mean age = 37.05 ± 17.92 months) with stable bilateral severe-to-profound SNHL using binaural hearing aids for 1-54 months (Mean duration = 22.29 ± 14.60 months) selected from among those referred to Pejvak Rehabilitation Center in Iran. We included children who had behind-the-ear Phonak Naida Venture SP hearing aids or their Phonak Naida Venture SP hearing aids were fitted with a formula other than the study formula. Children wore hearing aids for at least 10 hours a day. A double-blind protocol was used where the audiologist, parents, and teachers were unaware of the formula used for fitting children's hearing aids during each trial. Hearing thresholds were assessed by electrophysiological tests or, if possible, behavioral tests. Hearing aids were fitted according to the NAL-NL2 or DSL v5 formula at low-, mid-, and high-input levels in Pejvak center. All children were present in the center at least three days a week each for five hours. Due to being a double-blind study, all hearing aids were fitted by another audiologist. After fitting the hearing aids using the mentioned prescription, real-ear measurement using Affinity 2.0 system was used to verify the hearing aids.

There were two trials in this study each for six weeks because of acclimatization [15]. In the first trial, the hearing aids of 11 children were fitted according to the DSL v5 prescription, and those of 10 children were fitted according to the NAL-NL2 prescription. During this trial, their parents and teachers were asked to complete the Persian versions of PEACH and TEACH questionnaires at least for one week to write down

Table 1. Descriptive statistics for Persian versions of teachers' and parent's evaluation of aural/oral performance of children scores in children with severe to profound hearing loss (n= 21)

	TEACH score (%)			PEACH score (%)		
	Mean	**SD**	**Min-Max**	**Mean**	**SD**	**Min-Max**
DSLv5						
Total	73.19	25.00	25-100	67.02	25.12	17.50-93.18
Quiet	74.67	26.08	25-100	72.02	24.06	20-100
Noise	70.41	25.87	25-100	64.28	22.48	15-90
NAL-NL2						
Total	70.49	27.23	16.66-100	67.59	23.04	17.50-93.18
Quiet	71.90	27.72	15-100	70.67	23.82	20-100
Noise	68.75	27.31	18.75-100	64.04	23.05	15-90

TEACH; teacher's evaluation of aural/oral performance of children, PEACH; parents' evaluation of aural/oral performance of children, DSL; desired sensation level, NAL-NL2; national acoustics laboratories' nonlinear fitting procedure

their observations about their child's listening behavior in different situations. After one week and at the end of first trial, the questionnaires were completed by the researcher via an interview with them. In the second trial and after six weeks, the prescription formulas for the hearing aids were replaced, such that the children whose hearing aids were fitted by the DSLv5 formula in the first trial received the NAL-NL2 prescription and vice versa. At the end of six weeks, both questioners were completed. The parents and teachers were unaware of the prescription procedure. Due to the COVID-19 pandemic, we had to not consider a washout period between the two trials.

As mentioned before, there were two subscales in each questionnaire, one for listening in quiet and one for listening in noise. The items were rated on a 4-point Likert scale as 0 = Never (0%), 1 = Seldom (1-25%), 2 = Sometimes (26-50%), 3 = Often (51-75%), and 4 = Always (75-100%). Hearing aid usage and loudness discomfort were evaluated by PEACH and TEACH questionnaires, although the items related to them were not calculated under functional hearing assessment; they were analyzed separately [10]. Since children had did not used or rarely used the telephone, the item related to telephone use was excluded. The data collected from two questionnaires were analyzed in SPSS v.26. For each questionnaire, the mean total score, and the mean scores in quiet and in noise were calculated.

Results

The mean scores of PEACH and TEACH questionnaires are presented in Table 1. In the TEACH questionnaire, the mean total and subscale scores using the DSL v5 prescription were higher than those using the NAL-NL2 prescription, although there was little difference between the results of prescriptions in mean scores. Wilcoxon test results showed no significant differences between the mean total scores ($p = 0.23$) and mean subscale scores in noise ($p = 0.13$) and in quiet ($p = 0.61$) of PEACH and TEACH using the NAL-NL2 prescription. By using the DSLv5 prescription, no significant differences between the mean subscale scores in quiet ($p = 0.30$) of PEACH and TEACH was reported, but the difference between their mean total scores

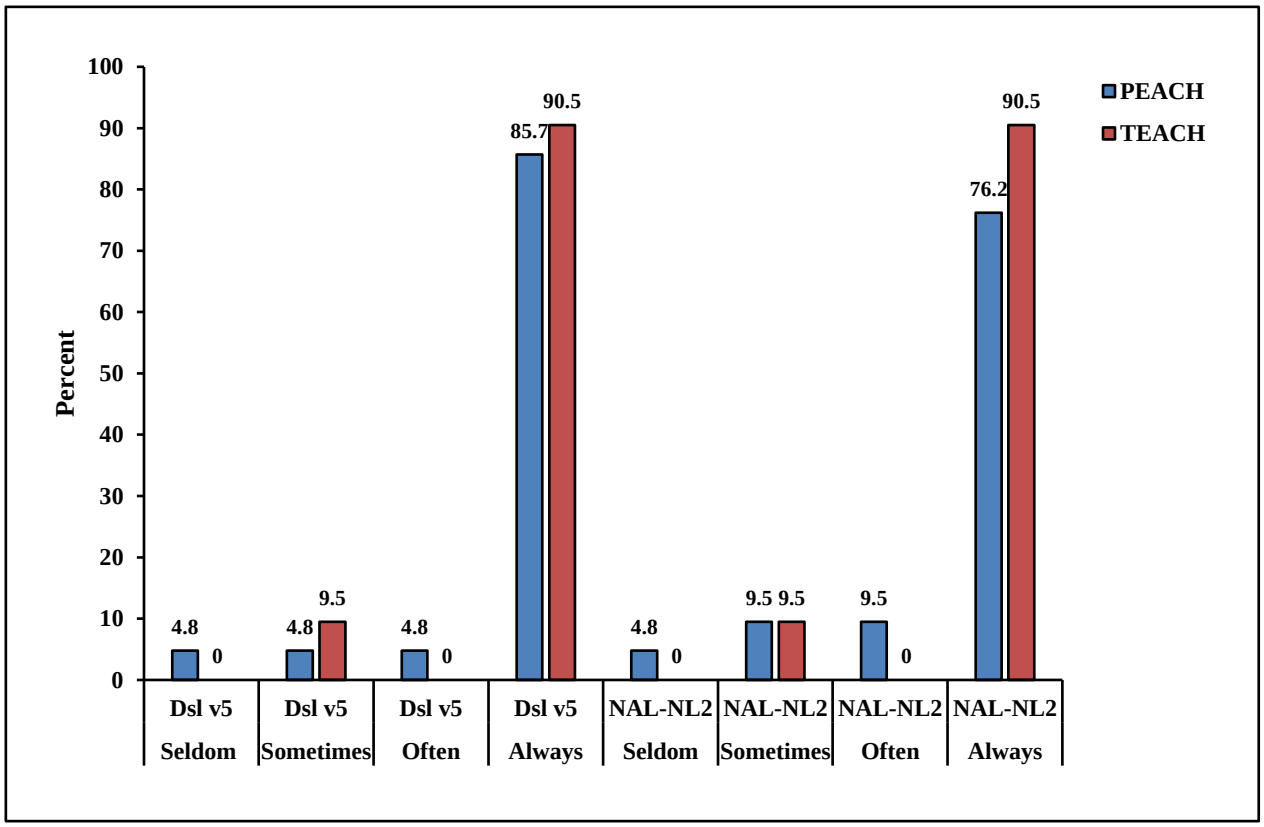

Fig. 1. Descriptive statistics for hearing-aid usage score in Persian versions of teachers' and parent's evaluation of aural/oral performance of children with severe to profound hearing loss. PEACH; parents' evaluation of aural/oral performance of children, TEACH; teacher's evaluation of aural/oral performance of children, DSL; desired sensation level, NAL-NL2; national acoustics laboratories' nonlinear fitting procedure.

(p = 0.01) and mean subscale scores in noise (p = 0.02) was significant. Moreover, the results showed no significant differences between the results of prescriptions in terms of total score (p = 0.85) and subscale score in quiet (p = 0.30) and in noise (p = 0.86) of the PEACH and in terms of total score (p = 0.23) and subscale score in quiet (p = 0.13) and in noise (p = 0.35) of the TEACH. Spearman correlation test on the mean total and subscale scores showed a significant correlation between the PEACH and TEACH in total score (r = 0.82, p < 0.001), subscale score in quiet (r = 0.81, p < 0.001), and in noise (r = 0.79, p < 0.001) using the DSLv5 prescription and a significant correlation between the PEACH and TEACH in total score (r = 0.82, p < 0.001), subscale score in quiet (r = 0.78, p < 0.001), and in noise (r = 0.82, p < 0.001) using the NAL-NL2 prescription. The mean subscale scores in quiet were higher than the mean subscale scores in noise suggesting that children had better functional performance in quiet than in noise.

Hearing aid use and loudness discomfort were analyzed by the PEACH and TEACH questionnaires. Mann-Whitney U test results showed no significant difference between the results of DSL v5 and the NAL-NL2 prescriptions neither in hearing aid use assessed by PEACH (p = 0.46) and TEACH (p = 1.00) nor in loudness discomfort assessed by PEACH (p = 0.98) and TEACH (p = 0.68). The mean scores are shown in Figures 1 and 2 for the PEACH and TEACH.

Discussion

Comparison of PEACH and TEACH scores for children with severe-to-profound hearing loss

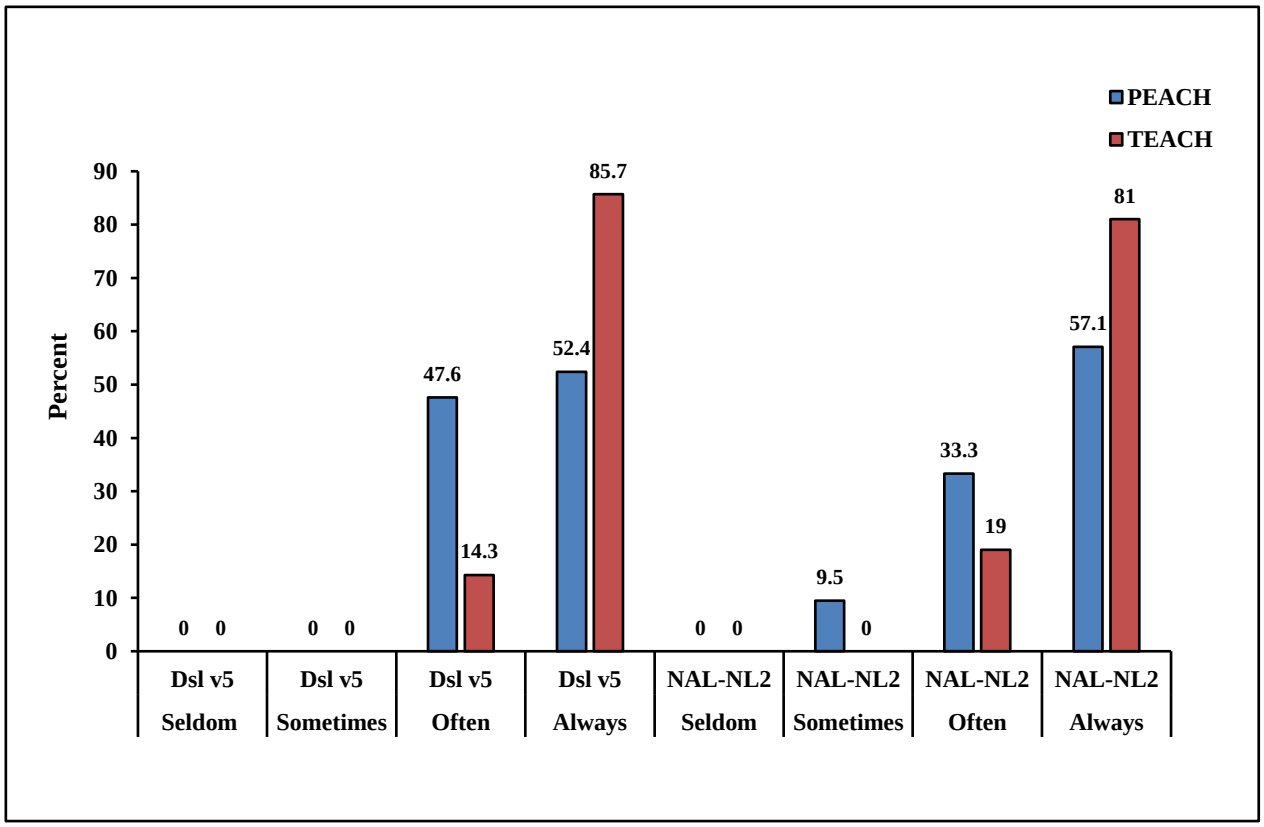

Fig. 2. Descriptive statistics for loudness discomfort score in Persian versions of teachers' and parent's evaluation of aural/oral performance of children with severe to profound hearing loss. PEACH; parents' evaluation of aural/oral performance of children, TEACH; teacher's evaluation of aural/oral performance of children, DSL; desired sensation level, NAL-NL2; national acoustics laboratories' nonlinear fitting procedure.

showed that they had better performance in quiet than in noisy situation. Their scores in a quiet situation were higher than in a noise situation after six weeks of using hearing aid in each condition. Spearman correlation test results showed a high correlation between the total and subscale scores of TEACH and PEACH, where the PEACH scores were lower than the TEACH scores. It can indicate that one of the questionnaires can be sufficient to measure the child's performance in real-life situations. This finding is consistent with the results of Emerson and Quar et al. who showed a strong correlation between total and subscale scores of TEACH and PEACH [9,15]. Fatahi et al. also showed a high correlation between total and all subscale scores of TEACH and PEACH, but the score of TEACH was lower than the PEACH scores [14]. Questionnaires are useful tools for confirming the results of electrophysiological tests such as aided cortical testing in children with limited behavioral response [12].

There was no significant difference in the mean total and subscale scores in quiet and in noise between PEACH and TEACH using the NAL-NL2 prescription. By using the DSLv5 prescription, there were no significant differences between PEACH and TEACH in terms of subscale score in quiet, but the difference was significant in the mean total score and subscale score in noise where the TEACH scores were higher than the PEACH scores. In Emerson's study, there were no significant differences between PEACH and TEACH using the NAL-NL1 prescription in terms of mean total score and subscale score in noise [9].

In this study, there were no significant differences between the results of DSLv5 and NAL-NL2 prescriptions using the PEACH and TEACH questionnaires. Hearing aid use and loudness discomfort showed no significant difference using the PEACH and TEACH. This finding is consistent with the results of Ching et al. who showed no significant difference between the results of NAL and DSL prescriptions and functional auditory performance in children using the PEACH questionnaire, but additional disability and parental educational level affected their functional performance [5]. Previous studies have shown that the selection of prescription has little effects on predicted speech intelligibility [6] and there is no significant differences between the results of DSLv5 and NAL-NL1 prescriptions at mid- and high-input levels [16]. Assessment of the NAL-NL1 and DSL v4.1 prescriptions for children aged 6-19 years showed no preference for the use of these prescriptions in the PEACH and TEACH questionnaires on Australian children [17]. We found no study on comparing the results of NAL-NL2 and DSL v5 prescriptions using the PEACH and TEACH questionnaires.

The use of DSLv5 prescription in children with moderate hearing loss in a study led to significantly higher mean scores than the NAL-NL1 in using PEACH, TEACH, and self-evaluation of listening function, although consonant discrimination test showed no significant differences in a quiet situation between the prescriptions [15], which is consistent with our results. These differences may be because of prescribed gain-frequency responses in the NAL-NL1 and NAL-NL2. The NAL-NL2 prescribes relatively more gain at low and high frequencies than the NAL-NL1. Low frequencies are so important in speech intelligibility for tonal languages [4]. The DSLv5 prescribes less gain at high-input levels and low frequencies, such that it can be used for noisy situations [5].

Conclusion

There is a correlation between the scores of parents' evaluation of aural/oral performance of children (PEACH) and teachers' evaluation of aural/oral performance of children (TEACH) questionnaires using the dslv5 and NAL-NL2 prescriptions for fitting hearing aids in children with severe-to-profound sensotinaural hearing loss (SNHL). Therefore, they are useful tools for indirectly assessment of these children's communication abilities. These questionnaires can help audiologist optimally amplify the hearing aid for hearing-impaired children. When parents are not available to complete the PEACH questionnaire, the TEACH questionnaire can be used instead to measure the child's performance in real-life situations. There is no difference in the performance of children with severe-to-profound SNHL using NAL-NL2 and DSL v5 prescriptions.

In this study, there was no significant association between choice of hearing-aid prescription and children's performance with sever to profound hearing loss in real life.

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Conflict of interest

No potential conflict of interest relevant to this article was reported.

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